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FINAL AND SUMMARY REPORT
7/15/86 - 9/29/93

ON

R&D IMPROVED SEED PRODUCTION
AND UTILIZATION
CA-A I D/DAN-4143-A-00-6047-00
936-4143

APRIL, 1994

SEED TECHNOLOGY LABORATORY
MISSISSIPPI STATE UNIVERSITY
MISSISSIPPI STATE, MISSISSIPPI

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Mississippi State University
Division of Agriculture, Forestry and Veterinary Medicine
Office of International Programs
Department of Plant and Soil Sciences (Agronomy)
Seed Technology Laboratory

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BACKGROUND

Mississippi State University (MSU) entered into a cooperative agreement with AID/S&T/AGR on July 16, 1986. The CA was originally programmed for a five year period but a subsequent amendment extended it through September 29, 1993. The initial obligation of funds was for period July 16, 1986 through September 30, 1987. Subsequent amendments extended the funding obligation period through September 29, 1993. The level of funding since the end of the first year has been approximately $255,000/yr. Total funding for the 7+ years of the CA was $1.875 million. A companion Basic Ordering Agreement (BOA) (DAN-4143-B-00-6049-00) was also entered into to provide a convenient mechanism by which USAID Missions and developing country governments could

access technical services in specified areas when costs were above $25,000 or more per task. The areas specified in the companion Basic Ordering Agreement were related to activities and development areas under the Cooperative Agreement. Other mechanisms such as purchase orders were approved for use for accessing assistance tasks costing less than $25,000 or which were not covered under the companion BOA.

The Cooperative Agreement provided for work and activities in four areas and for activities under a 5th mode, i.e., buy-ins and other funding:

AREA	APPROXIMATE BALANCE
I. Research	40%
II. Training	25%
III. Information Services	20%
IV. Networking (Administration Services of 12% included in above)	15%
V. Buy-ins/Other Funding (no limit)	

Funds made available under the Cooperative Agreement provided for basic or core support of work and activities in the different areas. Additional funds from the Missions, Contractors, other development assistance agencies and the LDCs themselves were used to expand services beyond the core level for such activities as regional and in-country workshops and training courses, reviews and analyses of seed programs and industries, advisory services in the areas of seed

policy, development of facilities and operational programs, and technical assistance in a variety of other seed related areas.

Activities under and/or related to the MSU-AID/CA are summarized for the five areas listed above under two categories (as possible): **A, Activities Funded under the CA with MSU Cost Sharing; and B, Activities Funded from Other Sources**.

I. RESEARCH AND DEVELOPMENT
(See Also ANNEXES A and B)

A. Activities Funded under CA with MSU Cost Sharing

The seed related R&D work was carried out primarily by the core staff and an on-board corps of graduate students from many developing countries that averaged about 32 students during the period of the CA. The graduate students who were predominantly funded under AID, World Bank, FAO/UNDP, various bilateral projects, or by their Government represented, in effect, a huge "buy-in" into collaborative and related R&D; about $160,000/yr. at a very conservative per annum R&D value per participant of $5,000 x avg. of 32 participants on-board at any one time.

Topical Areas Emphasized In R&D Work

R&D work was undertaken by the core staff of the Seed Technology Laboratory (STL) and the graduate students they advised in about eight major topical areas. These areas were selected on the basis of interests of the graduate student researchers, experiences of the STL staff in many countries and general

perceptions of needs and potential benefits. The eight areas are highlighted below.

1. Identification of inherent properties of seeds that contribute to resistance to weathering (i.e., field deterioration) and superior storability and emergeability for incorporation by breeders into improved crop varieties. The main crop species investigated were soybean, sorghum, cotton, corn, and cowpea.
2. Seed multiplication and production procedures that minimize field deterioration, the incidence of seedborne diseases and pests, and the storage time required for seeds.
3. Efficient systems for storage of different kinds and quantities of seeds based on moisture proof packaging materials, dehumidification and treatments that extend the longevity of seeds under warm humid conditions.
4. Farmer seed selection and storage practices with emphasis on varietal purity, freedom from disease, and maintenance of germination.
5. Computer simulation (modelling) and prediction of seed longevity in storage (corn, soybean, rice) and emergence (soybean).
6. Quality assurance and control criteria, standards and operational methods adaptable to different scales of production, crops and climatic zones.
7. Upgrading of seed quality through processing (soybeans, rice, sorghum, cowpeas, wheat).

8. Evaluating the role of extension, credit, pricing, and marketing on seed production and supply and collecting data for base-line analyses.
9. Policy reforms and assessment methodologies for promoting and assisting private sector entry into seed production and supply operations in the LDCs.

The balance of work was decidedly in favor of the first seven topical areas. Topical areas 8 and 9 relating to the economic and policy dimensions of seed industry development received much less attention than the more technical areas during the first 5 years because the staff expertise and graduate student interests were predominately in the technical areas. During the last 3 years, however, much more time was given to economic aspects and policy. The products of this attention and "thinking", however, were mainly in the form of country specific technical assistance reports relating to seed policy, seed legislation, establishing a favorable environment for private sector participation, privatization and similar. It should be recognized, of course, that anecdotal information of this sort is not highly visible although it is extremely useful in advisory services in subsequent tasks and to those who peruse and take into account such information and experiences in their advisory work.

Productivity and Outputs

The scope and productivity of the R&D activities pursued under the terms of this CA are evident in the listing of Papers/Abstracts/Technical Presentations & Informational Materials in ANNEX A, I (page A-2) and the theses and

dissertations prepared by graduate students on their research projects (Theses/Dissertations Completed) in ANNEX A, II (page A-15) and ANNEX B.

- 16 papers in referred journals, 18 technical papers, proceeding articles, bulletins and similar, 3 chapters in books or manuals, 37 abstracts of technical papers, and 73 presentations were published, prepared and/or made during the period of the CA. Some of these communications were based on older research and accumulated expertise of the staff, but in almost every case they benefited from the contact with and information derived from the on-going R&D under the CA.
- 65 M.S. theses and 28 Ph.D. dissertations were completed and are cited/referenced in the abstracting journals. Unfortunately only a few of these research reports could be developed into formal papers and articles for publication in appropriate journals due to lack of time because the theses/dissertations were many, the advisors were few, and the students didn't usually have time to write papers based on their theses/dissertations before returning home. Many of them, however, did write papers after return to their home country for publication in local national journals in French, Spanish, or local language, e.g. Thai.

The core staff time allocated to R&D was difficult to measure and monitor since it was confounded with Training, i.e., supervision of graduate students. Overall, however, at least 40% of the time on core activities was spent on R&D.

Major Accomplishments

There were many very noteworthy accomplishments in the applied seed research work, most achieved by graduate students working closely with a faculty advisor. The following were some accomplishments of special note.

- "Strategies for Improving the Physiological Quality of Seeds", a powerful conceptual frame for applied research in the area of seed quality, evolved from the R&D work under the CA on seed density/size/quality relationships, inherent properties of seeds associated with superior storability and performance in the field, conditions for maintenance of seed quality during storage, and enhancement of seed performance by osmo-conditioning, coatings, and plant growth regulators. In terms of formulation, the conceptual frame was progressively advanced and critiqued during conferences/discussions at CIAT, several seed meetings in the US, the XIII Panamerican Seed Seminar (Bolivia), and the 4th Australian Seed Research Conference.
- Important information was developed on the hygroscopic properties of seeds and especially the rate of moisture exchange in blends of seeds with different moisture contents. This information provided answers to several important and frequently asked questions.
- Seed properties were identified that provide resistance to deterioration of seeds in the field prior to harvest (field deterioration) and in storage. Variability in crop species populations was also demonstrated for

responses to seed bed microenvironmental factors such as temperature and soil moisture potential. This work which built on R&D dating back into the 1970s has provided models and/or stimulated work on genetic improvements in seed quality in the U.S. and around the world, e.g., IITA, Thailand, Indonesia, India, Brazil.

- Some powerful methods for evaluating and assuring seed quality were improved, validated and adapted for rather routine application. In related work physical, physiological and biochemical changes associated with deterioration of seeds, hence loss of vigor and performance potential, were identified/clarified and or verified. The dynamic model of seed deterioration first proposed by MSU-STL researchers in 1968 was further validated in most essential aspects.
- The biology and phenology of red rice types which are troublesome weeds in all rice areas where the crop is direct seeded were comprehensively researched. The information gathered has already had an impact on farmer and researcher views about the red rice problem and the development of control strategies.

There is no question that the results and information obtained through the R&D work under the CA has significantly benefited seed propagated crop agriculture in the U.S. as well as in the developing countries. The major shortfall in the R&D area is in publication of results. While most of the significant findings have been communicated in some fashion - referred papers, technical and popular articles, presentation and abstracts, original theses/dissertations - much remains

to be done to ensure a permanent record. The main problem as noted previously was that the corps of on-board graduate students, hence number of theses/dissertations produced each year, turned out to be much greater than expected, while the number of faculty advisors remained stable for about half of the CA period and then decreased (by 1) during the last 3 yrs. when the number of theses/dissertations was highest.

B. Activities Funded with Other Funds

The major funding for the R&D activities was provided from the core budget of the CA and MSU cost sharing. The second most important source of funds was provided by the sponsors of graduate students, e.g., USAID, World Bank, FAO, UNDP, National Governments. Substantial support was also provided from state funds appropriated for agricultural research (Mississippi Agricultural and Forestry Experiment Station). There were also some grants from the Mississippi Soybean Promotion Board, Cotton Inc., Pioneer Hybrid International, and several chemical companies. These, however, were rather minor.

II. TRAINING

A. Activities Funded under CA with MSU Cost Sharing &

B. Activities Funded from Other Sources

Core funds were used for partial support of salaries of the faculty in Agronomy-Seed Technology and support staff. In this sense, therefore, maintenance of the faculty in place provided the resources required for graduate

training and even the special training programs that were offered to participants from developing countries. Further, some of the expendable supplies and similar items provided from core funds for R&D were useful and used in teaching and training, and, of course, in the thesis and dissertation research of graduate students which was a major part of the R&D effort. Considering just these several confounding, it should be evident that there can be no sharp differentiation or distinction among sources regarding support of the very large and productive training program implemented during the period of the CA. Core funds, however, were not used for teaching assistants or similar supporting elements relating solely to teaching.

In view of the inextricable mixing of Training and R&D and the several sources of funding that supported both activities, no attempt is made here to strictly distinguish between activities funded under the CA with MSU cost sharing, and those funded from other sources. Those training activities, mainly the special non-degree training programs and in-country and regional training, that were specifically arranged through "buy-ins" are identified as possible.

Productivity and Outputs

The level of training at all levels and the accomplishments under the CA in this area greatly exceeded expectations and, in some cases, resources. There can be no question that Training was the premier activity under the CA as it was under the previous contracts and cooperative agreements. The successes of and accomplishments under the Training component are strikingly evident in the following listings.

- 114 degree training programs in Agronomy-Seed Technology were completed during the period of the CA for participants from 30 countries excluding the U.S.: 14 B.S. degrees; 64 M.S. and 2 M.AGR. degrees; 27 Ph.D. degrees. In terms of gender 29 of the degree earners were female and 80 were male. (The distribution of degree earners by country and the titles of their theses and dissertations are in ANNEX A, II, page A-15). Essentially all of the students were "sponsored" and financed by some agency. At about $5,000/student/year in tuition and other allowances, the 114 students represented, in effect, a "buy-in" by the various sponsors valued at more than $1 million.
- 7 Seed Improvement Courses (9 weeks) were conducted at MSU for participants from the developing countries with participant numbers ranging from 13 to 30, average of about 18. (These were buy-ins through OICD, USDA.)
- 23 special training programs at MSU were arranged for participants from the developing countries at request of sponsoring agencies. The length of the special training programs ranged from 1 week to 9 months, while the number of participants per program ranged from 1 to 9. (All were buy-ins - World Bank, FAO, USAID.)
- 7 in-country training courses were organized and conducted in 6 countries. The average length of the in-country training course was 2.5 weeks while the average number of participants was about 25. (These were buy-ins.)

- 4 regional training courses were organized and conducted - two in Africa and two in Latin America; the average number of participants was about 25. (Buy-ins.)

Accomplishments

The Seed Technology Laboratory is a section of the Department of Plant and Soil Sciences (formerly, Agronomy Department). It has naturally emphasized teaching and training since its establishment in 1950, and has made very important contributions to the development of the U.S. seed industry in terms of training, technology transfer, and informational services. It first became involved in international agriculture as a training resource and "change" agent for USAID, then US-ICA. Given this background and setting, therefore, the emphasis and successes of the MSU-STL in training - development of the human resources needed for agricultural, economic and social betterment - should not be surprising. The MSU-STL group has long and strongly believed - and still does - that its most important and lasting contributions are made in the teaching-training area. Most of the key persons in most of the seed program/industries in the developing countries, in the national Universities involved in seed related training, and in the advisory and consulting groups still active in seed industry development received at least part of their training at MSU or in-country and regional training courses organized and conducted by the MSU-STL.

Critique

Activities and accomplishments in the area of Training under the CA greatly exceeded expectations. The one self-criticism is that at times there were

more students on-board than could be efficiently handled and advised. Nevertheless, the staff of the MSU-STL is very satisfied that no qualified student who applied for undergraduate or graduate studies was turned away.

III. TECHNOLOGY TRANSFER AND INFORMATIONAL SERVICES

A. Activities Funded under the CA with MSU Cost Sharing &

B. Activities Funded from Other Sources

Distinctions among technology transfer, informational services, training and communications related to results of R&D are essentially impossible to make even though they have separate "pigeon holes." Teaching and training essentially involve technology transfer and information as well as the sharpening of mental processes involved in the in-mind cataloguing of information and data, reasoning, and retrieval. Technical assistance as set forth in a later section also heavily involves the transfer of technology and information.

Productivity and Outputs

The great emphasis on and exemplary accomplishments in teaching/training activities in the Seed Technology program at MSU as noted above also imply and mean great emphasis on and substantial accomplishments in the technology transfer, "extension type" activities and informational services. The main avenues for technology transfer and informational services were of both the formal and informal types.

- Technology and information was formally transferred in a massive way to the 114 participants in degree training programs from 30 countries,

and the 40+ participants in special non-degree training programs of at least 4.5 months.

- Technology and information was formally transferred in a very substantial way to the 126 participants in the seven 9-week Seed Improvement Courses at MSU, the approx. 175 participants in the seven 2 - 3 week in-country training courses, and the 100+ participants in the four 2 - 3 week regional training courses.
- Technology and information was informally transferred verbally and in printed form to the many visitors to the MSU-STL each year (20 or more) and the many written requests for information from former students and others informed about the informational services of the MSU-STL by visitors, former students and trainees. The MSU-STL has long (last 25 years or so) maintained an informal informational service consisting of more than 200 separate informational materials and/or references (reprints, specially prepared articles, information collected from other sources, etc.) which are made available to students, trainees, visitors, and on written request. Thousands of these informational materials have been distributed and many have been translated into local languages for use as in-country teaching and operational references.

Accomplishments

The MSU-STL was the major resource for technology transfer and informational services in the areas of seed technology and seed industry

development long before mid-1986 beginning of the CA that is the subject of this report. It continued in this capacity during the period of the CA and continues under the present arrangements (CASP), although admittedly and unfortunately, at a substantially diminished level. Development and completion of informational materials has been and remains a never ending task.

Critique

The major shortfall under informational services was the failure to complete up-to-date handbooks on several topical areas that were planned, worked on and developed to a substantial degree - but not completed. Although rather desperate efforts were made to complete these works, the efforts were unsuccessful. Diminishing faculty time coupled with activities that actually increased and could not be postponed, e.g., graduate student advising, technical assistance, did not leave time enough to complete the time consuming, final editing and illustrating of the publications. Unlike degree programs, these tasks could be deferred and were. It is hoped and expected that the current low number of degree program participants will free the time needed for completion of the several informational projects well underway. Despite this shortfall, it can be stated that lack of a reference under development was never a seriously debilitating matter. Other, older informational materials in the same topical area(s) were and still are available.

IV. NETWORKING

Networking and collaboration was one of the major features in the design of the CA, "Improved Seed Production and Utilization, R&D." During the preparatory phases for the CA, visits were made to countries with good potential for collaboration and networking and memorandums of agreement were signed in several cases. Unfortunately, a substantial reduction in the funding level of the CA, i.e., below the "planned" level, at about the time it got underway essentially sabotaged both networking and collaboration primarily due to lack of funds under the CA and lack of interest and/or funds on the part of the Missions. In any event it proved to be essentially impossible to network and collaborate with the key institutions identified in the cooperating countries without offering some support, even if just for travel. Since core funds were reduced at the beginning of the CA and remained at the same level during the next 7 years until the closing date of the CA there was never a real opportunity to become seriously involved in Networking and Collaboration. The constant struggle was to accommodate the core program to the diminishing level of funding in terms of current "dollars."

Despite the seemingly intractable problem of lack of funding for networking and collaboration, these very desirable tasks were not entirely neglected. Informal collaboration was continued with the CIAT Seed Unit, the Seed Division and Kasetsart University in Thailand, Bogor Agricultural University, Indonesia, the Panamerican Agricultural School, Honduras, Federal Rural University of Pelotas, Brazil, the National Seed Center, Haryana University, India, the Agricultural University, Saltillo, Mexico, and others. Informal collaboration was established

and has continued because these units are directed/managed by graduates of the MSU-STL who want to maintain contact and collaboration as much as does the staff of the MSU-STL. These institutions and programs and many others are part of the seed technology network of which the MSU-STL has long been the center.

Accomplishments

The accomplishments in a formal sense were minimal. In informal terms, however, they were considerable due to ties of key personnel to MSU, i.e., graduates or trainees.

Critique

The critique was set forth in the first part of this section.

V. TECHNICAL ASSISTANCE (BUY-INS)

About 95% of the technical assistance activities under the CA were financed through buy-ins. The technical assistance activities are summarized in the table below and set forth in detail in ANNEX A, III (Technical Assistance Provided under Buy-ins and Other Funding), Page A-26 and ANNEX A, IV (Activity Reports Prepared), Page A-40.

Summary of Technical Assistance 7/16/86 - 9/29/93

	Year								
Activity	86	87	88	89	90	91	92	93	Total
	No.								
Training Programs:									
At MSU	2	3	3	4	8	5	3	2	30
In-Country	-	1	-	-	3	1	1	1	7
Regional	1	1	1	1	-	-	-	-	4
Technical Assistance:									
Short Term	2	2	7	11	8	5	3	4	42
Long Term	-	2	2	2	2	3	3	3	*
*Approx. 14 years TA									

Value (Approx.) of Buy-ins in $1000.

Yr.	1986*	1987	1988	1989**	1990	1991	1992	1993***	Total
$(000)	133.5	419	514.5	663	604.8	643	662	546	4185

*7/15 - 12.31/86

**Includes 330,000 for degree-training over 4 year period.

***1/1 - 9/29/93

The level of buy-ins was considerable but somewhat less than envisaged during the preparation of the CA. Substantial technical assistance in various

areas were provided to 23 countries. Long term assistance was provided under subcontracts with other USAID contractors to Indonesia (2.25 yr), Egypt (6 yr), Burundi (3 yr), Honduras (2.2 yr). Multiple and major short term assistance was provided to Honduras, Sri Lanka, Bangladesh, Egypt, Burundi, China, Indonesia, Thailand, Senegal and The Gambia. Several other countries were provided with lesser assistance.

The principal "buyers" of technical assistance were the prime contractors of USAID funded projects (e.g., CID, U. of AR, Winrock), and IFDC, USAID Missions, World Bank, and FAO.

The specific technical assistance "purchased" ranged from in-country and regional training courses, thru project development and preparation, help on various technical operations, to seed policy, seed sector reform, privatization, economic analyses and other business aspects.

Productivity and Outputs

As indicated in the tabulation of activities above, during the period of the CA 30 training programs were conducted at MSU, 7 in-country training courses and 4 regional training courses were organized and executed, and 42 separate TA assignments - other than for training - were undertaken, many involving more than one staff person. The average period of short term TA assignments was about 4 weeks. In addition approx. 14 years of long term technical assistance were provided to four different countries.

Accomplishments

The accomplishments were substantial and numerous. The MSU-STL was involved in the reform of seed policy and privatization of the seed sector in Egypt, Honduras, Indonesia, Burundi, Sri Lanka, El Salvador, and Bangladesh, It was involved in the first national seed project in the People's Republic of China. In cooperation with IITA, it organized and conducted the first two regional seed training courses in Africa. It made the first survey and review of the status of seed technology and phytosanitary regulations in the ASEAN region. In collaboration with Winrock and the Center for PVO/University Collaboration in Development (Western Carolina U.) it formulated the first on-farm seed production project recognizing and highlighting the importance and contributions of the age-old and ubiquitous farmer seed selection and saving tradition in the development of crop agriculture. The first model of a "linkages" development project involved the MSU-STL and the Seed Division, DOAE, Thailand.

Critique

The buy-in mode was implemented without any major problems, but the methodology turned out to be quite different than envisaged. The BOA or companion ordering agreement was initially advanced as the most likely and preferred method for accessing technical assistance. In the present case this turned out to not be the case. The major method for accessing long term assistance was a subcontract with a prime contractor for USAID financed projects. In the case of short term assistance, subcontracts were also widely used as were purchase orders since the funding involved was usually less than $25,000.

Competition between core supported activities and technical assistance "buy-ins" was a problem from the beginning of the CA and the problem increased as core support progressively decreased in current "dollars" as a consequence of level funding during the 7 year period. Maintaining the core program and keeping the staff intact required progressively more strenuous efforts to "market" technical assistance, i.e., solicit buy-ins. Perhaps this was the expectation under the buy-in mode, but it was, nevertheless, an unfortunate and mostly no-win situation for the cooperator, i.e., the MSU-STL. A university connected unit has enormous resources as compared with "consulting firms" (which often rely on University expertise) but also considerable limitations. It is not organized for or experienced in marketing of products or services. And, marketing, a lot of marketing, was necessary to gather enough buy-ins to maintain the core program and the staff.

OVERALL ASSESSMENT

Tasks Completed and Outputs

Most of the goals and tasks taken on in the design of the cooperative agreement were met or exceeded. The R&D activity was more productive than envisioned due primarily to the heavy load of sponsored graduate students on-board during the entire period of the CA. The 16 papers in referred journals, 18 technical papers, proceeding articles, bulletins and similar communications, 3 chapters in books or manuals, 37 abstracts of technical presentations and an additional 36 formal presentations during the 7 years of the CA is an exceptional accomplishment by any measure considering the level of funding. This does not

include the 93 theses and dissertations deposited in the MSU library with abstracts in the common bibliographic references and the papers and articles published in home countries based on them. Despite these substantial accomplishments, the MSU-STL faculty is disappointed that more of the fine research products produced by the corps of graduate students has not yet been published. This deficiency will be overcome to some extent with the completion and publication in CY 1994 and first half of CY 1995 of several summary research bulletins long in preparation. One area that did not develop in the manner envisaged and planned is the analyses of economic and policy dimensions of seed industry development in the developing countries. Again, a long overdue treatise on the objectives, scope and sectoral roles in seed industry development based on anecdotal and experiential material should be finalized in CY 94.

As already mentioned and emphasized, the STL faculty is most pleased with the accomplishments in training at all levels. The 95 M.S. and Ph.D. graduates and 14 B.S. graduates joined the nearly 300 previous graduates of the MSU-Agronomy-Seed Technology curricula in more than 63 countries. This corps of graduates is a dominant factor in the development of seed policy, liberalization of the seeds sector, and management of the seed supply operations in many countries, and constitutes the most important technical and human resource in seed industry development around the world. Supplementing these nearly 400 graduates are the 1000+ participants in the annual Seed Improvement Course at MSU (126 during the CA period), and the several thousand participants in MSU organized and conducted regional and in-country training courses (275 during the

CA period), and the several hundred "graduates" of special training programs at MSU (47 during CA period). There is no question that these "products" of the MSU-STL training programs under the CA with USAID will become - and already are - the leaders in seed industries and related activities in countries around the world.

The level of technical assistance under the buy-in mode was less than envisaged in the CA design, but about as much as should have been realistically expected. Unfortunately and, perhaps, unavoidably, there was competition between the R&D tasks and technical assistance and services, especially as the general level of program funding became more stressful.

Over-all, the MSU-STL is pleased and satisfied with its accomplishments under the CA. It is especially pleased that much of the R&D and informational services have served the interests of U.S. agriculture in important ways, and that the MSU-STL continues as the premier seed technology center for the U.S. seed industry as well as for the developing countries.

Unfinished Works

The unfinished works have mostly been identified in the previous sections. They are compilations/summations of the R&D under the CA and some of the previous CAs and contracts, viz.:

- The Phenology and Biology of Red Rices in Mississippi and the Southern Rice Region (interpretive summary of R&D work since 1976);
- Soybean Seed Technology (interpretive summary of R&D effort of the MSU-STL since about 1965);

- Development, Maturation and Field Deterioration of Major Crop Seeds (summation of R&D work since the early 1960s);
- Strategies for Improving the Physiological Quality of Crop Seeds - A Conceptual Framework for Seed Quality R&D;
- Seed Drying, Aeration and Storage - Principles and Practices (a handbook that is being developed based on a Chapter in forthcoming volume on "Crop Drying and Storage" prepared in 1993 and presently under review, and several "classic" technical articles written in the 1970s and widely distributed as part of informational service.)
- Seed Industry Development: Objectives, Scope and Sectoral Roles (a treatise initially written in the early 1980s which has continued to involve and to strongly influence seed industry development policies, most recently, the policy paper on "seeds" issued by the World Bank for which James C. Delouche served as a principal consultant and resource.

While the above appears to be a long list and represent overly ambitious goals, most are achievable by the end of CY 94. Three of the publications are 90% complete, while the others are 50 to 75% complete. James C. Delouche has been the lead compiler and writer for the publications and has agreed to undertake their completion as his major remaining task before retirement in June, 1995. He will not be involved in graduate student advising after his last student completes Ph.D. studies in July, an activity that has taken up much of his time.

LESSONS LEARNED AND RECOMMENDATIONS

Two main lessons were learned or relearned:

- Collaboration and networking with institutions and scientists/technologists in the developing countries are not feasible without adequate funds for the LDC partner as incentive, and most importantly, to finance acquisition of essential apparatus and supplies, and essential travel. Networking, especially, requires periodic "getting together" and/or reciprocal visits, which requires funds.
- Development of the human resource base through training, workshops, seminars, networking and "continuing linkages" is the most important component of any development assistance strategy, and its impact and effects last the longest. Indeed, the impact and effects increase with time as the persons trained train others, and knowledge, technology, and purpose diffuse in wider and wider areas.
- Over-commitment of human and physical resources available is useful for full and unwavering engagement and high productivity during the beginning of a program or project, but leads to frustration, greatly lessened enthusiasm and loss of creativity when continued too long.

There is one main recommendation:

- An agreement or contractual relationship should clearly define the tasks and works that are to be undertaken and ensure that they are accomplishable by providing for the necessary resources including time and attention. The party doing the work should not be placed in the

ambiguous and no-win position of hustling other agreements to obtain funding to maintain staff and other resources to accomplish the tasks and works agreed to in the first instance.

ANNEX A

Page

RESEARCH AND DEVELOPMENT

I. Papers/Abstracts/Technical Presentations & Informational Materials . A-2

II. Theses/Dissertations Completed A-15

TRAINING

See I, Page A-15 for Degrees Awarded

See III, Page A-27 for Training Courses Conducted at MSU & In-Country and Regional

TECHNICAL ASSISTANCE

III. Technical Assistance Provided under Buy-ins and Other Funding . . A-26

IV. Activity Reports Prepared A-40

TECHNOLOGY TRANSFER

See I (Page A-2), II (Page A-15), III (Page A-26) and IV (Page A-40).

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1. PAPERS/ABSTRACTS/TECHNICAL PRESENTATIONS AND INFORMATIONAL MATERIALS

SUMMARY

7/15/86 - 9/29/93

Category	No.
Papers, Referred Journals	16
Technical Papers; Proceeding Articles, Bulletins, etc.	18
Chapters in Books/Manuals	3
Abstracts[1]	37
Presentations	73
Informational Materials (handbooks, handouts, etc.)	N/A

PERIOD: 7/15/86 - 12/86

H. C. Potts. 1986. Post-harvest handling of sorghum seed. In: La Produccion de la Semilla de Sorgho en America Latina, p. 98-105. Guiragossian, C. Paul and G. Peterson (eds.). INTSORMIL-ICRISAT-CIMMYT.

H. C. Potts. 1986. Recent research advances in seed technology and needs for the future. In: La Produccion de la Semilla de Sorghum in America Latina, p. 150-162. V. Guiragossian, C. Paul and G. Peterson (eds.). INTSORMIL-ICRISAT-CIMMYT.

[1]Most abstracts were also included in presentations.

C. E. Vaughan, 1986. Laboratory quality control. In: La Produccion de la Semilla de Sorgho en American Latina, p. 127-134. V. Guiragossium, C. Paul and G. Peterson (eds.). INTSORMIL- ICRISAT-CIMMYT.

J. C. Delouche. 1986. Seed storage practices and problems. Abstracts: 1986 International Food Legume Research Conference on Pea, Lentil, Faba Bean, and Chickpea. p. 52. Spokane, WA. R J. Summerfield. (ed.). Martinus Nijhoff Pub., Boston.

A. DoLago and J. C. Delouche. 1986. Characterization of red rice phenotypes. Annual Meeting, Association of Official Seed Analysts, Minneapolis, MN. Abstract and Presentation (15 min.).

T. Teekachunhateen and J. C. Delouche. 1986. Release of dormancy in red rice seeds under field conditions. Annual Meeting, Association of Official Seed Analysts & Society of Commercial Seed Technologists, Minneapolis, MN. Abstract & Presentation (15 min.).

G. Kaiser, E. R. Cabrera and F. Bourland. 1986. Rapid deterioration of cottonseed using hot water. 1986. Agronomy Abstracts: p. 127.

PERIOD: 1/87 - 12/87

J. C. Delouche, 1987. Weeds as rice seed contaminants. 18 p. 2 illus. International Workshop on Rice Seed Health. UNDP & IRRI, Manila, Philippines. Invitational papers. Abstracts and Presentations.

J. C. Delouche. 1987. Quality Control. Proc. 1987 MS Short Course for Seedsmen 28:83-89.

J. C. Delouche et al. 1987. Brief on activities and accomplishments under contracts & cooperative agreements on improved seed production and utilization between MSU & AID. BIFAD Mtg. April 10, 1987. Washington. 9 p.

R. Koslunand and J. C. Delouche. 1987. Factors affecting imbibitional injury in soybeans. Annual Meeting, Association of Official Seed Analysts and Society of Commercial Seed Technologists. Sacramento, CA. Abstract & Presentation (15 min.).

S. M. Furbert, F. Bourland, and E. R. Cabrera. 1987. Comparison of the hot water and accelerated aging techniques for deterioration of cottonseed. 1987 Agronomy Abstracts: p. 129.

E. R. Hartwig and H. C. Potts. 1987. Development and evaluation of impermeable seed coats for preserving soybean seed quality. Crop Sci. 27:506-508.

C. E. Vaughan and S. I. Izaguirre. 1987. Influence of temperature on germination and seedling development of cowpea [*Vigna unguiculata* (L.) Walp]. Annual Meeting, Association of Official Seed Analysts, Sacramento, CA. Abstract and Presentation (15 min.).

C. C. Baskin. 1987. Developing seed quality assurance and control systems to meet tomorrow's needs. Keynote Lecture. CIAT Sponsored Workshop on Seed Quality Improvement Systems, Nov. 9-13, 1987, Montevideo, Uruguay. Workshop Proceedings: p. 120-133.

C. C. Baskin, 1987. Useful tests for an internal quality control program. Presentation (30), CIAT Sponsored Workshop on Seed Quality Improvement Systems. Nov. 9-13, 1987. Montevideo, Uruguay. Workshop Proceedings: p. 134-143.

Review: 1987. Seed Plant Conditioner's Handbook prepared by CIAT Seed Unit and translated into Spanish was reviewed and revised by E. R. Cabrera and J. E. Cortes, Spanish speaking members of the MSU/STL staff. 1987.

PERIOD: 1/88 - 12/88

J. C. Delouche. 1988. Mechanization of seed testing. Symposium on Automation in Seed Technology. Annual Meeting, Association of Official Seed Analysts and Society of Commercial Seed Technologists, Rochester, NY. Presentation (20 min.).

J. C. Delouche. 1988. Strategies for improving seed quality. Seminar, BORIF, Bogor, Indonesia, April 5, 1988. (1 hr.).

Review: 1988. Maize seed Quality Audio-Tutorial originally prepared by CIAT Seed Unit in Spanish with assistance from MSU/STL, and recently adapted by CIMMYT into English was reviewed and critiqued by E. R. Cabrera and J. E. Cortes, Spanish speaking members of the MSU/STL.

PERIOD: 7/15/88 - 7/14/89

J.S. Taft, J. C. Delouche, and C. C. Baskin. 1988. Influence of seed coat permeability on the rate of cottonseed deterioration. Proc. 1988 Beltwide Cotton Res. Conf. 1988: 86-87.

E. R. Cabrera and A. H. Boyd. Effect of moisture content and temperature on the germination of cottonseed. Proc. 1988 Beltwide Cotton Res. Conf. 1988: 88-90.

C. C. Baskin. 1988. Cottonseed quality control. Talk presented before 1988 meeting, American Cottonseed Delinters Association. Ruidosa, NM.

J. C. Delouche. 1988. Seed storage practices for cool season food legumes. p. 331-341. In: R. J. Summerfield (ed.), World Crops: Cool Season Food Legumes. Kluwer Academica Pub. Dordraht/Boston/London.

E. R. Cabrera. Workshop presentations made to technical staff of Pioneer Hybrid International, Inc.: (1) Quality soybean seed conditioning; (2) Corn seed drying principles & procedures. Aug., 1988.

J. E. Armstrong, C. C. Baskin and J. C. Delouche. 1988. I. Effects of mechanical sizing of soybean seeds on seed quality. II. Sizing soybean seeds to improve plantabiltiy. Jour. Seed Tech. 12:54-58, 59-65.

B. Aswathaiah and J. C. Delouche. 1988. Effectiveness of sulfuric acid scarification in reducing hardseededness in vetch seeds. Seed Research (India) 15:20-23.

J. C. Delouche. 1988. Weeds as rice seed contaminants. p. 179-88. In: Rice Seed Health, Proc. Int. Workshop Rice Seed Health, IRRI, 16-20 Mar. 1987. 362 p.

E. R. Cabrera and J. Diaz. 1988. Removal of balloonvine seeds from soybean seeds. 1988 Agron. Abstr. p. 144.

J. C. Delouche. 1988. Strategies for improving seed quality. Ann. Convention Southern Seedsmen's Association, Nashville, TN. Nov. 23-24, 1988.

F. M. Bourland, G. Kaizer and E. R. Cabrera. 1988. Rapid deterioration of cottonseed using hot water. Seed Sci. & Tech. 16:673-684.

E. R. Cabrera. 1989. Principles and procedures of drying ear corn. Workshop for Pioneer International, Inc., collaborators: (1) Eastern Europe, collaborators, Parndoft, Austria. Feb. 20-21, 1989; (2) Western European collaborators, Parndoft, Austria. Feb. 22-23, 1989

A. Bashir and J. C. Delouche. 1989. Seed steep water pH as a rapid measure of germinability in corn. Abstr. Sou. Branch, Am. Soc. Agron. 1989 meeting. Nashville, TN. No. 16, p. 12.

J. C. Delouche. 1989. Seed quality improvement strategies. Proc. 1988 MS Short Course for Seedsmen 30:1-14.

C. C. Baskin. 1989. Seed quality enhancement through quality assurance. Proc. 1988 MS Short Course for Seedsmen. 30:69-74.

C. C. Baskin, S. Paliwal and J. C. Delouche. 1989. Estimating field emergence of sorghum. Int. Seed Test. Assoc. 22nd Congress. Seed Symposium. Edinburgh, Scotland, June 21-30, 1989. Abstract No. 61.

E. R. Cabrera. 1989. Factors affecting the development of a seed industry. Workshop, Seed Program Development. Panamerican Agricultural School (EAP), Zamorano, Honduras. May 23, 1989. Oral Presentation.

S. Paliwal, C. C. Baskin, and J. C. Delouche. 1989. Relationship between TZ test, soil cold test and standard germination test in assessing sorghum seed quality. AOSA\SCST Ann. Meeting, Periora, IL. June 1989. Abstract & Presentation (15 min.).

A. Bashir and J. C. Delouche. 1989. Rapid non-germinative methods for evaluating germination and vigor in corn. AOSA/SCST Ann. Meeting. Peoria, IL. June 1989. Abstract & Presentation (15 min.).

C. H. Andrews, 1989. Potential of hardseeded soybeans. Southern Regional Meeting, Association of Official Seed Certifying Agencies. Jackson, MS. July 1989. Presentation (30 min.).

C. C. Baskin and Y. Ratanavipulya. 1989. Germination of sorghum seeds treated with various chemicals before and after accelerated aging. AOSA/SCST Ann. Meeting. Peoria, IL. June, 1989. Abstract & Presentation (15 min.).

J. Narvaez and C. C. Baskin. Soil moisture stress as a potential method for determining differences in seed quality of *Amaranthus*. AOSA/SCST Ann. Meeting. Peoria, IL. June, 1989. Abstract & Presentation. (15 min.).

S. M. Furbeck, F. M. Bourland and E. R. Cabrera. 1989. Comparison of the hot water and accelerating aging techniques for deterioration of cottonseed. Seed Sci. & Technol. 17:255-261.

PERIOD: <u>1/01/90 - 12/30/90</u>

J. C. Delouche. 1990. Strategies for improving seed quality. Proc. MS Short Course for Seedsmen. 30:1-13.

J. C. Delouche. 1990. Variation in the storability of crop seed lots. Invitational Paper Int. Conf. Seed Sci. & Technol. New Delhi, India. Feb. 21-25. Abstracts: Paper No. 2.19.

J. C. Delouche. 1990. Precepts of seed storage. Invitational Paper. Satellite Symposium on Seed Sci. & Technol. Feb. 26, 1990. Haryana Agricultural University, Hissar, India. 22 p. MSS, In press.

J. C. Delouche. 1990. Seed deterioration: causes and consequences. 1990 MS Short Course for Seedsmen. April, 1990. Presentation (45 min.).

J. C. Delouche, J. Barlian and Zaidan. 1990. Development, reversibility and release of the hard seed condition in soybean [*Glycine max* (L.) Merr.]. AOSA/SCST Ann. Meeting. Annapolis, MD. June 9-15, 1990. Abstr. AOSA NewsLetter, June, 1990. Presentation (15 min.).

S. Paliwal, C. C. Baskin and J. C. Delouche. 1990. The relationship between the tetrazolium test, soil cold test, and standard germination test in assessing sorghum [*Sorghum bicolor* (L.) Moench] seed quality. Jour. Seed Tech. 14:56-60.

S. Paliwal, C. C. Baskin, and J. C. Delouche. 1990. Predicting field emergence of grain sorghum. Jour. Seed Tech. Accepted for Pub.

E. R. Cabrera, A. H. Boyd, G. B. Welch. 1990. A soil temperature simulator for seed germination studies. Crop Sci. 30:1133-1135.

E. R. Cabrera, and J. Diaz. 1990. Removal of balloonvine seeds from soybean seeds using a color sorting machine. Seed Sci. & Technol. Accepted.

C. H. Andrews. 1990. Precepts of seed conditioning. MS Short Course for Seedsmen. April 9-11, Miss. State, MS. Presentation (45 min.).

C. C. Baskin. 1990. Physical properties of seeds useful in upgrading quality. MS Short Course for Seedsmen. April 9-11, Miss. State, MS. Presentation (45 min.).

E. R. Cabrera. 1990. Seed aeration and drying: principles and practices. MS Short Course for Seedsmen. April 9-11, Miss. State, MS. Presentation (45 min.).

E. R. Cabrera. 1990. Fine tuning the air screen cleaner. 4th Mid-west Seed Workshop. Feb. 20. St. Louis, MO. Presentation (45 min.).

E. R. Cabrera. 1990. Seed Conditioning Workshop: (1) Precepts of seed conditioning; (2) Basic separations; (3) length separations; (4) weight separations; (5) special purpose separators; (6) principles of vegetable seed drying and storage. Ferry-Morse Seed Co. and International Collaborators and Co-producers. July 12-13. Modesto, CA. Presentations and Discussions (8 hr.).

E. B. Cabrera. 1990. Seed Dryer Management Workshop: (1) Factors determining drying efficiency and their effect on seed quality; (2) A layman's explanation of the Pioneer drying prediction model. Pioneer Hi-Bred International, Inc., Workshop for Technical Supervisors. August 13-14. Tipton, ID. Presentations and Discussions (6 hr.).

E. R. Cabrera. 1990. Pioneer Soybean Seed Workshop. Soybean seed handling and aeration. Pioneer Hi-Bred International, Inc. Workshop for Contract Producers. August 16. St. Louis, MO. Presentation and Discussions (4 hr.).

W.C. Couvillion. 1990. Hidden costs and payback in seed conditioning, 1990 MS Short Course for Seedsmen. Seed Technology Laboratory, Mississippi State University. April. Presentation (45 min.).

W. C. Couvillion. 1990. International Agriculture. Presented to students in IFAL Summer Project at Mississippi State University, July 1990. (30 min.).

W. C. Couvillion and J. C. Delouche. 1990. Private seed sector in Bangladesh. Seminar for Bangladesh Seed Dealers Association on the results of a survey of Private Sector Seed Activities in Bangladesh, Dhaka, Bangladesh, May 1990. Presentation (2 hr.).

J. C. Delouche. 1990. The mortal seed. Proc. 1987 MS Short Course for Seedsmen. 29:47-56.

J. C. Delouche. 1990. Invited Seminar. Global issues in seed industry development. Keynote presentation at day long seminar on Seed Industry Problems in Indonesia. Bogor Agricultural University, Bogor, Indonesia. Jan. 20, 1990. Summary Abstract: 4 pages. Presentations and Discussions (6 hr.).

J. C. Delouche. 1990. Invited Seminar. Experiences and lessons learned in seed industry development in the LDCs with emphasis on Asia. Seminar called by Secretary, MOA, Bangladesh for high officials involved in formulation of policies in Bangladesh related to agricultural development. Dhaka. May 9. Presentation and Discussions (3 hr.).

J. C. Delouche. 1990. Lecture notes and case studies for seed technology training course for presentation in Indonesia as follows (see next entry):

Seed development and maturation. 17 p.
Field deterioration of seeds. 12 p.
Seed deterioration and vigor. 14 p.
Seed Storage. 26 p.
Physical properties of seed associated with quality. 31 p.
Temperature and moisture relation of seed germination. 12 p.
Seed Certification and Control. 6 p.

J. C. Delouche. 1990. Seed Technology Training Course for Researchers in Indonesia. Sukamandi (SURIF). Indonesia. Jan. 1-20, 1990. 32 participants. Presentations and Guided Discussions (24 hr.).

J. C. Delouche and W. C. Couvillion. 1990. Invited Paper. Seed industry development: objectives, scope and sectorial roles. Keynote Paper, Section 10. Int. Conf. Seed Sci. & Technol. New Delhi, India. Feb. 21-25. Abstracts: Paper No. 10.1.

PERIOD: 1/01/91 - 12/31/91

J. C. Delouche. 1991. Program Co-Chairman, Garden Seed Industry Conference, American Seed Trade Association. Jan. 22-26. Hilton Head, S.C. Introduced and presided at program sessions. Theme: Enhancement of Seed Quality.

J. C. Delouche. 1991. Other uses of accelerated aging techniques in seed technology. AOSA/SCST Ann. Mtg. June 9-14. Lexington, KY. Abstract and Presentation (15 min.).

C. C. Baskin and L. Rushing. 1991. Effects of pericarp damage on germination of grain sorghum seed. AOSA/SCST Ann. Mtg. June 9-14. Lexington, KY. Abstract and Presentation (15 min.).

S. Goggi and J. C. Delouche. 1991. Influence of seed specific gravity on sorghum [*Sorghum bicolor* (L.) Moench] field performance. AOSA/SCST Ann. Mtg. June 9-14. Lexington, KY. Abstract and Presentation (15 min.).

S. Goggi and J. C. Delouche. 1991. Electron microscopic studies of low density sorghum seeds. Am Soc. Electron Microscopy, Southern Section. April 1991. Abstract and Presentation.

P. Klink and J. C. Delouche. 1991. Effects of mechanical injury on cowpea [*Vigna unguiculata* (L.) Walp.] seed germination. MSS prepared for reproduction & distribution on request.

Ratresni and J. C. Delouche. 1991. Seed maturation, development and hardseededness in okra (*Abelmoschus esculentus* L.). AOSA/SCST Ann. Mtg. June 9-14. Lexington, KY. Abstract & Presentation (15 min.).

C. C. Baskin. 1991. Some opportunities for improvement of cottonseed. Beltwide Cotton. Prod. Conf. Nashville, TN. Jan., 1991. Abstract & Presentation (15 min.).

C. C. Baskin. 1991. Quality assurance procedures in seed operations. Missouri Seed Improvement Association. Colombia. Feb. 1991. Seminar (45 min.).

E. R. Cabrera. 1991. Seed aeration and drying: principles and practices; quality assurance procedures; seed enterprise development. Lectures and seminars presented at EAO, Zamorano, Honduras during period Sep.-Dec. 1991.

J. C. Delouche. 1990. Seed germination. Proc. 1990 MS Short Course for Seedsmen. 31:49-66.

J. C. Delouche. 1991. Red rice phenotypes and biology. Rice States Workshops. DBES. Stoneville, MS. July, 1991. Presentation (30 min.).

J. C. Delouche. 1991. Seed research, CAS re-organization and seed supply privatization (in Egypt). Seminar presented to MOA-ARC, CAS, & USAID officials. 12/12/91. Cairo. Presentation and Paper (9 p.).

PERIOD: 1/01/92 - 12/31/92

J. C. Delouche. 1992. Keynote Speaker and Honorary Co-chairman, 4th Australian Seed Research Conference. Gold Coast, Australia, July. 1992. Keynote Address: Strategies for improving physiological seed quality. Proc. 4th Australian Seed Research Conference 4:1-45.

S. Paliwal, C. C. Baskin, and J. C. Delouche. 1992. Scanning electron microcospy of high quality and low quality sorghum seeds. J. Seed Tech. 15:42-48.

S. Paliwal, C. C. Baskin, and J. C. Delouche. 1992. Correlation between standard germination, cold test and field emergence of sorghum. J. Seed Tech. 16:16-26.

A. S. Goggi, J. C. Delouche, and L. M. Gourley. 1992. Morphological aspects of weathering and immaturity in sorghum [*Sorghum bicolor* (L.) Moench]. XXIII Intern. Seed Testing Congress. Buenos Aires. Nov. 1992. Symposium Abstracts: 1(4), p. 5.

A. S. Goggi, J. C. Delouche, and L. M. Gourley. 1992. Sorghum seed internal morphology related to seed specific gravity, weathering and immaturity. J. Seed Tech. In press.

C. Casini and C. H. Andrews. 1992. Water absorption by soybean [*Glycine max* (L.) Merrill] seeds with different levels of permeability and different sizes. XXIII Intern. Seed Testing Congress. Buenos Aires. Nov., 1992. Symposium Abstracts: No. 2A(1), p. 10.

C. Casini and C. H. Andrews. 1992. A new method to study water absorption by soybean [*Glycine max* (L.) Merrill] seeds. XXIII Intern. Seed Testing Congress. Buenos Aires. Nov. 1992. Symposium Abstracts: Poster Session. Poster No. 26, p. 55.

J. Narvaez, C. Baskin, and J. Ortegon. 1992. Maturation, field deterioration and storage of two species of Amaranth (*Amaranth hypochondriacus* (L.) and *A. cruentus* (L.). XXIII Intern. Seed Testing Congress. Buenos Aires. Nov. 1992. Symposium Abstracts: Poster Session, Poster No. 67, p. 86.

J. Ortegon, H. C. Potts, and J. Narvavez. 1992. Soybean [*Glycine max* (L.) Merrill] seed coat permeability effects on seed viability and seedling vigor. XXIII Intern. Seed Testing Congress. Buenos Aires, Nov. 1992: Symposium Abstracts. Poster Session, Poster No. 73, p. 91.

J. C. Delouche. 1992. Research priorities and needs in area of seed quality maintenance. Invited Seminar. Massey University, Palmerston North, New Zealand. Jul, 1992. Presentation & Discussion (1 hr.).

J. C. Delouche. 1992. Modern seed technology for soybean. Invited Seminar. University of Queensland, Australia. Jul. 1992. Presentation and Discussion (1 hr.).

C. C. Baskin. 1992. Seed density/performance relationships. MS Short Coruse for Seedsmen, April 1992. Presentation (45 min.).

E. R. Cabrera. 1992. Seed aeration and drying. MS Short Course for Seedsmen. April, 1992. Presentation (45 min.).

B. Keith. 1992. Upgrading seed quality. MS Short Coruse for Seedsmen. April, 1992. Presentation (45 min.).

C. E. Vaughan. 1992. Rapid viability tests. MS Short Course for Seedsmen. April, 1992. Presentation (30 min.).

J. C. Delouche. 1992. Deterioration of seeds. MS Short Course for Seedsmen. April, 1992. Presentation (45 min.).

C. H. Andrews. 1992. Seed quality/performance relationships. MS Short Course for Seedsmen. April 1992. Presentation (45 min.).

D. C. Stimpson. 1992. Seed development and morphology. MS Short Course for Seedsmen. April, 1992. Presentation (45 min.).

J. C. Delouche and E. R. Cabrera. 1992. Estrategia para realzar la calidad de Semillas. XIII Panamerican Seed Seminar. Santa Cruz, Bolivia. Invited Paper. Seminar Proceedings: In Press.

PERIOD: 1/93 - 9/93

K.W. Roy, B.C. Keith and C.H. Andrews. 1993. Hardseed soybean lines resistant to seed infection by Phomopsis and other fungi in Mississippi. Can. J. Plant Pathology: Accepted for publication.

B. Abidin, W.C. Couvillion and B. Keith. 1993. Economics of the gravity table to enhance seed quality. MSS in Review.

B. Abidin and W.C. Couvillion. 1993 Economics of specialized equipment to enhance seed quality. Accepted for presentation, Mid-South Academy of Economics and Finance (April 1994).

B. Keith, C.H. Andrews and K.W. Roy. 1993. Evaluation of hardseeded soybean genotypes for hard seed content and resistance to field deterioration. Agron. Abstract: p. 63.

Keith, B.C., C.H. Andrews and K.W. Roy. 1993. Evaluation of soybean genotypes for resistance to field deterioration. AOSA/SCST Sun Mfg., Fort Collins, CO. June. Abstract & Presentation (15 min.).

E.R. Cabrera and J.C. Delouche. 1993. Seed Drying and Storage. Chapter, In: Handling Agricultural Crop Drying and Storage, F.W. Bakker-Arkema and D.E. Maier (eds.). For Publication by Marel Dekker, Inc., new York, NY 10016. MSS: 53 p., 7 tables, 17 illustrations.

E.R. Cabrera. 1993. Short Courses & Workshops. Int. Seed & Grain Science Ctr. Panamerican Agricultural School, Zamorano, Honduras.

(1) Seed and grain storage short course. 3/8-12/93

(2) Utilization of Improved seeds (eleven seminars) during period. 3/15 - 5/15/93

(3) Seed quality assurance short course. 7/19-24/93

(4) On-farm seed production workshop. 8/19-20/93

U.R. Bishnoi and J.C. Delouche. 1993 Relationships among seed quality tests, seed emergence and yield in cotton. Int. Seminar on Quality Seeds for High Production. Hargano Agricultural University, Hissan, India. July 1993. Invited Paper. Seminar Proceedings: In press.

C.C. Baskin, S. Paliwal and J.C. Delouche. 1993. Estimation of field emergence of grain sorghum. MAFES Bull. 996. 5 p.

J.C. Delouche. 1993. Determinants of soybean seed and grain quality. INTSOY Special Seminars, Univ. of Illinois. July. Presentation (1 hr.).

J.C. Delouche. 1993. Methods for improving the physiological quality of seeds. Ain Shams University, Cairo. April. Invited Seminar: Presentations & Outline (1 hr., 2 p.).

J.C. Delouche. 1992. Some thoughts on seed storage. Proc. 1992 MS Short Course for Seedsmen, 32:45-56.

Special Informational Materials

Manual: Seed Technology Training Course - Participant's Manual. (A general handbook for organization and execution of comprehensive or selective, i.e., specialized, courses and/or workshops in area of seed technology). I. Administration and Evaluation; II. Seed Program Development; III. Seed Production; IV. Seed Quality Evaluation, Assurance and Control; V. Seed Aeration, Drying, Conditioning and Storage; VI. Seed Enterprise Management, Marketing and Economic

Considerations; VIII. Communication Training and Skills Development. Complete and available. 333 p.

Compilation. Seed Quality Evaluation, Assurance and Control. A compilation of reference materials prepared and updated by MSU-STL staff for use in training course and as a general reference. Available. Approx. 180 p.

Compilation. Seed Aeration, Drying, Conditioning, Storage and Plant Design. A compilation of references prepared and updated by STL staff for use in training courses and as a general reference. Available. Approx. 300 p.

Reference in Spanish. Fundamentos Del Sacamiento De Semillas. (E. R. Cabrera). 34 p. Illustrated.

Manual. Seed Post-Harvest Training Manual. (E. R. Cabrera). A general training reference with emphasis on seed conditioning. 69 p. Illustrated.

Proceedings. Mississippi Seedsmen's Short Course Proceedings.

1986 Proceedings, Vol. 28:149 p.
1987 Proceedings, Vol 29:144 p.
1988 Proceedings, Vol. 30:151 p.
1990 Proceedings, Vol. 31:113 p.
1992 Proceedings, Vol 32:82 p.

In addition to the references listed above, about 200 informational references including reprints were maintained, updated, added to and made available to visitors and on request.

II. THESES/DISSERTATIONS COMPLETED AND DEGREES AWARDED

SUMMARY

8/86 - 9/93

Distribution of Graduate Degree Students by Countries.

Argentina	5	Guinea	1	Panama	1
Brazil	4	Guyana	1	Pakistan	5
Bukino Paso	1	Haiti	1	Senegal	3
Burundi	2	Honduras	1	Sri Lanka	4
Columbia	3	India	1	Taiwan	1
Dominion Republic	2	Indonesia	10	Thailand	13
Egypt	11	Malawi	2	Tunisia	1
El Salvador	1	Malaysia	2	Venezuela	1
Ethiopia	2	Mexico	1	Yemen	2
Ghana	2	Niger	2	U.S.	9

Distribution of Graduate Students by Degree:

Ph.D., 27; M.S., 66; M. Agr., 2; Total, 95.

Distribution of Graduate Student Degree Student by Gender:

Female 20; Male 65.

Undergraduate (B.S.) Degrees Awarded: 14

PERIOD: 7/86 - 12/86

1. Koslanund, R. (Thailand). 1986. Factors affecting imbibitional injury in soybean [*Glycine max* (L.) Merrill] seeds. M.S. Thesis. Aug., 1986. J. C. Delouche, Major Professor, 60 p.

2. Asiedu, E. D. (Ghana). 1986. Influence of delayed harvest, chilling and mechanical injury on stored seed corn (*Zea mays*). M.S. Thesis. Dec., 1986. C. H. Andrews, Major Professor: 100 p.

3. Bianchetti, A. (Brazil). 1986. Effects of moisture content, temperature and storage interval on secondary dormancy of seeds of loblolly pine (*Pinus taeda* L.), Ph.D. Dissertation. Dec., 1986. F. Bonner and C. H. Andrews, Major Professors. 65 p.

PERIOD: 1/87 - 12/87

4. Vaughan, T. R. (U.S.). 1987. Influence of seed coat condition on germination and emergence of soybean. M.S. Thesis. May, 1987. C. H. Andrews, Major Professor. 54 p.

5. Tatang, M. H. (Indonesia). 1987. Effects of planting date on sunflower oil and seed quality. Ph.D. Dissertation. Aug. 1987. C. H. Andrews, Major Professor. 93 p.

6. Unsirisong, S. (Thailand). 1987. Relationship of specific gravity to quality and performance of soybean [*Glycine max* (L.) Merr.] seeds. Ph.D. Dissertation. Dec., 1987. C. E. Vaughan and late H. C. Potts, Major Professors. 73 p.

7. Rodriquez-Ardon, R. (Honduras). 1987. Improvement in storability of maize seeds through selection using accelerated aging. Ph.D. Dissertation. Aug. 1987. G. Scott and late H. C. Potts, Major Professors. 72 p.

8. Goggi, A. S. (Argentina). 1987. Electrical conductivity and pH of exudate indicators as predictors of seed quality in corn (*Zea mays* L.). M.S. Thesis. Aug. 1987. C. E. Vaughan, Major Professor. 42 p.

9. Turnipseed, B. (U.S.). 1987. Evaluation of methods for measuring and monitoring field deterioration in soybean [*Glycine max* (L.) Merr.] seeds. M.S. Thesis. Dec. 1987. J. C. Delouche, Major Professor. 56 p.

10. Madawanarachchi, W. P. (Sri Lanka). 1987. Equilibrium relative humidity methods for estimating the moisture content of crop seeds. M.S. Thesis. Aug. 1987. J. C. Delouche, Major Professor. 46 p.

11. Cortes, J. (Colombia & U.S.). 1987. Relationship of seed size and density to seed quality in sorghum [*Sorghum bicolor* (L.) Moench]. Ph.D. Dissertation. Dec. 1987. J. C. Delouche, Major Professor. 120 p.

12. Nugraha, U. (Indonesia). 1987. Association of seed coat color and permeability in soybeans [*Glycine max* (L.) Merr.] with resistance to weathering stress and adverse storage conditions. Ph.D. Dissertation. J. C. Delouche, Major Professor. 91 p.

13. Garcia-Quiroga, E. (Colombia). 1987. Release and induction of dormancy in seeds of red rice (*Oryza sativa* L.) in the field and laboratory. Ph.D. Dissertation. Dec. 1987. J. C. Delouche, Major Professor. 95 p.

14. Casini, C. (Argentina). 1987. Effects of harvest time and method and storage condition on seed quality of soybean [*Glycine max* (L.) Merr.] genotypes with the impermeable seed coat trait. M.S. Thesis. Dec., 1987. C. H. Andrews, Major Professor. 93 p.

15. Lansakara, H. (Sri Lanka). 1987. Quality changes of soybean [*Glycine max* (L.) Merr.] seeds in storage as influenced by ambient conditions. M.S. thesis. Dec. 1987. E. R. Cabrera, Major Professor. 68 p.

PERIOD: 1/88 - 12/88

16. Pitty, N. (Panama). 1988. Effects of temperature on germination and dormancy release in cultivated and red rice (*Oryza sativa L.*). M.S. Thesis. May, 1988. J. C. Delouche, Major Professor. 66 p.

17. Ratnayake, W.R.A.S. (Sri Lanka). 1988. Characterization of soybean [*Glycine max* (L.) Merr.] cultivars by laboratory techniques, M.S. Thesis. May, 1988. C. E. Vaughan, Major Professor. 78 p.

18. Pung, C. Y. (Taiwan). Aug. 1988. Relationship between soybean [*Glycine max* (L.) Merr.] seed quality and seed size. M.S. Thesis. Aug. 1988. C. H. Andrews, Major Professor.

19. Bashin, A. (Yemen). Dec. 1988. The effects of storage environments on maintenance of soybean and corn seed quality. M.S. Thesis. Dec. 1988. C. H. Andrews, Major Professor.

20. Bulan, P. (Malaysia). Dec. 1988. Tetrazolium evaluation of mungbean (*Phaseolus aureus*) and whitebean (*P. vulgaris*) seeds. M.S. Thesis. Dec. 1988. C. E. Vaughan, Major Professor.

21. Barlain, J. (Indonesia). Dec. 1988. Reversability and persistence of hardseededness in soybean [*Glycine max* (L.) Merrill]. M.S. Thesis. Dec. 1988. J. C. Delouche, Major Professor.

22. Chindavipard, V. (Thailand). Dec. 1988. Upgrading soybean [*Glycine max* (L.) Merrill] seed quality with a color sorter. M.S. Thesis. Dec. 1988. E. R. Cabrera, Major Professor.

23. Diaz, J. (Dominican Republic). Dec. 1988. Removal of baloonvine (*Cardiospermum halicacabum* L.) seeds from soybean seeds. M.S. Thesis. Dec. 1988. E. R. Cabrera, Major Professor.

24. Hathayatham, A. (Thailand). Dec. 1988. Tetrazolium evaluation of chickpea (*Cicer arietinum* L.) and Austrian winter pea [*Pisum sativum v. arvense* (L.) Poir] seeds. M.S. Thesis. Dec. 1988. C. E. Vaughan, Major Professor.

25. Ratanavipulya, Y. (Thailand). Dec. 1988. Effects of chemical treatments on sorghum [*Sorghum bicolor* (L.) Moench] seed germination, initially and in storage. M.S. Thesis. Dec. 1988. C. C. Baskin, Major Professor.

26. Seneewong, A. (Thailand). Dec. 1988. The relationship between gin-run cottonseeds and internal disease organisms. M.S. Thesis. Dec. 1988. C. C. Baskin, Major Professor.

27. Viriyangkura, L. (Thailand). Dec. 1988. Effects of drying air temperature on the germination of sorghum [*Sorghum bicolor* (L.) Moench] seeds. M.S. Thesis. Dec. 1988. E. R. Cabrera, Major Professor.

PERIOD: <u>1/89 - 12/89</u>

28. Ahmad, B. (Pakistan). May, 1989. Influence of environmental factors and husk protection on the quality of corn [*Zea mays* L.) seeds. Ph.D. Dissertation. May 1989. J. C. Delouche, Major Professor.

29. Moncrief, R. (USA). May, 1989. Predicting stand establishment potential of cotton planting seeds. M.S. Thesis. May 1989. C. C. Baskin, Major Professor.

30. Butsayawit, S. (Thailand). Aug. 1989. Evaluation of techniques for prolonging the storage life of small samples of seeds. M.S. Thesis. Aug. 1989. C. E. Vaughan, Major Professor.

31. Chebbi, M. (Tunisia). Aug. 1989. Effects of seed specific gravity on germination, field and storage performance in wheat (*Tritium aestivum* L.). M.S. Thesis. Aug. 1989. J. C. Delouche, Major Professor.

32. Kamragai, N. (Thailand). Aug. 1989. A study of the impermeable seed coat characteristic in soybean. M.S. Thesis. Aug. 1989. C. H. Andrews, Major Professor.

33. Rosso, B. (Argentina). Aug. 1989. Effects of a cyclohexane polymer on soybean [*Glycine max* (L.) Merr.] seed deterioration in storage and in the field. M.S. Thesis. August. 1989. C. C. Baskin, Major Professor.

34. Paliwal, S. (India). Aug. 1989. Predicting field emergence of grain sorghum [*Sorghum bicolor* (L.) Moench]. Ph.D. Dissertation. Aug. 1989. C. C. Baskin, Major Professor.

35. Sewamontri, P. (Thailand). Aug. 1989. Effects of the shell on field emergence and storability of peanut (*Arachis hypogaea* L.) seeds. M.S. Thesis, August. 1989. J. C. Delouche, Major Professor.

36. Wattiranggoon, S. (Thailand). Aug. 1989. Seed density and quality relationships in sorghum [*Sorghum bicolor* (L.) Moench]. M.S. Thesis. Aug. 1989. J. C. Delouche, Major Professor.

37. Thongket, T. (Thailand). Aug. 1989. Effects of drying temperature on the quality of cowpea (*Vigna unguiculata* (L.) Walp.] seeds. M.S. Thesis. Aug. 1989. E. R. Cabrera, Major Professor.

38. Asuboah, R. (Ghana). Dec. 1989. Evaluation of field deterioration of seeds of two corn hybrids. M.S. thesis. Dec. 1989. C. H. Andrews, Major Professor.

39. Barillas, J. (El Salvador). Dec. 1989. Effect of packaging materials and moisture content on storability of corn (*Zea mays* L.) seed. M.S. Thesis. Dec. 1989. E. R. Cabrera, Major Professor.

40. Castillo, B. (Dominican Republic). Dec. 1989. Imbibitional injury in soybean [*Glycine max* (L.) Merr.] seed. M.S. Thesis. Dec. 1989. E. R. Cabrera, Major Professor.

41. Marwanto (Indonesia). Dec. 1989. Relationship between laboratory tests and field emergence in soybean [*Glycine max* (L.) Merr.] seeds. M.S. Thesis. Dec. 1989. C. E. Vaughan, Major Professor.

42. Nsapato, L. (Malawi). Dec. 1989. Seed maturation and development of hardseededness in Pinkeye Purple Hull cowpea [*Vigna unguculata* (L.) Walp.]. M.S. Thesis. Dec. 1989. C. C. Baskin, Major Professor.

43. Zaidan. (Indonesia). Dec. 1989. Development and release of the hard seed condition in soybean [*Glycine max* (L.) Merr.] and its influence on seed longevity. M. S. Thesis. J. C. Delouche, Major Professor.

PERIOD: 1/90 - 12/90

44. Casini, C. (Argentina). May, 1990. Seed imbibitional studies related to seedcoat and seed size in soybean [*Glycine max* (L.) Merrill] genotypes with different levels of permeability. Ph.D. Dissertation. C. H. Andrews, Major Professor. 160 p.

45. Goggi, A. S. (Argentina). May, 1990. Variation in seed specific gravity in sorghum [*Sorghum bicolor* (L.) Moench]: sources, morphological bases, and effects on field performances. Ph.D. Dissertation. James C. Delouche, Major Advisor. 89 p.

46. Narvaez, J. (Mexico). May, 1990. Maturation, deterioration, storability and quality evaluation of seeds of two species of *Amaranth*. Ph.D. Dissertation. C. C. Baskin, Major Professor. 95 p.

47. Possamai, E. (Brazil). May, 1990. Development of equations for predicting germination of soybean [*Glycine max* (L.) Merrill] seeds stored under ambient conditions at Miss. State University. Ph.D. Dissertation. E. Cabrera and C. H. Andrews, Major Professors. 91 p.

48. Fofana, A. (Guinea). Dec. 1990. Evaluation of a debearder in removing glumes from sorghum seeds. M.S. Thesis. C. E. Vaughan, Major Advisor. 42 p.

49. Guevara, C. (Colombia). Dec. 1990. A study of the relationship between soybean [*Glycine max* (L.) Merrill] seed coat characteristics and the incidence of seed borne pathogens. M.S. Thesis. C. H. Andrews, Major Professor. 56 p.

50. Klinck, P. (USA). Aug. 1990. Appropriate technologies for maintaining and enhancing seed quality in cowpea [*Vigna unguiculata* (L.) Walp.]. M.S. Thesis. J. C. Delouche, Major Advisor. 72 p.

51. Moreno, O. J. (Venezuela). Dec. 1990. Evaluation of competitiveness and dormancy release treatments in red rices (*Oryza sativa* L.). M.S. Thesis. J. C. Delouche, Major Advisor. 60 p.

PERIOD: 1/91 - 12/91

52. Bulan, P. (Malaysia). 1991. Some effects of seed coating and aging treatments on soybean [*Glycine max* (L.) Merrill] germination and emergence. Ph.D. Dissertation. Dec. 1991. J. C. Delouche, Major Advisor. 76 p.

53. Hasmeda, Mery (Colombia). 1991. Identification and evaluation of mechanical damage effects in hybrid corn (*Zea mays* L.). M.S. Thesis. May, 1991. C. H. Andrews, Major Advisor. 39 p.

54. Keith, B.C., Jr. (U.S.A.). 1991. Evaluation of hardseeded soybean genotypes for agronomic traits, hard seed content and resistance to seed deterioration. Ph.D. Dissertation. Dec. 1991. C. H. Andrews, Major Advisor. 74 p.

55. Luhanga, J.H. (Malawi). 1991. Evaluation of sorghum [*Sorghum bicolor* (L.) Moench] genotypes for resistance to field deterioration. Ph.D. Dissertation. Aug. 1991. C. H. Andrews, Major Advisor. 91 p.

56. Mahmoud, S.A.M. (Egypt). 1991. Separation of sorghum [*Sorghum bicolor* (L.) Moench] seeds with a fractionating aspirator, multi-aspirator, and gravity table. M.S. Thesis. Dec. 1991. Major Advisor. E. R. Cabrera. 57 p.

57. McCarty, W. H. (U.S.). 1991. Germination and emergence of cotton seed as affected by seed quality, substrate temperature and substrate moisture content. Ph.D. Dissertation. Aug. 1991. C. C. Baskin, Major Advisor. 97 p.

58. Mourad, H.A.A. (Egypt). 1991. Development of procedures for moisture determination in cottonseed. M.S. Thesis. Dec. 1991. E. R. Cabrera, Major Advisor. 53 p.

59. Ratresni, Eni (Indonesia). 1991. Seed development, maturation and hardseededness in okra [*Abelmoschus esculentus* (L.) Moench]. M.S. Thesis. May, 1991. J.C. Delouche, Major Advisor. 50 p.

60. Velloza T. (Guyana). 1991. Evaluation of some indices of seed quality that affect imbibitional injury in cowpea [*Vigna unguiculata* (L.) walp.]. M.S. Thesis. August 1991. J. C. Delouche, Major Advisor. 68 p.

61. Vieira, E. H. (Brazil). 1991. Relationship between seed density and quality in cowpea (*Vigna unguiculata*). Ph.D. Dissertation. Dec. 1991. C. C. Baskin, Major Advisor. 86 p.

62. Vieira, N. R. (Brazil). 1991. Enhancement effects of pre-sowing treatments on seed performance of rice (*Oryza sativa*). Ph.D. Dissertation. Dec. 1991. J. C. Delouche, Major Advisor. 116 p.

63. Bakhoum, A. (Senegal). 1991. Relationship between size and quality of pearl millet seeds. M.S. Thesis. Dec. 1991. C. C. Baskin, Major Advisor. 56 p.

64. de Paul Da, S. V. (Burkino Faso). 1991. Upgrading alfalfa seed quality with the color sorter. M.S. Thesis. Dec. 1991. E. R. Cabrera, Major Advisor. 46 p.

65. Ibssa, G. S. (Ethiopia). 1991. Comparison of seed quality between two corn (*Zea mays* L.) inbreds, their reciprocal crosses, and an open-pollinated variety. M.S. Thesis. Dec. 1991. C. H. Andrews, Major Advisor. 59 p.

66. Iqbal, S. (Egypt). 1991. Effects of deterioration of seeds upon field performance of soft red winter wheat. M.S. Thesis. Dec. 1991. C. E. Vaughan, Major Advisor. 56 p.

67. Massaly, F. (Senegal). 1991. Effects of planting date, seed size-density, and plant population on growth and reproduction of two cultivars of cowpea. M.S. Thesis, Dec. 1991. J. C. Delouche, Major Advisor. 64 p.

68. Midany, A. I. (Egypt). 1991. Relationship between seed size and quality in soybean. M.S. Thesis. Dec. 1991. C. H. Andrews, Major Advisor. 47 p.

69. Rodriguez, G. A. (Colombia). 1991. Effect of seed size on germination and vigor of corn. M. S. Thesis. Dec. 1991. C. H. Andrews, Major Advisor. 53 p.

70. Shiferaw, Y. (Ethiopia). 1991. Characterization of wheat [*Triticum aestivum* (L.)] cultivars by laboratory and field techniques. M.S. Thesis. Dec. 1991. C. E. Vaughan, Major Advisor. 53 p.

71. Yoakim, M.A. (Egypt). 1991. Temperature relations of wheat seed germination. M.S. Thesis. Dec. 1991. J. C. Delouche, Major Advisor. 45 p.

72. Abayazeed, S. (Egypt). 1991. M.Agr. Dec. 19091. Non-thesis option. C. E. Vaughan, Major Advisor.

73. Attya, G. (Egypt). 1991. M. Agr. Dec. 1991. Non-thesis option. C. C. Baskin, Major Advisor.

PERIOD: 1/92 - 12/92

74. Chuntirapongsa, S. (Thailand). 1992. Effects of seed coat color on storability of soybean seeds. Ph.D. Dissertation. Dec. 1992. 68 p. J. C. Delouche, Major Advisor.

75. Siddiqui, N. U. (Pakistan). 1992. Prediction of the storage viability of corn seeds in relation to seed moisture content, temperature and seed vigor. Ph.D. Dissertation. Dec. 1992. J. C. Delouche and E. R. Cabrera, Major Advisors. 82 p.

76. Henain, E. S. (Egypt). 1992. Rates of absorption and desorption of hygroscopic moisture by gin run and acid delinted cotton seeds at 10° and 30°C. M.S. Thesis. Dec. 1992. J. C. Delouche and E. R. Cabrera, Major Advisors. 64 p.

77. Paquiot, K. (Haiti). 1992. Evaluation of methods for releasing seed dormancy in cultivated and red rices. M.S. Thesis. Dec. 1992. J. C. Delouche, Major Advisor. 61 p.

78. Saad, M. A. H. (Egypt). 1992. Field deterioration of cowpea seed. M.S. Thesis. Dec. 1992. C. E. Vaughan, Major Advisor. 46 p.

79. Sorour, S. E. H. A. (Egypt). 1992. Variation among rice varieties and red rice lines in initial level and period of seed dormancy. M.S. Thesis. Dec. 1992. J. C. Delouche, Major Advisor. 61 p.

80. Sukarman (Indonesia). 1992. Physiological quality of mung bean seeds as affected by weathering and adverse storage conditions. M.S. Thesis. Dec. 1992. J. C. Delouche, Major Advisor. 63 p.

81. Wague, K. (Senegal). 1992. Comparison of seedling vigor and competitiveness in selected red rices and cultivated rices. M.S. Thesis. Dec. 1992. J. C. Delouche, Major Advisor. 53 p.

PERIOD: 1/93 - 9/29/93

82. Banyankiye, P. (Burundi). 1993. Some aspects of seed development, maturation and field deterioration in sorghum. M.S. Thesis. May. 1993. J.C. Delouche, Major Advisor. 57 p.

83. Baramburiye, J. (Burundi). 1993. Effects of seed specific gravity and seed size on vigor and field performance in wheat seed. M.S. Thesis. May. 1993. C. H. Andrews, Major Advisor. 63 p.

84. Khan, M. Q. (Pakistan). 1993. Effects of gravity separation and seed treatment on seed quality in wheat. M.S. Thesis. May 1993. B. C. Keith and J. C. Delouche, Co-major Advisors. 50 p.

85. Mahamadou, I. (Niger). 1993. Performance of pearl millet as affected by seed size. M.S. Thesis. May 1993. C. H. Andrews, Major Advisor. 58 p.

86. Marwanto. (Indonesia). 1993. Moisture exchange and equilibria in soybean seed blends. Ph.D. Dissertation. May 1993. J. C. Delouche & E. R. Cabrera, Co-major professors. 80 p.

87. Sambo, B. H. (Niger). 1993. Effects of seed specific gravity and plant population on seed quality, growth and development, and yield of three cultivars of pearl millet. M.S. Thesis. May 1993. C. H. Andrews, Major Advisor. 67 p.

88. Turnipseed, E. B. (USA). 1993. Deteriorative changes in soybean and cotton seeds. Ph.D. Dissertation. May 1993. J. C. Delouche, Major Advisor. 102 p.

89. Zaidan (Indonesia). 1993. Establishment and release of the hard seed condition in soybean. Ph.D. Dissertation. May 1993. J. C. Delouche, Major Advisor. 70 p.

90. El Hawary, M. I. (Egypt). 1993. Model seed legislation for the West Asia and North Africa region. Ph.D. Dissertation. July 1993. C. E. Vaughan and J. C. Delouche, Co-major Advisors. 262 p.

91. Hussain, M. A. H. (Pakistan). 1993. Water absorption by vegetable seeds. M.S. Thesis. July 1993. C. E. Vaughan, Major Advisor. 45 p.

92. Lansakara, H. (Sri Lanka). 1993. Moisture exchange and hygroscopic equilibria in field and pop-corn seeds. Ph.D. Dissertation. July 1993. J. C. Delouche and E. R. Cabrera, Co-major Advisors. 99 p.

93. Mahfood, A. O. (Yeman). 1993. Seed treatment of wheat. M.S. Thesis. July 1993. B. C. Keith and C. E. Vaughan, Co-major Advisors. 41 p.

94. Reginelli, D. B. (USA). 1993. The relationship between seed quality, time of radicle emergence, and plant performance of cotton under competitive and non-competitive situations. Ph.D. Dissertation. July 1993. C. C. Baskin, Major Advisor. 92 p.

95. Ilhamuddin. (Pakistan). 1993. Relationships between planting seed quality and field deterioration in wheat seeds. M.S. Thesis. July 1993. B. Keith and C.H. Andrews, Co-Major Advisors. 53 p.

III. TECHNICAL ASSISTANCE PROVIDED UNDER BUY-INS AND OTHER FUNDINGS

Summary

7/15/86 - 9/29/93

By
Calendar Year

	Year								
Activity	86	87	88	89	90	91	92	93	Total
	No.								
Training Programs:									
At MSU	2	3	3	4	8	5	3	2	30
In-Country	-	1	-	-	3	1	1	1	7
Regional	1	1	1	1	-	-	-	-	4
Technical Assistance:									
Short Term	2	2	7	11	8	5	3	4	42
Long Term	-	2	2	2	2	3	3	3	*
*Approx. 14 years TA									

Value (Approx.) of Buy-ins in $1000.

Yr.	1986*	1987	1988	1989**	1990	1991	1992	1993***	Total
$(000)	133.5	419.0	514.5	663.0	604.8	642.5	662.0	546.0	4,185.3

*7/15 - 12.31/86
**Includes 330,000 for degree-training over 4 year periodl.
***1/1 - 9/29/93

PERIOD: 7/15/86 - 12/31/86

Amount (US$)
(Approx.)

Training Courses/Programs at MSU/STL

OICD/USDA. Organization, implementation and management of 9 week Seed Improvement Training Course. 31 participants from 13 countries. June-July 1986

OIP & STL 64,000

Burma/USAID/MOPP. Four-weeks training at MSU and surrounding area for four participants. August 1986.

STL Staff & Cooperators 14,500

Training Courses/Programs In-Country or Regional

CIAT/Seed Unit. Services of two senior Spanish speaking instructors for advanced seed training course. E. Cabrera and J. Cortes. Partial "buy-in" and MSU cost sharing. July-August, 1986.

E.R. Cabrera and J.C. Cortes 3,000

Technical Assistance

Niger/Labat-Anderson, Inc. Services of W. Couvillion, agricultural economist, for economic study of seed program. Three weeks. July-August, 1986.

W. C. Couvillion 8,000

Niger/Labat-Anderson, Inc. (Request of USAID/Mission). Three-person team including two economists to make complete review of seed program/industry in Niger. J. C. Delouche, W. Couvillion, S. Swinton. Fall, 1986.

J.C. Delouche, W.C. Couvillion, & S. Swinton 44,000

Subtotal 133,500

PERIOD: 1/01/87 - 12/31/87

Training Courses/Programs at MSU/STL

USDA/OICD. 1987 Seed Improvement Course. June - August 1987 (nine weeks); 23 participants from 12 countries.

OIP & STL 65,000

USAID/Burma MOPP. A special one-month training program was organized and conducted in U.S. based at MSU for three Burmese participants. August, 1987.

STL Staff & Cooperators 11,000

USAID/Thailand. Special 2-week study tour of the U.S. seed industry for 12 Thai officials was planned, programmed, and conducted. Oct. 1987.

STL & Offfice of Intl. Programs 22,000

Training Courses/Programs In-Country or Regional

IITA/Nigeria. IITA made partial buy-in for 3 weeks training course at IITA for participants from Africa region. The course was held in March-April, 1987. IITA funded travel, living allowances at IITA and partial salary for one instructor. MSU provided salary for one instructor, partial salary for second instructor and waived indirect costs.

C.E. Vaughan & E.R. Cabrera 9,000
(plus $5,000 MSU cost sharing)

USAID/Thailand. Three-week training course in seed technology organized and conducted by MSU/STL at Korat, Thailand in cooperation with Seed Division, DOAE, RTG; 34 participants. Sep.-Oct. 1987.

J.C. Delouche 12,000

Technical Assistance

CID under USAID/Egypt. MSU awarded "seeds component" of USAID financed NARP project through sub-contract with CID. One full-time seed specialist on-board July 1, 1987.

B.R. Gregg . . . . . 150,000/yr.

Winrock/Joint PVO/University Center. Services of MSU staff made available to "On-Farm Seed Production in Sub-Saharan Africa" project (4 years) handled collaboratively by Winrock and the Joint Center (AID/PVO matching grant project). Funding: approx. $15,000/yr. reserved by Joint PVO/University Center for MSU services to cover travel, per diem, out-of-pocket costs, and some salaries; some of salaries, indirect costs are cost shared by MSU. Start January, 1987.

STL Staff . . . . . budgeted (15,000/yr.)

OICD/USDA ASEAN Plant Quarantine and Training Project. Services of J. C. Delouche for 5 weeks study of phytosanitary requirements related to movement of seeds and status of seed technology in ASEAN region. July-Aug. 1987.

J.C. Delouche 15,000

Winrock/Indonesia (USAID). MSU awarded the seeds applied research component of the AARP II project with Winrock International as lead. The seeds component provides for one full-time specialist for at least two years, and about 4 months short term technical assistance. Start time for MSU: Dec., 1987.

M.M. Lassim . . . . . approx. 120,000/yr.

Subtotal 419,000

PERIOD: 1/01/88 - 12/312/88

Training Courses/Programs at MSU/STL

OICD, USDA. 1988 Seed Improvement Short Course; 18 participants; 9 weeks. June-August 1988.

OIP & STL 63,000

Burma/World Bank. Special 4.5 month training program for three Burmese; MSU campus. 8/88 to 1/89.

STL 22,000

OICD/USDA for FAO. Special post-doctoral training program for Dr. B.P.S. Lather, National Seed Center, India. 8/88 - 12/88.

STL 14,000

Training Courses/Programs In-Country or Regional

IITA (Nigeria). 2nd International Seed Technology Training Course (3 weeks) for participants from Africa was organized by MSU/STL and IITA and conducted by two MSU instructors. Mar.-April, 1988; (IITA, $7,400; OICD, $3,800; MSU, $3,300).

C.E. Vaughan & E.R. Cabrera 15,500

Technical Assistance

Niger/Center for Research on Economic Development (CRED), University of Michigan. Advice on and development of an appropriate "Seed Policy" for Niger. Supervision by USAID/Niger and cooperation with Labat-Anderson Team, and National Cereals Program. Jan. 1988.

W.C. Couvillion 7,500

Winrock/Indonesia AARP II Project. Short-term consultation on seed research to the USAID financed AARP II; 18 days, Apr.-May, 1988.

J.C. Delouche 10,000

DAI/Sri Lanka (USAID). Consultation in Sri Lanka on AID financed DARP project on economic aspects of seeds component: 25 days, Jun.-Jul., 1988.
W.C. Couvillion 15,000

DAI under USAID/Sri Lanka DARP Project. Seed component, economic analyses. June/July, 1988, four weeks.
W. C. Couvillion 17,000

USAID/Burundi. Approximately 8 weeks. Assistance with preparation of seed project. August/September, 1988.
C.H. Andrews, W.C. Couvillion, & C.E. Vaughan 45,000

World Bank/China. Supervision of Seeds I project; pre-appraisal of seed component of Shandong Agricultural Development Project. July-August, 1988. 5 weeks.
J. C. Delouche 15,000

CID under USAID/Egypt. NARP Project; Seeds Component; 6 yrs TA. Start 1987. (1988).
B.R. Gregg . . . . . 150,000/yr.

Winrock under USAID/Indonesia AARP Project. Seeds Component. 2nd Year TA. (1988).
M.M. Lassim . . . . . 135,000/yr.

Winrock & Joint PVO/University Center. Activities under the On-Farm Seed Project for Sub-Saharan Africa. Continuing assistance and participation. J. Cortes, 2 wks Senegal and The Gambia, 8/88.
J. Cortes 5,500
Subtotal 514,500

PERIOD: 1/01/89 - 12/31/89

Training Courses/Programs at MSU/STL

OICD, USDA. 1989 Seed Improvement Short Course; 16 participants; 9 weeks. June-August, 1989.
STL 58,000

FAO. Special training program for Dr. Tyagi (India) in Seed Production and Certification. Aug.-Dec. 1989.
STL 13,000

56

FAO. Special training program for Dr. Rai (India) in seed marketing. Aug. 1989. 4 weeks.
STL & Agr. Econ. 3,000

USAID/Egypt. Special degree training program at MSU for Egyptian participants allied to NARP project. Start 8/89. 4 years.
MSU . . . . . 330,000 (total)

Training Courses/Programs In-Country or Regional

Escuela Agricola Panamerican. Under BID financing. Survey of seed training needs in Central America and Caribbean. Nov. 1989. 2 1/2 weeks.
E.R. Cabrera 3,000
(plus $4,000 MSU Cost Sharing)

Technical Assistance

Blount World Trade for USAID/Cameroon Financed Seed Multiplication Project. Analysis and review of seed facility design and equipment specifications, preparation of operator's manual and 3 wks on-job training on operation of seed facility - 1989 and continuing into 1990.
E.R. Cabrera, G.B. Welch, & J.C. Delouche 18,000

USAID/Thailand funded MSU-DOAE Seed Division (Thailand). Continuing Linkages Project (effective July 1, 1988); two-week visit May, 1989 by Delouche; three-week visit to MSU & U.S. by three Thai officials, Sep-Oct. 1989.
J.C. Delouche (3 years) . . . . . 20,000/Yr.

Taiwan, Council of Agriculture, Executive Yuan. Invitational review of seed industry. March, 1989, 2 weeks.
J.C. Delouche & C.H. Andrews 8,000

USAID/Honduras. Analysis of opportunities for changes in organization of seed production and supply. May, 1989, 4 weeks.
E. R. Cabrera 15,000

USAID/Honduras. Preparation of proposal for special allocation, Jun. 1989, 1 1/2 wk.
E. R. Cabrera 5,000

DAI under USAID/Sri Lanka DARP project. Continued analyses of seed marketing, distribution and pricing policies. June/July 1989, 4 weeks.
W. C. Couvillion 16,000

CID under USAID/Egypt. NARP Project; 6 yr. TA start 1987 (1989)
B. R. Gregg . . . . . 160,000/yr.

University of Arkansas under the USAID/Burundi Small Farm Improvement Project. Continued assistance with planning and organization of seed production and supply. May and June 1989, 4 weeks.
C.H. Andrews 16,000

Winrock & Joint PVO/University Center. On-Farm Seed Production Project. Continuing assistance and participation. Senegal & The Gambia. J.C. Delouche, 2/89; C. E. Vaughan, 5/89.
J.C. Delouche & C.E. Vaughan 15,000

World Bank/China. Fourth year supervision of China Seeds Project May/June 1989, 4 weeks.
J. C. Delouche 14,000

World Bank/China. Pre-appraisal of Hebei Agricultural Development Project (seeds component). Aug.-Sep. 1989, 3 weeks.
J.C. Delouche 12,000

U. of Arkansas under USAID/Burundi - Small Farm Project. Continued assistance on planning and implementation of seed production and supply component. Sep.-Dec. 1989, 15 wks.
C.H. Andrews & Peter Klink 47,000

Winrock under USAID/Indonesia AARP II Project. Seeds Component. 4 month extension of technical assistance. Dec. 1989 - Feb. 1990.
M.M. Lassim 50,000

FAO/India. India National Seed Center Project. Consultation on seed testing. Sep. 1989. 4 wk.
C.E. Vaughan 10,000
Subtotal 663,000

PERIOD: 1/01/90 - 12/31/90

Training Courses/Programs at MSU/STL

USAID/Egypt. Degree training for NARP participants; start 8/89.
MSU (continuing, 4 yr.) . . . . . 330,000 (total)

USDA/OICD: 1990 Seed Improvement Course; June-August, 1990 (nine weeks); 22 participants from 9 countries.
OIP & STL . . . . . approx. 70,000

FAO\India: Special 4.5-month training program was organized and conducted for Dr. R. S. Hooda, Haryana Agricultural University, India. 8-12/90.
STL.. 13,000

USAID/Peru (MUIAC). Special 4.5 month training program for participant (F. Arana) from Peru was organized and conducted. 8-12/90.
STL. 10,000

USAID/Pakistan. Seven days special training program from M. Jahangir, Pakistan, participant from private sector. 8/90.
STL. 1,200

MIC/Cochran Group. Two week special training program for three participants from Poland (D. J. Panasiuk, M. Sucha and M. Beresnewicz) and one participant from Algeria (N. Merouabi). 8/90.
STL. 3,800

INTSORMIL/SADCC. Two week special intensive training course in general seed technology for six participants at other U.S. institutions under SADCC, organized by INTSORMIL. 8/90.
STL.. 8,800

USAID/Thailand. Three-week special training and observation/study tour was organized and conducted for three Thai seed specialists under the MSU/DOAE/Thai Continuing Linkeages Project.
STL 9,000

Training Courses/Programs In-Country or Regional

Peru/N.C. State U./MUIAC/ATT (USAID). (2) Organization and instruction in "First Seed Testing Workshop", Chiclayo, Peru, and design of seed conditioning plant for maize and rice in jungle area. 8/90.
E. R. Cabrera 9,000

Winrock under USAID/Indonesia AARP Project. Training course in seed technology for researchers in FCRI system. J.C. Delouche served as instructor and resource person; 1/90.
J. C. Delouche 11,000

Blount World Trade for USAID/Cameroon financed Seed Multiplication Project. Organization and conduct of training course on operation of seed facilities; 3/90.
E.R. Cabrera 13,000

Technical Assistance

Peru/N.C. State U./MUIAC/ATT **(USAID)**. Assistance in developing seed certification programs for cotton and rice (4 weeks). 4-5/90.
C. C. Baskin 12,000

USAID/Bangladesh. Review of seed program/industry; recommendations on policy; preparation of baseline data on seed industry development in Asia; preparation of concept paper. 7 weeks, 3-5/90
J.C. Delouche & W.C. Couvillion 48,000

World Bank/China. Supervision of Seeds I project; pre-appraisal of seeds component of Henan Agricultural Development Project. 5 weeks, 7-8/90.
J.C. Delouche 18,000

CID under USAID/Egypt. NARP project. Provided training input for NARP Seed Technology component implementation plan for TY 90-91. 5-6/90.
C.E. Vaughan 11,500

CID under USAID/Egypt. NARP Project. Seeds Component, 6-yr TA. Start 1987. (1990).
B.R. Gregg . . . . . 165,000/yr.

Winrock & Joint PVO/University Center. Activities under the On-Farm Seed Project for Sub-Saharan Africa. Continuing assistance on extension program and participation in all other activities. C. C. Baskin, visit to Senegal and The Gambia; 9/90.
C.C. Baskin & J.C. Delouche 10,500

USAID/Honduras. Consultation on privatization of the seed industry. 5-6/90.
C.H. Andrews & E.R. Cabrera 15,000

U. of Arkansas under the USAID/Burundi-Small Farming Systems Research Project. Continued assistance with planning and organization of seed production and supply and seeds component update for World Bank ASM; 10/90.
C.H. Andrews 15,000

U. of Arkansas under USAID/Burundi - Small Farming Systems Research Project. Subcontract with U. of Ark. for the seeds component TA. 3 years. Stephen Walls on post in Burundi for MSU; start 10/90.

Stephen Walls . . . . . 159,000/yr.

Escuela Agricola Panamerica (Honduras). Under BID financing. Assisted EAP with the development of a proposal for seed and grain post-harvest training in CA and Caribbean area (visits by E. R. Cabrera, Jan. 28-Feb. 5, and Nov. 25-30, 1990).

E.R. Cabrera 2,000

(Plus $1,000 MSU Cost Sharing) Subtotal 604,800

PERIOD: 1/01/91 - 12/31/91

Training Courses/Programs at MSU/STL

USDA/OICD: The 1991 Seed Improvement Course (OICD/USDA and MSU) was held June - August, 1991 at MSU. The enrollment was 22 participants from nine countries.

OIP & STL . . . . . approx. 70,000.

FAO/India: Special 3.5-month training program was organized and conducted for Dr. R. S. Punia, Haryana Agricultural University, India; 10-12/91.

STL 10,000

FAO/China: One participant for 8 months training in cotton; 10/91-6/92.

STL 13,000

FAO/Burma: Four Burmese participants for 4.5 mo. special training in general seed production and certification; 1-6/91.

STL 18,000

USAID/Egypt. Degree training programs for NARP participants; start 8/89.

MSU (continuing, 4 yr.) . . . . . 330,000 (total)

Training Courses/Programs In-Country or Regional

CID under USAID/Egypt. NARP project. Tetrazolium training workshop, 1, 91.

C.E. Vaughan 9,000

Technical Assistance:

USAID/Thailand funded MSU-DOAE Seed Division (Thailand). Continuing Linkages Project (effective July 1, 1988). One-week visit in May and two week visit in Dec., 1990. Terminated mid-1991 due to military takeover of government.
J.C. Delouche (3 years) . . . . . (20,000/yr.)

CID under USAID Egypt. NARP Project. Consultation on applied seed research & seed sector reform 11-12/91.
J.C. Delouche 13,000

World Bank/Egypt. Preparation of document on seed industry in Egypt. 8-10/91.
J.C. Delouche & W.C. Couvillion 6,000

CID under USAID/Egypt. NARP Project. Seeds Component, 6 yr TA. Start 1987. (1991).
B.R. Gregg . . . . . 170,000/yr.

Winrock & Joint PVO/University Center. Activities under the On-Farm Seed Project for Sub-Saharan Africa. Continuing assistance on extension program and participation in all other activities. J. C. Delouche, visit to Senegal and The Gambia; 9/91.
C.C. Baskin & J. C. Delouche 5,500
(in 1991)

USAID/Honduras. Agreement with USAID/Honduras under BOA. 24 months: 7/91-8/93.
E.R. Cabrera . . . . . 125,000/yr.

U. of Arkansas under the USAID/Burundi-Small Farming Systems Research Project. Assistance with seed legislation, varietal release procedures, and privatization of seed industry. Two consultations. 4-5/91 & 11/91.
J.C. Delouche 24,000

U. of Arkansas under USAID/Burundi - Small Farming Systems Research Project. Subcontract with U. of Ark. for the seeds component TA. 3 years. Stephen Walls on post in Burundi for MSU. (1991).
Stephen Walls . . . . . 159,00/yr.

USAID/El Salvador. Review of seed industry and recommendations. 9-10/91.
C.H. Andrews & D. C. Stimpson 20,000
Subtotal 642,500

PERIOD: 01/01/92 - 12/31/92

Training Courses/Programs at MSU/STL

USDA/OICD: The 1992 Seed Improvement Course (OICD/USDA and MSU) was held June - August, 1992 at MSU. The enrollment was 14 participants from six countries.

OIP and STL . . . . . approx. 55,000

FAO/China. One participant for 8 months. Special training in cotton seed technology. 10/91-6/92

STL (continued from CY91). . . . . (13,000)

USAID/Egypt. Degree-training programs for NARP participants; start 8/89.

MSU (continuing, 4 years) . . . . . 330,000 (total)

Training Courses/Programs In-country or Regional

USAID/Kenya-U. of Missouri. Three-week training course in Kenya for 40 participants from the public and private sectors. MSU provided two instructors; 2-3/92.

S. Goggi & C.E. Vaughan 28,000

Technical Assistance:

CID under USAID/Egypt. NARP project. Two consultations: reform and privatization of seed sector, 1-2/92; and seed legislation, 5-6/92.

J. C. Delouche 36,000

CID under USAID/Egypt. NARP Project. Seeds Component, 6-yr TA. (1992).

B. R. Gregg (Cairo) . . . . . 175,000/yr.

USAID/Honduras. Techncial assistance agreement with USAID/Honduras under BOA. (1992).

E. R. Cabrera (Tegucigalpa) . . . . . 150,000/yr.

U. of Arkansas under the USAID/Burundi-Small Farming Systems Research Project. Economic analyses of public sector seed operations to determine feasibility for privatization, 2-3/92.

W. C. Couvillion 16,000

IFDC/Bangladesh/USAID. Preparation of ATD project with IFDC and Winrock. 10-12/92.

C. E. Vaughan 42,000

U. of Arkansas under USAID/Burundi - Small Farming Systems Research Project. Subcontract with U. of Ark. for the seeds component TA. 3 yr. (1992).

Stephen Walls (Bujumbura) 160,000/yr

Subtotal 662,000

PERIOD: 01/01/93 - 09/29/93

Training Courses/Programs at MSU/STL

USDA/OICD: The 1993 Seed Improvement Course (OICD/USDA and MSU) was held June - August, 1992 at MSU. The enrollment was 17 participants from five countries.

OIP and STL . . . . . approx. 65,000

World Bank/Nigeria. One participant for 8 weeks. Special up-dating training in seed technology for Dr. A. Ogundipe, Jul-Sep, 1994

STL. 10,000

Training Courses/Programs In-country or Regional

Burundi Seed Training Course. One-week training course in Burundi for 20 participants from the public and private sectors. MSU provided two instructors; Funding under U. of Arkansas/MSU Agreement . . . . . (see below)

Technical Assistance

CID under USAID/Egypt. NARP project. Two consultations: Continuation of reform and privatization of seed sector and seed legislation (1) 3-4/94 & (2) 8-9/94.

J. C. Delouche 36,000

CID under USAID/Egypt. NARP Project. Seeds Component, 6th yr. TA, 9/92-8/93; approx. 8 mo. in CY 94.

B. R. Gregg (Cairo) . . . . . (approx.)150,000

USAID/Honduras. Technical assistance agreement with USAID/Honduras under BOA. 2nd yr., 10/92-9/93; approx. 8 mo. in CY 94.

E. R. Cabrera (Tegucigalpa) . . . . . (approx.) 115,000

U. of Arkansas under the USAID/Burundi-Small Farming Systems Research Project. Training; review of National Seed Policy; privatization.

C.H. Andrews & B.C. Keith 30,000

IFDC/Bangladesh/USAID. Preparation of ATD project with IFDC and Winrock. 1-2/93.

C. E. Vaughan 15,000

U. of Arkansas under USAID/Burundi - Small Farming Systems Research Project. Subcontract with U. of Ark. for the seeds component TA. 3rd yr. 9/92 - 8/93; approx. 8 mo. in CY 93.

Stephen Walls (Bujumbura) . . . . . (approx.) 115,000

Indonesia/DAI (Agribusiness Development Project). Review of current status of seed industry, identification of constraints and opportunities for entry of agribusinesses. 9/93.

B.C. Keith 10,000

IV. ACTIVITY REPORTS PREPARED[2]

PERIOD: 7/86 - 12/86

E .R. Cabrera and J. Cortes. 1986. MSU/STL Participation in the CIAT Advanced Course on Seed Certification. 7-8/86 Rept. to AID/W, OIP/MSU, CIAT. 8 p. R-3-86.

Staff. 1986. MSU/STL Special Training Course (at MSU) for Four Burmese Seed Officials of the MOPP Project. 8-9/86 Staff. Rept. to USAID/Burma, AID/W, OIP/MSU. 6 p. u/n.

C. H. Andrews and E. R. Cabrera. 1986. Report on Collaborative Research in Seed Technology between MSU/STL and MONR, Honduras, and EAP, Zamorama, Honduras. 11/86. Rept. to USAID/Honduras, AID/W, OIP/MSU. 10 p. 86-R-1.

C. H. Andrews and E. R. Cabrera. 1986. Report on Collaborative Research in Seed Technology between MSU/STL and CIGRAS, UCR, and ONS, GOCR, Costa Rica. 11/86. Rept. to USAID/Costa Rica, AID/W, OIP/MSU. 8 p. 86-R-2.

W. C. Couvillion. 1986. Economic Study of Niger Seed Multiplication Program. Rept. to Labat-Anderson, Inc., USAID/Niger, GON. 48 p. u/n.

J. C. Delouche, W. C. Couvillion, and Scott Swinton. 1986. Multiplication et Production de Semences au Niger. Rept. to Labat- Anderson, Inc., USAID/Niger, GON. 88 p. u/n. (Report originally prepared in English, then translated to French).

PERIOD: 1/87-12/87

C. E. Vaughan and E. R. Cabrera. 1987. 1st Seed Technology Training Course at IITA (Nigeria) for Seed Program Personnel from Tropical Africa, 3-4/87. Rept. to IITA, OIP/MSU, AID/W. 8 p. AR 87-2.

C. H. Andrews. 1987. Report on Field Implementation Plan for On-Farm Seed Project (Senegal & The Gambia). 5-6/87. Rept. to Winrock International, Joint PVO/University Center, OIP/MSU, AID/W. 31 p. AR 87-3A.

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[2]Reports on some TA assignments were confidential or part of a larger report, hence, are not included here.

J. E. Cortes. 1987. Collaborative Research in Seed Technology in Honduras with MONR, GOH and EAP, and Seminar on Privatization of the Seed Industry in Honduras. 7/87. 12 p. AR 87-3B.

J. C. Delouche. 1987. Seed Technology Training Course in Thailand (Korat) for Seed Division (DOAE) Personnel & Related Services. 9-10/87. Rept. to USAID/Thailand, AID/W, OIP/MSU, DOAE. RD/BY 87-2.

Staff. 1987. Special Training Course for Three Burmese Seed Officials of the Burma Agricultural Production Project. 8-9/87. Rept. to USAID/Burma, AID/W, OIP/MSU. 4 p. AR 87-7.

C. C. Baskin and others 1987. Seed Industry Study Tour (U.S.) and Related Activities for Twelve Royal Thailand Government Officials, 10/87. Rept. to USAID/Thailand, AID/W, OIP/MSU. 12 p. RD/BY 87-3.

C. C. Baskin. 1987. Twelfth Panamerican Seed Seminar, Montevideo, Uruguay, 11/2-6/87. Rept. to AID/W, OIP/MSU. 13 pp. AR 87-5.

C. C. Baskin. 1987. Workshop (CIAT Sponsored) on Seed Quality Improvement Systems, Montevideo, Uruguay. 11/9-13/87. Rept. to CIAT, OIP/MSU, AID/W. 45 p. AR 87-6.

C. H. Andrews. 1987. Report on Site Visits to Honduras and Brazil with AID Impact Evaluation Review Team. 10/87. C. H. Andrews. Rept. to OIP/MSU, AID/W. 6 p. u/n.

PERIOD: 1/88 - 12/88

C. E. Vaughan and E. R. Cabrera. 1988. 2nd Seed Technology Training Course for Agricultural Seed Program Personnel from Africa. 2-3/88. Rept. to OIP/MSU, IITA, AID/W. 6 p. AR 88-2.

J. C. Delouche. 1988. Seed Technology and Related Activities, ASEAN Region. 7-8/87. Rept. to ASEAN/PLANTI, OICD/USDA, dated April, 1988. 123 p.

C. H. Andrews and J. E. Cortes. 1988. Memo on PCCMCA Meeting, San Jose, Costa Rica. 3/88. 3 p. u/n.

W. C. Couvillion and D. Rachmueller. 1988. Action Plan for Seed Policy, Government of Niger. 1/88. Rept. for University of Michigan, Center for Research on Economic Development. 2/88. 37 p. u/n.

C. H. Andrews. 1988. Proposed Project Design for ISGSC at EAP. Rept. to EAP and USAID/Honduras. 6 p. w/appendix. 8/88. AR 88-3.

J. E. Cortes. 1988. Consultation Visits with OFSP Project in Senegal and The Gambia. Rept. to Winrock & Joint University/PVO Center, WCU. 22 p. 8/88. u/n.

C. H. Andrews, C. E. Vaughan, and W. C. Couvillion. 1988. National Seed Plan for Burundi. Report to AID/W, USAID/Burundi & U. of Arkansas. 53 p. 9/88. AR 88-4.

C. H. Andrews. 1988. National Seed Plan Design. Rept. to USAID/Burundi and AID/W. 5 p. 9/88. u/n.

C. H. Andrews. 1988. Poster presentation - Seed Technology Collaborative Projects: Agr. Dev. - Today & Tomorrow. AID/S&T Collaborators Conf., Washington, D. C. Sep. 28-30, 1988.

J. E. Cortes. 1988. Burkino Fasso Renewable Resources Management Project. Rept. on Meeting, Ouagadogou. Joint University/PVO Center & PVOs of B. F. Nov. 21-30, 1988. 12 p. u/n.

PERIOD: 1/89 - 12/89

C. H. Andrews. 1989. International Seed and Grain Science Center (ISGSC), EAP, Honduras: Laying the Corner Stone. Rept. to USAID/Honduras & AID/W. Feb. 1-4, 1989. 12 p. AR 89-1.

C. H. Andrews and J. C. Delouche. 1989. Review of Seed Industry Development and Seed Related Research in Taiwan. Invitation Consultation. COA, Republic of China. March, 1989. 10 p. u/n.

J. C. Delouche. 1989. Technical Dimensions of the On-Farm Seed Production Project. Project Review and Evaluation Conference. Sept. 18-19, 1989. Winrock International, Washington, D. C. 3 p.

C. H. Andrews. 1989. Seed Component of Small Farming Systems Research Project. Rept. to OIP/MSU, USAID/Burundi and U. of Arkansas. 40 p. AR 89-7.

E. R. Cabrera. 1989. Seed Post-Harvest Training Manual. Prepared for MEDEVI, Cameroon. USAID/Cameroon and Blount, Inc. 69 p. illustrated.

J. C. Delouche and F. Mertens. 1989. USAID and Mississippi State University: Partners in Seed Technology. USAID/S&T. (News Release)

J. C. Delouche. 1989. MSU graduates 300th International Seed Technology. S&T Newsletter. 11/89. (News Release)

J. C. Delouche. 1989. Progress Report: Continuing Linkages Agreement between MSU & RTG/DOAE Seed Division. Rept. to USAID/Thailand. 12/89. 12 p.

C. C. Baskin. 1989. Consultancy with the OFSP Project in The Gambia. Rept. to Winrock to Joint PVO/University Center, WCU. 19 p.

P. Klinck. 1989. Interim TDY assignment with Small Farming System Project in Burundi. Rept. to OIP/MSU, USAID/Burundi and U. of Arkansas. 10-12/89. 56 p.

PERIOD: 1//90 - 12//90

C. H. Andrews and E. R. Cabrera. 1990. Seed Privatization in Honduras. Rept. to USAID/Honduras. 50 p. AR 90-2.

C. H. Andrews. 1990. SFSR Seed Component for World Bank ASM. Report to USAID/Burundi and Univ. Arkansas/SFSR Project. 19 p.

C. C. Baskin. 1990. Report on Consultancy to the OFSP Project in Senegal and The Gambia. Rept. to Winrock Int. & Joint Univ./PVO Center, WCU. 18 p.

C. C. Baskin. 1990. Recommendations for rice and cotton seed production in Peru. Rept. to NCSU/MUIAC/ATT & USAID Peru. 34 p.

E. R. Cabrera with others. 1990. Training Proposal for Appropriate Seed and Grain Post-Harvest Technology. Rept. to EAP/Honduras & BID. 81 p.

E. R. Cabrera. 1990. Course Curricula for Training Program in ISGSC at EAP. Rept. to EAP/Honduras & BID. 12 p.

E. R. Cabrera. 1990. Training of Seed Conditioning Plant Personnel in MEDEVI North Cameroon Seed Multiplication Project. Rept. to Blount Int. & USAID/Cameroon. 25 p.

E. R. Cabrera. 1990. Seed Testing Workshop in Chiclayo and Design of Seed Conditioning Facilities in Tarapota, Peru. Rept. to NCSU/MUIAC/ATT and USAID/Peru. 55 p.

J. C. Delouche. 1990. R&D Improved Seed Production and Utilization. Progress Reports, 7/15/88 - 12/31/89. Rept. to AID/W/S&T/AGR, 12 p., plus Annexes A, B & C (57 p).

J. C. Delouche. 1990. R&D Improved Seed Production and Utilization. Proposed Work Plans - CY 1990. Report to AID/W/S&T/Agr. 12 p.

J. C. Delouche. 1990. Progress Report: Continuing Linkeages Agreement between MSU and the RTG/DOAE Seed Division. 9/16/88 - 12/31/89. Report to USAID/Thailand. 13 p.

J. C. Delouche. 1990. Seed Technology Training Course for Researchers. Rept. to Winrock, USAID/Indonesia, AARD, GOI. 44 p.

J. C. Delouche. 1990. Seed Industry Development in Asia. Selected Case Studies. Paper Prepared for USAID/Bangladesh. 59 p.

J. C. Delouche. 1990. Report on Supervision Mission, China Seeds Project. Rept. to World Bank and MOA/PRC. 31 p. (confidential).

J. C. Delouche. 1990. Seeds Component, Henan Agricultural Development Project. Rept. to World Bank and MOA/PRC. 38 p. (confidential).

J. C. Delouche and W. C. Couvillion. 1990. Draft Concept Paper on Agricultural Inputs, Marketing and Distribution Project. Paper Prepared for USAID/Bangladesh. 14 p.

C. E. Vaughan. 1990. Seed Industry Development in Egypt/Seed Technology Training Component: A Study and Recommendation for NARP. Rept. to USAID/Egypt, GOE, NARP/CID. 40 p.

PERIOD: 1//91 - 12/91

C. H. Andrews and D. C. Stimpson. Appraisal of the Seed Industry in El Salvador. 8-9/91. 88 p. AR 91-3.

C. H. Andrews and D. C. Stimpson with C. Hugo (KSU). 1991. Invigorating the Seed Industry in El Salvador. 11/91. 167 p. TA-Rept No. 121.

J. C. Delouche. 1991. R&D Improved Seed Production and Utilization. Progress Reports, 11/1/90 - 12/31/90 and Proposed Work Plans, 1/1-12/31/91. Rept. to AID/W/S&T/AGR, 12 p. plus Annexes A, B & C. 57 p.

J. C. Delouche. 1991. Seed Legislation Consultation with SFRS Project, Burundi. 4-5/91. BR 91/1. 57 p.

J. C. Delouche. 1991. Visit with the On-Farm Seed Production Project, Senegal and The Gambia. 9-10/91. MIS 91-1. 19 p.

J. C. Delouche. 1991. Review of Crop Varietal Development and Release Procedures, Seed Legislation and the NSP in Burundi, SFRS Project. Oct. 26 - Nov. 17, 1991. BR 91/2. 70 p.

J. C. Delouche. 1991/92. Consultations with the Seeds Component, NARP Project. 11-12/91 & 1-2/92. REP 92-2. 128 p.

J. C. Delouche and W. C. Couvillion. 1991. Egyptian Seed Subsector. Description and Analyses. Confidential Document for World Bank. 113 p.

C. E. Vaughan. 1991. Report on Seed Viability Testing Short Training Course in Egypt under NARP. Rept. to CID/NARP. 16 p.

B. Keith. 1991. Study Tour for Four Guyanese Agricultural Officials Sponsored by CARDI. 7/31-8/3. Report to CARDI. 6 p.

B. Keith. 1991. Study Tours for Burundi Agricultural Officials (2). 10/6-21. Report to UGAR & USAID Burundi. 10 p.

PERIOD: 1/92-12/92

J. C. Delouche. 1992. Applied Seed Research in Egypt, (p. 3-29), Reform of Seeds Sector in Egypt (p. 30 116). Rept. to USAID/Egypt CID/NARP/U. of AZ, ARC/MALR & OIP/MSU. 3/92. Rep. 92-2. 128 p.

J. C. Delouche. 1992. Reform of Seeds Sector & Seed Legislation. Rept. to USAID/Egypt, CID/NARP/U. of AZ, ARC/MALR & OIP/MSU. 6/92. Rep. 92-2. 108 p.

J. C. Delouche. 1992. Progress Report (01/01/91-12/31/91). Progress Work Plants. (01/01/92-12/31/92). MSU/AID/CAR&D Improved Seed Production and Utilization. Rept. to AID/W/S&T & OIP/MSU. 38 p.

C. E. Vaughan & others. 1992. ATD Project Paper for Bangladesh (first draft for review). For USAID/Bangladesh by IRDC, Winrock, MSU, Ronco. Draft for review.

B. Keith. 1992. Workship on Seed Certification and Supply in Honduras. 7/92. Rept. to USAID/Honduras. 10 p.

W. C. Couvillion. 1992. Economic Analyses of the National Seed Industry in Burundi. 2-3/92. Rept. & USAID/Burundi, U. of AR, and OIP/MSU. 102 p.

C. E. Vaughan and A. S. Goggi. 1992. Seed Technology Training Course for Kenya. 2-3/92. Rept. to Mid-America Agr. Consortium, Kenya Agr. Res. Inst., and USAID/Kenya. 15 p.

PERIOD: 1/93-9/93

C. E. Vaughan & others. 1993. ATD Project Paper for Bangladesh. For USAID/Bangladesh. by IFDC, Winrock, MSU and RONCO. Vol. I, II, III.

C. H. Andrews and B. Keith. 1993. Training Activities, Review of Release of Improved Plant Materials, Equipment Evaluation, Seed Handling and Storage in Burundi. Rept. to USAID/Burundi, U. of AR, MSU, GOB. 1-2/93. 138 p.

B. Keith. 1993. Review of Current Status of Seed Industry in Indonesia and Related Matters for the USAID Financial Agribusiness Development Project. Rept. to Development Alternatives, Inc., USAID/Indonesia. 10 p.

E. Cabrera. 1993. Asesoria and Programa de Semilla de Honduras. Informe Final. Rept. to SRN, USAID/Honduras. 9/93. 20 p.

J. C. Delouche. 1993. Review of Progress of Seed Sector Reform. Rept. to USAID/Egypt, CID/NARP/U. of AZ, OIP/MSU, ARC/MALR. 4/93. 97 p.

J. C. Delouche. 1993. Liberalization of Cotton Seeds Supply System in Egypt; Draft Seed Legislation; Progress on Seed Sector Reform; Plans for Workshops. Rept. to USAID/Egypt, CID/NARP/U. of AZ, OIP/MSU, ARC/MALR. 9/93. 68 p.

J. C. Delouche. 1993. R&D Improved Seed Production and Utilization. Progress Report 1992. Work Plans 1993. Rept. to AID/U/S&T. 42 p.

ANNEX B

Mississippi State University
Division of Agriculture, Forestry and Veterinary Medicine
Office of International Programs
Agronomy Department
Seed Technology Laboratory

FINAL AND SUMMARY REPORT

7/15/86 - 9/29/93

ON

R&D IMPROVED SEED PRODUCTION
AND UTILIZATION

CA - AID/DAN - 4143 - A - 00 - 6047 - 00
936-4143

ANNEX B

I. THESES/DISSERTATIONS COMPLETED AND DEGREES AWARDED . . . . . Page B-2

II. ABSTRACTS OF THESES/DISSERTATIONS . . . . . Page B-14

April, 1994

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I. THESES/DISSERTATIONS COMPLETED AND DEGREES AWARDED

THESES/DISSERTATIONS COMPLETED

SUMMARY

8/86 - 9/93

Distribution of Graduate Degree Students by Countries.

Argentina	5	Guinea	1	Panama	1
Brazil	4	Guyana	1	Pakistan	5
Bukino Paso	1	Haiti	1	Senegal	3
Burundi	2	Honduras	1	Sri Lanka	4
Columbia	3	India	1	Taiwan	1
Dominion Republic	2	Indonesia	10	Thailand	13
Egypt	11	Malawi	2	Tunisia	1
El Salvador	1	Malaysia	2	Venezuela	1
Ethiopia	2	Mexico	1	Yemen	2
Ghana	2	Niger	2	U.S.	9

Distribution of Graduate Students by Degree:

Ph.D., 27; M.S., 66; M. Agr., 2; Total, 95.

Distribution of Graduate Student Degree Student by Gender:

Female 20; Male 65.

Undergraduate (B.S.) Degrees Awarded: 14

PERIOD: 7/86 - 12/86

1. Koslanund, R. (Thailand). 1986. Factors affecting imbibitional injury in soybean [*Glycine max* (L.) Merrill] seeds. M.S. Thesis. Aug., 1986. J. C. Delouche, Major Professor, 60 p.

2. Asiedu, E. D. (Ghana). 1986. Influence of delayed harvest, chilling and mechanical injury on stored seed corn (*Zea mays*). M.S. Thesis. Dec., 1986. C. H. Andrews, Major Professor: 100 p.

3. Bianchetti, A. (Brazil). 1986. Effects of moisture content, temperature and storage interval on secondary dormancy of seeds of loblolly pine (*Pinus taeda* L.), Ph.D. Dissertation. Dec., 1986. F. Bonner and C. H. Andrews, Major Professors. 65 p.

PERIOD: 1/87 - 12/87

4. Vaughan, T. R. (U.S.). 1987. Influence of seed coat condition on germination and emergence of soybean. M.S. Thesis. May, 1987. C. H. Andrews, Major Professor. 54 p.

5. Tatang, M. H. (Indonesia). 1987. Effects of planting date on sunflower oil and seed quality. Ph.D. Dissertation. Aug. 1987. C. H. Andrews, Major Professor. 93 p.

6. Unsirisong, S. (Thailand). 1987. Relationship of specific gravity to quality and performance of soybean [*Glycine max* (L.) Merr.] seeds. Ph.D. Dissertation. Dec., 1987. C. E. Vaughan and late H. C. Potts, Major Professors. 73 p.

7. Rodriquez-Ardon, R. (Honduras). 1987. Improvement in storability of maize seeds through selection using accelerated aging. Ph.D. Dissertation. Aug. 1987. G. Scott and late H. C. Potts, Major Professors. 72 p.

8. Goggi, A. S. (Argentina). 1987. Electrical conductivity and pH of exudate indicators as predictors of seed quality in corn (*Zea mays* L.). M.S. Thesis. Aug. 1987. C. E. Vaughan, Major Professor. 42 p.

9. Turnipseed, B. (U.S.). 1987. Evaluation of methods for measuring and monitoring field deterioration in soybean [*Glycine max* (L.) Merr.] seeds. M.S. Thesis. Dec. 1987. J. C. Delouche, Major Professor. 56 p.

10. Madawanarachchi, W. P. (Sri Lanka). 1987. Equilibrium relative humidity methods for estimating the moisture content of crop seeds. M.S. Thesis. Aug. 1987. J. C. Delouche, Major Professor. 46 p.

11. Cortes, J. (Colombia & U.S.). 1987. Relationship of seed size and density to seed quality in sorghum [*Sorghum bicolor* (L.) Moench]. Ph.D. Dissertation. Dec. 1987. J. C. Delouche, Major Professor. 120 p.

12. Nugraha, U. (Indonesia). 1987. Association of seed coat color and permeability in soybeans [*Glycine max* (L.) Merr.] with resistance to weathering stress and adverse storage conditions. Ph.D. Dissertation. J. C. Delouche, Major Professor. 91 p.

13. Garcia-Quiroga, E. (Colombia). 1987. Release and induction of dormancy in seeds of red rice (*Oryza sativa* L.) in the field and laboratory. Ph.D. Dissertation. Dec. 1987. J. C. Delouche, Major Professor. 95 p.

14. Casini, C. (Argentina). 1987. Effects of harvest time and method and storage condition on seed quality of soybean [*Glycine max* (L.) Merr.] genotypes with the impermeable seed coat trait. M.S. Thesis. Dec., 1987. C. H. Andrews, Major Professor. 93 p.

15. Lansakara, H. (Sri Lanka). 1987. Quality changes of soybean [*Glycine max* (L.) Merr.] seeds in storage as influenced by ambient conditions. M.S. thesis. Dec. 1987. E. R. Cabrera, Major Professor. 68 p.

PERIOD: 1/88 - 12/88

16. Pitty, N. (Panama). 1988. Effects of temperature on germination and dormancy release in cultivated and red rice (*Oryza sativa L.*). M.S. Thesis. May, 1988. J. C. Delouche, Major Professor. 66 p.

17. Ratnayake, W.R.A.S. (Sri Lanka). 1988. Characterization of soybean [*Glycine max* (L.) Merr.] cultivars by laboratory techniques, M.S. Thesis. May, 1988. C. E. Vaughan, Major Professor. 78 p.

18. Pung, C. Y. (Taiwan). Aug. 1988. Relationship between soybean [*Glycine max* (L.) Merr.] seed quality and seed size. M.S. Thesis. Aug. 1988. C. H. Andrews, Major Professor.

19. Bashin, A. (Yemen). Dec. 1988. The effects of storage environments on maintenance of soybean and corn seed quality. M.S. Thesis. Dec. 1988. C. H. Andrews, Major Professor.

20. Bulan, P. (Malaysia). Dec. 1988. Tetrazolium evaluation of mungbean (*Phaseolus aureus*) and whitebean (*P. vulgaris*) seeds. M.S. Thesis. Dec. 1988. C. E. Vaughan, Major Professor.

21. Barlain, J. (Indonesia). Dec. 1988. Reversability and persistence of hardseededness in soybean [*Glycine max* (L.) Merrill]. M.S. Thesis. Dec. 1988. J. C. Delouche, Major Professor.

22. Chindavipard, V. (Thailand). Dec. 1988. Upgrading soybean [*Glycine max* (L.) Merrill] seed quality with a color sorter. M.S. Thesis. Dec. 1988. E. R. Cabrera, Major Professor.

23. Diaz, J. (Dominican Republic). Dec. 1988. Removal of baloonvine (*Cardiospermum halicacabum* L.) seeds from soybean seeds. M.S. Thesis. Dec. 1988. E. R. Cabrera, Major Professor.

24. Hathayatham, A. (Thailand). Dec. 1988. Tetrazolium evaluation of chickpea (*Cicer arietinum* L.) and Austrian winter pea [*Pisum sativum v. arvense* (L.) Poir] seeds. M.S. Thesis. Dec. 1988. C. E. Vaughan, Major Professor.

25. Ratanavipulya, Y. (Thailand). Dec. 1988. Effects of chemical treatments on sorghum [*Sorghum bicolor* (L.) Moench] seed germination, initially and in storage. M.S. Thesis. Dec. 1988. C. C. Baskin, Major Professor.

26. Seneewong, A. (Thailand). Dec. 1988. The relationship between gin-run cottonseeds and internal disease organisms. M.S. Thesis. Dec. 1988. C. C. Baskin, Major Professor.

27. Viriyangkura, L. (Thailand). Dec. 1988. Effects of drying air temperature on the germination of sorghum [*Sorghum bicolor* (L.) Moench] seeds. M.S. Thesis. Dec. 1988. E. R. Cabrera, Major Professor.

PERIOD: <u>1/89 - 12/89</u>

28. Ahmad, B. (Pakistan). May, 1989. Influence of environmental factors and husk protection on the quality of corn [*Zea mays* L.) seeds. Ph.D. Dissertation. May 1989. J. C. Delouche, Major Professor.

29. Moncrief, R. (USA). May, 1989. Predicting stand establishment potential of cotton planting seeds. M.S. Thesis. May 1989. C. C. Baskin, Major Professor.

30. Butsayawit, S. (Thailand). Aug. 1989. Evaluation of techniques for prolonging the storage life of small samples of seeds. M.S. Thesis. Aug. 1989. C. E. Vaughan, Major Professor.

31. Chebbi, M. (Tunisia). Aug. 1989. Effects of seed specific gravity on germination, field and storage performance in wheat (*Tritium aestivum* L.). M.S. Thesis. Aug. 1989. J. C. Delouche, Major Professor.

32. Kamragai, N. (Thailand). Aug. 1989. A study of the impermeable seed coat characteristic in soybean. M.S. Thesis. Aug. 1989. C. H. Andrews, Major Professor.

33. Rosso, B. (Argentina). Aug. 1989. Effects of a cyclohexane polymer on soybean [*Glycine max* (L.) Merr.] seed deterioration in storage and in the field. M.S. Thesis. August. 1989. C. C. Baskin, Major Professor.

34. Paliwal, S. (India). Aug. 1989. Predicting field emergence of grain sorghum [*Sorghum bicolor* (L.) Moench]. Ph.D. Dissertation. Aug. 1989. C. C. Baskin, Major Professor.

35. Sewamontri, P. (Thailand). Aug. 1989. Effects of the shell on field emergence and storability of peanut (*Arachis hypogaea* L.) seeds. M.S. Thesis, August. 1989. J. C. Delouche, Major Professor.

36. Wattiranggoon, S. (Thailand). Aug. 1989. Seed density and quality relationships in sorghum [*Sorghum bicolor* (L.) Moench]. M.S. Thesis. Aug. 1989. J. C. Delouche, Major Professor.

37. Thongket, T. (Thailand). Aug. 1989. Effects of drying temperature on the quality of cowpea (*Vigna unguiculata* (L.) Walp.] seeds. M.S. Thesis. Aug. 1989. E. R. Cabrera, Major Professor.

38. Asuboah, R. (Ghana). Dec. 1989. Evaluation of field deterioration of seeds of two corn hybrids. M.S. thesis. Dec. 1989. C. H. Andrews, Major Professor.

39. Barillas, J. (El Salvador). Dec. 1989. Effect of packaging materials and moisture content on storability of corn (*Zea mays* L.) seed. M.S. Thesis. Dec. 1989. E. R. Cabrera, Major Professor.

40. Castillo, B. (Dominican Republic). Dec. 1989. Imbibitional injury in soybean [*Glycine max* (L.) Merr.] seed. M.S. Thesis. Dec. 1989. E. R. Cabrera, Major Professor.

41. Marwanto (Indonesia). Dec. 1989. Relationship between laboratory tests and field emergence in soybean [*Glycine max* (L.) Merr.] seeds. M.S. Thesis. Dec. 1989. C. E. Vaughan, Major Professor.

42. Nsapato, L. (Malawi). Dec. 1989. Seed maturation and development of hardseededness in Pinkeye Purple Hull cowpea [*Vigna unguculata* (L.) Walp.]. M.S. Thesis. Dec. 1989. C. C. Baskin, Major Professor.

43. Zaidan. (Indonesia). Dec. 1989. Development and release of the hard seed condition in soybean [*Glycine max* (L.) Merr.] and its influence on seed longevity. M. S. Thesis. J. C. Delouche, Major Professor.

PERIOD: 1/90 - 12/90

44. Casini, C. (Argentina). May, 1990. Seed imbibitional studies related to seedcoat and seed size in soybean [*Glycine max* (L.) Merrill] genotypes with different levels of permeability. Ph.D. Dissertation. C. H. Andrews, Major Professor. 160 p.

45. Goggi, A. S. (Argentina). May, 1990. Variation in seed specific gravity in sorghum [*Sorghum bicolor* (L.) Moench]: sources, morphological bases, and effects on field performances. Ph.D. Dissertation. James C. Delouche, Major Advisor. 89 p.

46. Narvaez, J. (Mexico). May, 1990. Maturation, deterioration, storability and quality evaluation of seeds of two species of *Amaranth*. Ph.D. Dissertation. C. C. Baskin, Major Professor. 95 p.

47. Possamai, E. (Brazil). May, 1990. Development of equations for predicting germination of soybean [*Glycine max* (L.) Merrill] seeds stored under ambient conditions at Miss. State University. Ph.D. Dissertation. E. Cabrera and C. H. Andrews, Major Professors. 91 p.

48. Fofana, A. (Guinea). Dec. 1990. Evaluation of a debearder in removing glumes from sorghum seeds. M.S. Thesis. C. E. Vaughan, Major Advisor. 42 p.

49. Guevara, C. (Colombia). Dec. 1990. A study of the relationship between soybean [*Glycine max* (L.) Merrill] seed coat characteristics and the incidence of seed borne pathogens. M.S. Thesis. C. H. Andrews, Major Professor. 56 p.

50. Klinck, P. (USA). Aug. 1990. Appropriate technologies for maintaining and enhancing seed quality in cowpea [*Vigna unguiculata* (L.) Walp.]. M.S. Thesis. J. C. Delouche, Major Advisor. 72 p.

51. Moreno, O. J. (Venezuela). Dec. 1990. Evaluation of competitiveness and dormancy release treatments in red rices (*Oryza sativa* L.). M.S. Thesis. J. C. Delouche, Major Advisor. 60 p.

PERIOD: 1/91 - 12/91

52. Bulan, P. (Malaysia). 1991. Some effects of seed coating and aging treatments on soybean [*Glycine max* (L.) Merrill] germination and emergence. Ph.D. Dissertation. Dec. 1991. J. C. Delouche, Major Advisor. 76 p.

53. Hasmeda, Mery (Colombia). 1991. Identification and evaluation of mechanical damage effects in hybrid corn (*Zea mays* L.). M.S. Thesis. May, 1991. C. H. Andrews, Major Advisor. 39 p.

54. Keith, B.C., Jr. (U.S.A.). 1991. Evaluation of hardseeded soybean genotypes for agronomic traits, hard seed content and resistance to seed deterioration. Ph.D. Dissertation. Dec. 1991. C. H. Andrews, Major Advisor. 74 p.

55. Luhanga, J.H. (Malawi). 1991. Evaluation of sorghum [*Sorghum bicolor* (L.) Moench] genotypes for resistance to field deterioration. Ph.D. Dissertation. Aug. 1991. C. H. Andrews, Major Advisor. 91 p.

56. Mahmoud, S.A.M. (Egypt). 1991. Separation of sorghum [*Sorghum bicolor* (L.) Moench] seeds with a fractionating aspirator, multi-aspirator, and gravity table. M.S. Thesis. Dec. 1991. Major Advisor. E. R. Cabrera. 57 p.

57. McCarty, W. H. (U.S.). 1991. Germination and emergence of cotton seed as affected by seed quality, substrate temperature and substrate moisture content. Ph.D. Dissertation. Aug. 1991. C. C. Baskin, Major Advisor. 97 p.

58. Mourad, H.A.A. (Egypt). 1991. Development of procedures for moisture determination in cottonseed. M.S. Thesis. Dec. 1991. E. R. Cabrera, Major Advisor. 53 p.

59. Ratresni, Eni (Indonesia). 1991. Seed development, maturation and hardseededness in okra [*Abelmoschus esculentus* (L.) Moench]. M.S. Thesis. May, 1991. J.C. Delouche, Major Advisor. 50 p.

60. Velloza, T. (Guyana). 1991. Evaluation of some indices of seed quality that affect imbibitional injury in cowpea [*Vigna unguiculata* (L.) walp.]. M.S. Thesis. August 1991. J. C. Delouche, Major Advisor. 68 p.

61. Vieira, E. H. (Brazil). 1991. Relationship between seed density and quality in cowpea (*Vigna unguiculata*). Ph.D. Dissertation. Dec. 1991. C. C. Baskin, Major Advisor. 86 p.

62. Vieira, N. R. (Brazil). 1991. Enhancement effects of pre-sowing treatments on seed performance of rice (*Oryza sativa*). Ph.D. Dissertation. Dec. 1991. J. C. Delouche, Major Advisor. 116 p.

63. Bakhoum, A. (Senegal). 1991. Relationship between size and quality of pearl millet seeds. M.S. Thesis. Dec. 1991. C. C. Baskin, Major Advisor. 56 p.

64. de Paul Da, S. V. (Burkino Faso). 1991. Upgrading alfalfa seed quality with the color sorter. M.S. Thesis. Dec. 1991. E. R. Cabrera, Major Advisor. 46 p.

65. Ibssa, G. S. (Ethiopia). 1991. Comparison of seed quality between two corn (*Zea mays* L.) inbreds, their reciprocal crosses, and an open-pollinated variety. M.S. Thesis. Dec. 1991. C. H. Andrews, Major Advisor. 59 p.

66. Iqbal, S. (Egypt). 1991. Effects of deterioration of seeds upon field performance of soft red winter wheat. M.S. Thesis. Dec. 1991. C. E. Vaughan, Major Advisor. 56 p.

67. Massaly, F. (Senegal). 1991. Effects of planting date, seed size-density, and plant population on growth and reproduction of two cultivars of cowpea. M.S. Thesis, Dec. 1991. J. C. Delouche, Major Advisor. 64 p.

68. Midany, A. I. (Egypt). 1991. Relationship between seed size and quality in soybean. M.S. Thesis. Dec. 1991. C. H. Andrews, Major Advisor. 47 p.

69. Rodriguez, G. A. (Colombia). 1991. Effect of seed size on germination and vigor of corn. M. S. Thesis. Dec. 1991. C. H. Andrews, Major Advisor. 53 p.

70. Shiferaw, Y. (Ethiopia). 1991. Characterization of wheat [*Triticum aestivum* (L.)] cultivars by laboratory and field techniques. M.S. Thesis. Dec. 1991. C. E. Vaughan, Major Advisor. 53 p.

71. Yoakim, M.A. (Egypt). 1991. Temperature relations of wheat seed germination. M.S. Thesis. Dec. 1991. J. C. Delouche, Major Advisor. 45 p.

72. Abayazeed, S. (Egypt). 1991. M.Agr. Dec. 19091. Non-thesis option. C. E. Vaughan, Major Advisor.

73. Attya, G. (Egypt). 1991. M. Agr. Dec. 1991. Non-thesis option. C. C. Baskin, Major Advisor.

PERIOD: 1/92 - 12/92

74. Chuntirapongsa, S. (Thailand). 1992. Effects of seed coat color on storability of soybean seeds. Ph.D. Dissertation. Dec. 1992. 68 p. J. C. Delouche, Major Advisor.

75. Siddiqui, N. U. (Pakistan). 1992. Prediction of the storage viability of corn seeds in relation to seed moisture content, temperature and seed vigor. Ph.D. Dissertation. Dec. 1992. J. C. Delouche and E. R. Cabrera, Major Advisors. 82 p.

76. Henain, E. S. (Egypt). 1992. Rates of absorption and desorption of hygroscopic moisture by gin run and acid delinted cotton seeds at 10° and 30°C. M.S. Thesis. Dec. 1992. J. C. Delouche and E. R. Cabrera, Major Advisors. 64 p.

77. Paquiot, K. (Haiti). 1992. Evaluation of methods for releasing seed dormancy in cultivated and red rices. M.S. Thesis. Dec. 1992. J. C. Delouche, Major Advisor. 61 p.

78. Saad, M. A. H. (Egypt). 1992. Field deterioration of cowpea seed. M.S. Thesis. Dec. 1992. C. E. Vaughan, Major Advisor. 46 p.

79. Sorour, S. E. H. A. (Egypt). 1992. Variation among rice varieties and red rice lines in initial level and period of seed dormancy. M.S. Thesis. Dec. 1992. J. C. Delouche, Major Advisor. 61 p.

80. Sukarman (Indonesia). 1992. Physiological quality of mung bean seeds as affected by weathering and adverse storage conditions. M.S. Thesis. Dec. 1992. J. C. Delouche, Major Advisor. 63 p.

81. Wague, K. (Senegal). 1992. Comparison of seedling vigor and competitiveness in selected red rices and cultivated rices. M.S. Thesis. Dec. 1992. J. C. Delouche, Major Advisor. 53 p.

PERIOD: 1/93 - 9/29/93

82. Banyankiye, P. (Burundi). 1993. Some aspects of seed development, maturation and field deterioration in sorghum. M.S. Thesis. May. 1993. J.C. Delouche, Major Advisor. 57 p.

83. Baramburiye, J. (Burundi). 1993. Effects of seed specific gravity and seed size on vigor and field performance in wheat seed. M.S. Thesis. May. 1993. C. H. Andrews, Major Advisor. 63 p.

84. Khan, M. Q. (Pakistan). 1993. Effects of gravity separation and seed treatment on seed quality in wheat. M.S. Thesis. May 1993. B. C. Keith and J. C. Delouche, Co-major Advisors. 50 p.

85. Mahamadou, I. (Niger). 1993. Performance of pearl millet as affected by seed size. M.S. Thesis. May 1993. C. H. Andrews, Major Advisor. 58 p.

86. Marwanto. (Indonesia). 1993. Moisture exchange and equilibria in soybean seed blends. Ph.D. Dissertation. May 1993. J. C. Delouche & E. R. Cabrera, Co-major professors. 80 p.

87. Sambo, B. H. (Niger). 1993. Effects of seed specific gravity and plant population on seed quality, growth and development, and yield of three cultivars of pearl millet. M.S. Thesis. May 1993. C. H. Andrews, Major Advisor. 67 p.

88. Turnipseed, E. B. (USA). 1993. Deteriorative changes in soybean and cotton seeds. Ph.D. Dissertation. May 1993. J. C. Delouche, Major Advisor. 102 p.

89. Zaidan (Indonesia). 1993. Establishment and release of the hard seed condition in soybean. Ph.D. Dissertation. May 1993. J. C. Delouche, Major Advisor. 70 p.

90. El Hawary, M. I. (Egypt). 1993. Model seed legislation for the West Asia and North Africa region. Ph.D. Dissertation. July 1993. C. E. Vaughan and J. C. Delouche, Co-major Advisors. 262 p.

91. Hussain, M. A. H. (Pakistan). 1993. Water absorption by vegetable seeds. M.S. Thesis. July 1993. C. E. Vaughan, Major Advisor. 45 p.

92. Lansakara, H. (Sri Lanka). 1993. Moisture exchange and hygroscopic equilibria in field and pop-corn seeds. Ph.D. Dissertation. July 1993. J. C. Delouche and E. R. Cabrera, Co-major Advisors. 99 p.

93. Mahfood, A. O. (Yeman). 1993. Seed treatment of wheat. M.S. Thesis. July 1993. B. C. Keith and C. E. Vaughan, Co-major Advisors. 41 p.

94. Reginelli, D. B. (USA). 1993. The relationship between seed quality, time of radicle emergence, and plant performance of cotton under competitive and non-competitive situations. Ph.D. Dissertation. July 1993. C. C. Baskin, Major Advisor. 92 p.

95. Ilhamuddin. (Pakistan). 1993. Relationships between planting seed quality and field deterioration in wheat seeds. M.S. Thesis. July 1993. B. Keith and C.H. Andrews, Co-Major Advisors. 53 p.

II. ABSTRACTS OF THESES AND DISSERTATIONS

96

Period: 7/1986-12/1986

Name: Rumphan Koslanund

Date of Degree: August 1986

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Co-Major Professors: Dr. James C. Delouche

Title of Study: FACTORS AFFECTING IMBIBITIONAL INJURY IN SOYBEAN [*Glycine max* (L.) Merr.] SEEDS

Pages in Study: 60

Candidate for Degree of Master of Science

Studies were undertaken to determine the effects of seed size, seed coat color, initial seed moisture content, imbibition temperature and pre-imbibition humidification on imbibitional injury and germination of soybean seeds. Seeds of three isolines of the Lee cv. type differing in seed size (small, medium, large), the Tracy M cv. and a line (TM.1) from a black seeded variant, were used. Seed moisture content was adjusted to 4, 8, 12 and 16% before imbibition which was at three temperatures, 20-30C (control), 20C, adn 5C, under conditons of "excessive" water supply: very wet paper towels (24 hrs.) and water in petri dishes (12 hrs.).

Reduced germination associated with low moisture content (m.c.) seeds (4 and 8%) was not caused by desiccation per se, but rather by traumas sustained during imbitition. Humidification of 4 and 8% m.c. seeds to 12% m.c. or higher before the onset of imbibition protected the seeds from injury during imbibition.

The incidence and severity of imbibitional injury as manifested inreduced germination were influenced by seed size, seed coat color, initial seed moisture content, imbibitional temperature and the condition of water supply during imbibition. Over al levels of the several main factors, damage was more severe for the seeds imbibed in water in petri dish than for those imbibed in very wet paper towels. Within each condition of water supply, germination was progressively reduced as seed size increased, initial seed moisture content and

imbibition temperature decreased. Yellow coated seeds were more susceptible to imbibitional injury than were those with black coats.

All of the main factors interacted in their effects on injury to soybean seeds during imbibition so that the most drastic reduction in germination occurred for the large, yellow, 4% m.c. seeds imbibed at 5C in water in petrri dish.

Name: Ernest Assah Asiedu

Date of Degree: December 1986

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: C. Hunter Andrews

Title of Study: INFLUENCE OF DELAYED HARVEST, CHILLING AND MECHANICAL INJURY ON QUALITY OF STORED CORN SEED (*Zea mays* L.)

Pages in Study: 100

Candidate for Degree of Master of Science

Hybrid seed corn (*Zea mays* L.) was harvested at 32, 25 and 17% moisture. Harvested seed were initially tested for viability and subsequently subjected to chilling and mechanical injury. Chilling temperatures were -5 and -10C and dropping heights were of 10 and 20 ft.

Damaged seed together with check seed were stored for 0, 30, 60, 90 and 120 days. Tests were then conducted after varrrious storage periods to determine germination percentages, abnormal seedling percentages adn low and high vigor seedling pecentages.

Results showed that seed performance was generally superior when seed were stored at 10C/50% RH, as compared to storage at 30C/77% RH. Non-damage (check) seed germinated best and also produced the highest percentages of high vigor seedlings. Also seed harvestted at physiological maturity were the highest in germinability especially when undamaged. Furthermore, chilled seed that survived produced fewer abnormal seedling percentages that were comparable to the check seeds during the early stages of storage.

However, chilling at -5 and -10C had the most seveere adverse effect on seed viability and seedling vigor. In addition, a progrssive decline in seed germinability was observed under prolonged storage partcularly under the storage conditions of 30C/77% RH. Also, increasesin low vigor and abnormal seedling percentages were found to be associated with prolonged storage.

Name: Arnaldo Bianchetti

Date of Degree: December 1986

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Co-Major Professors: C. Hunter Andrews and Frank T. Bonner

Title of Study: EFFECTS OF MOISTURE CONTENT, TEMPERATURE, AND STORAGE INTERVALS ON SECONDARY DORMANCY OF SEED OF LOBLOLLY PINE (*Pinus taeda* L.)

Pages in Study: 69

Candidate for Degree of Doctor of Philosophy

The effects of moisture content, temperature, and storage on secondary dormancy were studied in two sizes of loblolly pine seed from two sources, Kemper County, Mississippi and Jasper County, Texas.

Moisture content and temperature were the most important factors in inducing secondary dormancy. Lenth of storage did not strongly influence the percentagee of dormant seed. Secondary dormancy was induced by reducing moisture content to 13% or less and/or by exposing seed to temperatures of 23C or higher for 48 hours. Both seed sources and see sizes reated in a similar manner to treatments used to induce secondary dormancy.

Period: 1/1987 - 12/1987

Name: Thomas Randal Vaughan

Date of Degree: May 1987

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. C. Hunter Andrews

Title of Study: INFLUENCE OF SEEDCOAT CONDITION ON GERMINATION AND EMERGENCE OF SOYBEAN

Pages in Study: 54

Candidate for Degree of Master of Science

Studies were undertaken to determine the effects of seedcoat condition upon germination and vigor of soybean seed. The specific seedcoat conditions identified in the study were wrinkled, etched, mechanical damage, smooth and a non-separated check. Seed from Tracy-M and Leflore cultivars were selected for the study. Seed from each seedcoat category were evaluated by standard germination, accelerated aging, electrical conductivity, and field emergence tests.

Highest germination percentages from both cultivars were found in seed with the smooth seedcoat condition. Etched seed -rom both cultivars were significantly lower in germination than the smooth seed; however, there were no differences in germination between the etched seed and the cheek. Lowest germination was obtained for those seed that were damaged mechanically. Wrinkled seed were of relatively low physiological quality, and surpassed only those seed that were damaged mechanically. They were also larger, in general, than seed with other seedcoat conditions. This was perhaps due to the alternate wetting and drying environments which often occurred prior to harvest.

The wrinkled and mechanically damaged seed were more adversely affected by accelerated aging than were the other seed. There was a significant increase

in dead seed percentage in the mechanically damaged category after accelerated aging.

In the electrical conductivity test, seed with mechanically damaged seedcoats expressed dramatic differences between predicted germination and standard germination. Predicted germination values were much lower than results obtained from standard germination. Therefore, conclusions concerning seed with cracked seedcoats must be considered questionable, since such contrasting readings were obtained.

Seed damaged mechanically were consistently poor from day 5 through day 20 of the field emergence test. Etched seed initially exhibited rapid emergence only to be surpassed by the smooth seed and the cheek seed as later emergence counts were made.

Name: Maharani Hasanah Tatang

Date of Degree: August 1987

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Minor: Biological Sciences (Botany)

Major Professor: Dr. C. Hunter Andrews

Title of Study: EFFECTS OF PLANTING DATE ON SUNFLOWER OIL AND SEED QUALITY

Pages in Dissertation:94

Candidate for Degree of Doctor of Philosophy

The effects of planting date on oil and seed quality were studied in two sunflower cultivars, and oil-seed type (NK-212) and a confectionary type (D-716).

Time of planting significantly affected plant height, head diameter, seed yield, seed weight, test weight (1b/bu), total oil content, free fatty acid, linoleic and oleic acid concentration of the oil, seedling growth rate and vigor potential. The oil-seed type gave greater definitive results than did the confectionary type.

It was concluded that sunflower on the MAFES Plant Science Research Center, Mississippi State, Mississippi should be planted during the period form about late March to late April in order to obtain favorable yields of seed having a high oil content and high vigor potenial.

Name: Sirichai Unsirisong

Date of Degree: December 1987

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Minor: Genetics

Co-Major Professors: Dr. Howard C. Potts (Deceased) and Dr. Charles E. Vaughan

Title of Study: RELATIONSHIP OF SPECIFIC GRAVITY TO QUALITY AND PERFORMANCE OF SOYBEAN [*Glycine max* (L.) Merrill] SEEDS

Pages in Study: 73

Candidate for Doctor of Philosophy

This study was conducted in 1985 and 1986 to determine if separation of soybean [*Glycine max* (L.) Merrill] seeds by specific gravity might be effective in improving physiological quality, plant characteristics, and storage potential. Seeds from two seed lots of two soybean cultivars ('Braxton' and 'Centennial') were separated into four specific gravity classes (<1.16, 1.16 to <1.18, 1.18 to <1.20, and 1.20 or greater) by floating in sucrose solutions. In the first experiment, physiological quality was evaluated in laboratory tests using standard germination, accelerated aging response, and tetrazolium (TZ) vigor tests. Results indicated that the quality of seeds increased as specific gravity of seeds increased. Germination was improved in both high and low quality seed lots. In the second experiment, the influence of specific gravity of seeds on emergence, plant characteristics, and yield was studied in the field using seeds from the various specific gravity classes. Decreased specific gravity adversely affected seedling emergence, especially in the lowest specific gravity class which also germinated lowest. Plant height and number of pods per plant were not affected by specific gravity, but the ability of seedlings to survive until harvest time was adversely affected. The stand from specific gravity class I was significantly less than the stand from the other classes. Yield was not different among the specific gravity classes or seed quality levels. Differences in the weight/100 seeds among plants produced from this

experiment were observed, but the results were not related to the specific gravity classes. The last experiment was conducted in 1986 by using the high quality seeds of both varieties from Experiment I. The seeds were stored in three different conditions which were in the cold room (IO°C 55% RH), 30°C 75% RH, and in the warehouse (ambient condition). Samples were taken every 3 months and then separated into four specific gravity classes and tested using standard germination and accelerated aging response. Specific gravity Classes I and IV germinated lower than the other classes after storage for 3 and 6 months in the three storage conditions.

Name: Roduel Rodriguez-Ardon

Date of Degree: August 1987

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Co-major Professors: Drs. Howard C. Potts (deceased), C. Hunter Andrews and Gene E. Scott

Title of Study: IMPROVEMENT IN STORABILITY OF MAIZE SEED THROUGH SELECTION USING ACCELERATED AGING

Pages in Study: 72

Candidate for Degree of Doctor of Philosophy

Even though corn (*Zea mays* L.) seeds have a relatively long storage life, they do deteriorate over time. The objective of this study was to improve corn populations for their seed storability. A recurrent selection methodology, using accelerated aging of seeds as the screening technique, was followed to produce 4 cycles of selection in two populations.

To evaluate for potential seed storability, seeds were aged for 10 days and then germinated. First count and total germination percentages were significantly higher in the advanced cycles of selection, which also had slightly shorter seedling root length. No significant differences were found for seedling shoot and dry weight.

Actual seed storability was evaluated by storing seeds from 3 to 12 months at 10C-50% RH, ambient warehouse conditions, and in a 30C-75% RH controlled chamber. In general, the advanced cycles of selection showed significantly higher first count and total germination percentages for both non-aged and aged seeds. Also, advanced cycles gave shorter seedling root and shoot length, and higher seedling dry weight.

One important change associated with improved storability was decreased membrane permeability of the seed. Also, increased kernel size and shorter seedling root and shoot length were found.

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These results indicate that selection for resistance to deterioration of seeds by accelerated aging was effective in improving the storability of maize seeds. Thus, the genotype of the seeds could be an important factor in reducing seed deterioration during storage, and in the success of carrying over seed lots.

Name: Alcira S. Goggi

Date of Degree: August 1987

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Charles E. Vaughan

Title of Study: ELECTRICAL CONDUCTIVITY AND PH OF EXUDATE INDICATORS AS PREDICTORS OF SEED QUALITY IN CORN [*Zea maize* (L.)]

Pages in Study: 42

Candidate for Degree of Master of Science

Twelve corn seed lots were tested by the conductivity test and the pH of exudate test to determine their ability to measure seed quality and their correlation. The standard germination test and the cold test were used as reference tests, since they are used and accepted worldwide.

The conductivity test was found to be precise in predicting seed germination. Even though two different partition numbers were used (140 μA and 150 μA), when compared with the standard germination test, no significant differences between them were found.

The pH of exudate test showed a high negative correlation with both the standard germination test and the cold test. A quadratic regression equation was calculated. When using this equation, germination and vigor percentage values were accurately obtained from the pH of exudate predicted values.

Name: E. Brent Turnipseed

Date of Degree: December 1987

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. James C. Delouche

Title of Study: EVALUATION OF METHODS FOR MEASURING AND MONITORING FIELD DETERIORATION IN SOYBEAN [*Glycine max* (L.) Merrill] SEEDS

Pages in Study: 55

Candidate for Degree of Master of Science

Three methods for measuring the physiological quality of deteriorating soybean seeds were evaluated and compared with the standard germination test: volatile aldehydes assay, seed leachate conductivity, and seed exudate pH.

The production of volatile aldehydes (VAP) increased as length of the weathering period increased, and as germination decreased except for the most weather resistant line, and weather susceptible cultivar. In the case of the weather resistant line, VAP was initially very low and it remained unchanged, while VAP by seeds of the susceptible cultivar was initially high and remained high throughout the period of weathering.

The predicted germination based on the seed exudate pH and actual germination was very close in terms of the over-all trends. In numerical terms, however, the exudate pH values decreased more slowly than actual germination with progressive weathering.

Germination predicted on the basis of seed leachate conductivity followed the same trends as actual germination, and the numerical values were very close for four of the seven cultivars/lines. Seed population conductivity profiles, constructed from the Gaussian histograms for the leachate conductivity data, showed very clearly the effects of weathering on general seed permeability, and the differential responses of the cultivars/lines to weathering.

The results of the three non-germinative measures of seed quality in soybeans were highly correlated with actual germination suggesting the same complex of physiological, properties were measured. The leachate conductivity and VAP assays were somewhat more sensitive than exudate pH and actual germination in measuring the early stages of deterioration, while the exudate pH method appeared to have the greatest potential for routine monitoring of seed quality because of its rapidity and simplicity.

Name: Waruna P. Madawanarachchi

Date of Degree: August 1987

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. James C. Delouche

Title of Study: EQUILIBRIUM RELATIVE HUMIDITY METHODS FOR ESTIMATING THE MOISTURE CONTENT OF SEEDS

Pages in Study: 46.

Candidate for Degree of Master of Science

Two inexpensive and portable equilibrium relative humidity methods for monitoring and determining seed and grain moisture content were evaluated and compared with the standard oven method. Corn, sorghum, wheat, soybean, sunflower, and peanut seeds (150 g) were placed in an 880 ml canister fitted with a 10 cm diameter, dial type membrane hygrometer (canister hygrometer method), or a 1000 ml ZIP LOC polyethylene bag containing a relative humidity (RH) paper strip indicator graduated from 10 to 100% RH (RH indicator strip method) for 3 and 8 hr., respectively. The equilibrium RH percentages obtained were converted to seed moisture percentages using available hygroscopic equilibrium moisture curves for the different kinds Of seeds. The standard heated air oven method, i.e., 105°C for 24 hr., was used to obtain values for comparison.

The equilibrium relative humidity methods were quite accurate in determining the moisture content of cereal seeds, i.e., corn, wheat, sorghum, in the range 12-17%. In most cases, the deviation in results from those obtained with the air oven was less than ±1.0. Above 17%, the equilibrium relative humidity methods underestimated seed Moisture content, but this discrepancy is not seriously limiting, since all seeds above 15% moisture must be dried.

The accuracy of the experimental methods was not as good for oil seeds, i.e., soybean, sunflower and peanut, as for cereal seeds. The level of accuracy, however, was adequate for their use to monitor and estimate seed moisture for

scheduling of harvest, determining the period of drying, and evaluating the need for re-drying during storage.

The equilibrium relative humidity methods are simple and inexpensive and require essentially no maintenance. They are ideal for use in the field in the less developed countries.

Name: Joseph E. Cortes

Date of Degree: December 1987

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Minor: Agricultural and Biological Engineering

Major Professors: Drs. James C. Delouche and Edgar R. Cabrera

Title of Study: RELATIONSHIPS OF SEED SIZE AND DENSITY TO SEED QUALITY IN SORGHUM [*Sorghum bicolor* (L.) Moench]

Pages in Study: 119

Candidate for Degree of Doctor of Philosophy

Hand harvested seeds from seven cultivars and lines of sorghum were separated into three relative size and density classes with a series of hand sieves and a Stults experimental seed blower. Seeds from the medium and large size classes were significantly higher in germination than those from the small size class and the unsized seeds. Volume weight, 100-seeds weight and germination all increased as the apparent density increased. Large seeds were concentrated in the heavy density class while small seeds were concentrated in the light density class. There was considerable overlapping in seed size within and among density classes except in the case of the four smallest size classes which contained 23.9, 8.0 and 3.3% of the seeds from the light, medium and heavy density classes, respectively.

The effects of seed density were isolated from those of seed size for four sorghum cultivars and lines by separating the seeds into seven specific gravity classes. About 85-90% of the seeds were in the three highest specific gravity classes, i.e., 1.26, 1.30 and 1.34, which had the highest germination values. Germination decreased sharply as specific gravity dropped below 1.26.

Weathering did not affect the 100-seeds weight or seed size except in one case where there was incipient germination in the panicle. Seed volume weight and germination, however, significantly decreased as intensity of weathering increased. There was also a sharp decline in the percentages of seeds in the

two highest specific gravity classes of 1.30 and 1.34, and a corresponding increase in percentages of seeds in the 1.26 and lower specific gravity classes as weathering intensity increased. Regression analysis of the relation of germination to specific gravity of the seeds indicated that elimination of seeds with a specific gravity <1.29 would increase germination to above 80% in most cases.

Germination was upgraded by the air-screen cleaner and gravity table, but with heavy losses of seeds. Volume weight of seeds after the air-screen cleaner in the medium and heavy fractions off the gravity table was significantly higher than that of unconditioned seeds and the light fraction off the gravity table.

Name: Udin Nugraha

Date of Degree: December 1987

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. James C. Delouche

Title of Study: ASSOCIATION OF SEEDCOAT COLOR AND PERMEABILITY IN SOYBEANS [*Glycine max* (L.) Merr.] WITH RESISTANCE TO WEATHERING STRESS AND ADVERSE STORAGE CONDITIONS

Pages in Study: 91

Candidate for Degree of Doctor of Philosophy

The effects of seedcoat color and permeability on seed deterioration in soybeans were evaluated and compared for 12 cultivars and experimental lines. The cultivars/lines were from maturity Groups V and VI and included five popular cultivars (Forrest, Epps, Mack, Centennial, Tracy-M), three black seedcoat isolines (TM-2, CTB-84, TRB-84) of Tracy-M and Centennial, three experimental hard seed (impermeable) lines (D83-3898, D81-9795, D83-4041) and one experimental soft seed (permeable) line (D83-3770). Three weathering and storage treatments were applied: natural weathering - harvest delayed for up to 9 wk after harvest maturity; artificial weathering - whole, harvested plants sprinkled for 1 hr daily with 2.5 cm water for up to 32 days; adverse storage - seeds stored at 30C and 75% RH for up to 4 mo.

The rate and extent of seed deterioration under the natural and artificial weathering conditions were evaluated in terms of total viable seeds percentage (germination + hard seeds) with the standard germination test, and by several supplemental seed quality assays, viz. conductivity of seed leachates, production of volatile aldehydes, and accelerated aging responses.

In maturity Group V, TM-2, a black seedcoat line, ranked first in resistance to weathering stress and adverse storage conditions; D83-3898, a hard seed line, ranked second; and the cultivar Mack ranked last. D81-9795 and D83-4041, hard seed lines, and TRB-84, a black coat mutant from Tracy-M,

exhibited superior resistance to weathering and storage stress in maturity Group VI. Resistance to weathering and storage stress, therefore, was associated with the hard or water impermeable and black pigmented seedcoat traits.

The results of the supplemental assays for seed quality were generally consistent with actual responses to weathering and storage conditions but did not provide an adequate basis for predicting performance of the genotypes under weathering and storage stresses. The findings do suggest, however, that development and use of more rigorous procedures for the accelerated aging and volatile aldehyde assays might produce information useful in screening genotypes of soybean and other species for weathering resistance.

Name: Edmundo Garcia-Quiroga

Date of Degree: December 1987

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Minor: Plant Breeding

Major Professor: Dr. James C. Delouche

Title of Study: RELEASE AND INDUCTION OF DORMANCY IN SEEDS OF RED RICE (*Oryza sativa* L.) IN THE FIELD AND LABORATORY

Pages in Study: 95

Candidate for Doctor of Philosophy

The release and induction of dormancy in seeds of three red rice phenotypes common in Mississippi and the Nato variety were investigated under field and laboratory conditions.

Dormancy in seeds retained in air storage near the panicles in simulated delay-in-shattering experiments was released much more rapidly than in those that shattered early and remained in contact with the soil. Prolongation of the dormancy period in the early shattered seeds through contact with the soil reduced fall germination and winter-kill, and increased emergence the following Spring when conditions were favorable for completion of the life cycle of rice.

The early shattering trait in the weedy red rices appears to be an adaptation for survival in a temperate climate. The beneficial effects of early shattering in terms of over-winter survival were more pronounced under marshy conditions, and increased as intensity of dormancy increased among the genotypes.

Drench treatments of red rice seeds buried 2.5 cm in soil with dilute solutions of ethylene chlorohydrin and, to a lesser extent, sodium hypochlorite were effective in releasing dormancy. The results obtained were sufficiently

interesting to recommend serious additional study in the context of weed control programs in rice.

Deeply buried (20 cm) seeds of red rice exhibited cyclical changes in germinability and dormancy that corresponded to seasonal rhythms in soil temperature. This periodicity in germinability/dormancy ensured that the seeds were in a non-dormant state in spring when conditions were favorable for germination and completion of the life cycle, and dormant in late summer and fall when conditions were not favorable due to the approach of winter. Secondary dormancy in rice was easily induced under controlled laboratory conditions by storing partially imbibed seeds (18% moisture content) at 20 or 30°C for 2 mo.

Non-dormant red rice seeds planted in the field in winter time (Dec. died and decayed without germinating, while dormant seeds remained dormant and survived to emerge in April when conditions were favorable. Dormancy, therefore, protected the seeds from the winter-time stress of freezing temperature.

Name: Cristiano Casini

Date of Degree: December 1987

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. C. Hunter Andrews

Title of Study: EFFECTS OF HARVEST DATE, HARVEST METHOD, AND STORAGE CONDITIONS ON SEED QUALITY OF SOYBEAN [*Glycine max* (L.) Merr.] GENOTYPES WITH IMPERMEABLE SEEDCOAT

Pages in Study: 93

Candidate for Degree of Master of Science

These studies were conducted to determine the effects of harvest date, harvest method, and storage condition on seed quality of soybean genotypes with permeable and impermeable seedcoats (ISC). Four genotypes, EPPS, D83-3770, D83-3893, and D83-3898 were compared.

Weathering effects in terms of deterioration were evaluated immediately after harvest by determining seed weight, physical damage,standard germination, and accelerated aging effects. After six months in cold room, aging room, and an open warehouse, seeds were evaluated for moisture content, weight 100 seeds, standard germination and field emergence. Additionally, only hard seeds of D83-3893 and D83-3898 genotypes were evaluated.

Studies revealed that the ISC genotypes deteriorated less than those with permeable seedcoats. Also, differences in rate of deterioration were observed between the ISC genotypes. Combine harvesting reduced the level of hardseededness and did not cause a decline in quality. The equilibrium moisture content was lower for impermeable seeds and was affected by level of mechanical damage.

The hard seed content of the D83-3893 ISC genotype which was harvested late and stored in open warehouse conditions was reduced to 1-2% and produced a satisfactory stand establishment.

Name: Herath L nsakara

Date of Degree: December, 1987

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Co-Major Professors: Drs. James C. Delouche and Edgar R. Cabrera

Title of Study: QUALITY CHANGES OF SOYBEAN [*Glycine max* (L.) Merrill] SEEDS IN STORAGE AS INFLUENCED BY AMBIENT CONDITIONS

Pages in Study: 68

Candidate for Degree of Master of Science

Two lots of soybean [*Glycine max* (L.) Merrill] seeds, one high and the other low in vigor, of Davis cultivar, were stored for 12 months in an open storage warehouse at Mississippi State University, Mississippi. The effects of ambient outdoor temperature and relative humidity changes on seed quality according to their location in stacks were evaluated. Two stacks containing low and high vigor seeds were erected 4 pallets high. Thermocouples were placed outdoors and at 0.3, 1.75, and 3.75 m from the floor inside the warehouse and in the bags. Ambient outdoor, warehouse, and seed temperatures were monitored and recorded hourly. Monthly evaluations of moisture, standard germination and germination after accelerated aging were conducted.

Warehouse ambient temperature changes closely followed outdoor changes. Average maximum seed temperatures were closer to average maximum ambient temperatures than average minimum seed temperatures were to average ambient minimum temperatures. Daily relative humidity changes inside the warehouse closely followed outdoor changes, but to a lesser degree.

Moisture content of seeds at the top of stacks fluctuated more than at the middle and bottom. Moisture was lower in the summer and higher during the rest of the year. Moisture of seeds in bags located at the inner portion of the stacks was lower than the outer portion.

Significant differences in germination at different locations were observed in the high vigor lot. Seeds at the bottom germinated significantly lower after accelerated aging in the high vigor lot. Seeds of the high vigor lot at the outer

position exhibited higher germination and accelerated aging values than in the inner position, while the opposite was observed in the low vigor lot.

Period: 1/88 - 12/88

Name: Norberto Pitty

Date of Degree: May 1988

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. James C. Delouche

Title of Study: EFFECTS OF TEMPERATURE ON GERMINATION AND DORMANCY RELEASE IN CULTIVATED AND RED RICES (*Oryza sativa* L.)

Pages in Thesis: 65

Candidate for Degree of Master of Science

The response patterns of non-dormant and dormant seeds of rice to temperature in terms of germination and dormancy release were investigated in cultivated and red rices. The cultivars used were Nato and Starbonnet, while the red rices studied were the BLKH, SHA-, SHA+, R79-15 and R79-1 types.

The germination response patterns of non-dormant seeds of the two cultivars and the red rices at constant temperatures from 14 to 44°C were remarkably similar in over all trends, but there were subtle and important differences among the cultivars and genotypes. Seeds of the SHA- and BLKH red rices germinated most rapidly and exhibited the widest temperature range (26-42°C) for germination ≥90% in 6 days, while those of the R79-1 red rice exhibited the narrowest range (30-40°C). SHA- and BLKH, the dominant red rices in Mississippi, germinated much higher at 40 and 42°C than the other red rices and the two cultivars. Overall the minimum and maximum temperatures for germination of the cultivated and red rices were 14 and 44°C, respectively. The optimal temperature range for germination of the non-dormant seeds appeared to be about 32-36°C.

Constant temperatures from 14 to 44°C had little effect on release of dormancy in the cultivated and red rice seeds. The alternating temperature

10-40°C, however, had a pronounced stimulating effect on germination of dormant seeds of Starbonnet, SHA-, and R79-1. Prechill treatment at 10°C completely released dormancy in seeds of Nato in 2 wk and R79-1 in 10 wk but had little effect on BLKH and SHA-. On the other hand, dormancy was slowly released in all genotypes during storage of the air-dry seeds at 10°C. The degree of dormancy, hence the effectiveness of various treatments in releasing dormancy, varied widely among the genotypes. The least dormancy was exhibited by the Starbonnet cultivar.

Name: W. R. A. Sunil Ratnayake

Date of Degree: May 1988

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Charles E. Vaughan

Title of Study: CHARACTERIZATION OF SOYBEAN [*Glycine max* (L.) Merrill] CULTIVARS BY LABORATORY TECHNIQUES

Pages in Thesis: 79

Candidate for Degree of Master of Science

Cultivar identification plays an integral role in plant improvement, seed production, seed certification, and seed law enforcement programs. The proliferation of large numbers of soybean cultivars has made it increasingly difficult to identify soybean cultivars in field testing. It has necessitated the development of applicable and accurate laboratory techniques for cultivar testing.

In this study, laboratory tests for hilum color, seed coat color, seed weight, seed shape, hypocotyl color, hypocotyl length, leaf length-width ratio, peroxidase activity, and analysis of proteins by polyacrylamide gel electrophoresis were conducted to differentiate 25 soybean cultivars grown in southern U.S.

This study verified the usefulness of hilum color, seed coat color, hypocotyl color, peroxidase activity, and analysis of proteins by electrophoresis in characterization of soybean cultivars. However, peroxidase activity was variable. Because of this variability, the possibility exists for differentiation of soybean cultivars into more than two groups with the peroxidase test.

Of the tests conducted, analysis of seed proteins by polyacrylamide gel electrophoresis emerged as a very important test for characterization of soybean cultivars. It provided more information than any other test in this study. Of the polypeptide bands resolved on the gels by the electrophoresis analysis, molecular weights of 22 bands were estimated. Among them, seven

polypeptide bands provided qualitative and quantitative differences sufficient for differentiation of soybean cultivars.

Name: Ching-Yen Pung

Date of Degree: August 1988

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. C. Hunter Andrews

Title of Study: RELATIONSHIP BETWEEN SOYBEAN [*Glycine max* (L.) Merrill] SEED QUALITY AND SEED SIZE

Pages in Thesis: 66

Candidate for Degree of Master of Science

This study was conducted to determine the effect of seed size on subsequent seed quality and crop performance. Seeds were sized into a large and small size category with appropriate hand screens. An unsized sample was used as the check.

Sized seeds of the Centennial soybean cultivar were evaluated for crop performance from four locations. Plant height at R8 was not significant as influenced by size of planting seeds but was significant according to location. In addition, flower stage at R1 and physiological maturity were not different as influenced by seed size.

No significant difference in yield (g/seed lot) was observed according to seed size, but there was a difference associated with location. Seed yield was similar across all seed sizes.

Standard germination, seedling growth rate, and seedling vigor classification were conducted on the original sized-seed and also on the harvested seeds. The results revealed no significant difference associated with seed size except that seedling growth rate was significantly different for the sized seed prior to planting.

Size of planting seed had no effect on seed size distribution of harvested seeds. Weight of 100 seeds was significantly different as influenced by the size of the planting seeds, location of production, and their interaction.

Name: Abdulla M. Bashin

Date of Degree: December 1988

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. C. Hunter Andrews

Title of Study: THE EFFECTS OF STORAGE ENVIRONMENTS ON MAINTENANCE OF SOYBEAN AND CORN SEED QUALITY

Pages in Study: 51

Candidate for Degree of Master of Science

Seeds of soybean and corn were used to evaluate the effects of various storage environments on maintenance and preservation of seed quality. Seeds were stored at 30°C in six environments: ziploc plastic bags, dry sand, ground charcoal, thin coating of vegetable oil, and submerged in vegetable oil. A check sample was stored in ideal conditions of 7°C - 50% RH. Laboratory tests to evaluate seed quality at two-month storage intervals consisted of the standard germination and sand emergence tests and moisture percentage determination.

Results clearly showed that soybean seeds failed to store as well as did corn seeds in all environments. None of the environments, even including conditioned storage, proved adequate for maintaining soybean seed quality at levels acceptable for planting. On the other hand, however, quality of corn seeds was maintained at sufficiently high levels in the environments created by dry sand, ground charcoal and ziploc plastic bags, even after ten months storage. The environments created by the vegetable oils were not satisfactory, especially the submerged oil treatment.

Although in general, seed moisture declined during storage, this did not appear to be significant enough to play an important role in the storage environment.

Name: Petrus Bulan

Date of Degree: December 1988

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Charles E. Vaughan

Title of Study: TETRAZOLIUM EVALUATION OF MUNGBEAN (*Phaseolus aureus* Roxb.) AND WHITEBEAN (*Phaseolus vulgaris* L.) SEEDS

Pages in Thesis: 62

Candidate for Degree of Master of Science

Two lots each of mungbean and whitebean seeds differing in initial germinability were used to evaluate techniques for preparation of seeds for effective tetrazolium testing of viability. A secondary objective was to categorize the staining patterns that were observed.

The potential germination from tetrazolium staining responses of the seeds was generally good in the high quality lots but somewhat erratic in low quality seed lots when compared to actual germination percentages. Potential germination values were consistently lower than predicted germination values except for two methods in mungbean lot preparation.

Staining after a shallow cut was made on the seed coat opposite the radicle was most suitable for both crops, though staining with the seed coat intact was equally superior for whitebean. Treatments at 1 hr/40°C and 2 hr/30°C in 0.5% solution exhibited color and recognition of staining at or slightly above optimum intensity. Overall trends of staining patterns were similar in seeds of the two crops.

Name: Jan Barlian

Date of Degree: December 1988

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. James C. Delouche

Title of Study: REVERSIBILITY AND PERSISTENCE OF HARDSEEDEDNESS IN SOYBEANS [*Glycine max* (L.) Merr.]

Pages in Thesis: 52

Candidate for Degree of Master of Science

The reversibility of the hardseed condition in soybean seeds and its persistence (or rate of release) under laboratory and field conditions were studied in six experimental lines of soybeans, four of which contained the hardseed trait.

The hardseed condition was repeatedly reversed through exposure of the seeds to sequential cycles of low and high relative humidity at a temperature of 24-26°C. The highest percentages of hard seeds were obtained by drying the seeds to about 4% moisture over silica gel for periods of 14-21 days, while the lowest percentages of hard seeds were obtained after exposure to 74-76% RH for periods up to 28 days which increased seed moisture content to about 12%. Small percentages of the seeds apparently lost their capacity to develop hardseededness during each cycle at high humidity so that the maximum percent of hardseededness generally decreased during each cycle of low humidity. Hardseededness in soybeans, therefore, is a conditional property depending on the seed moisture content which, in turn, is conditioned by the relative humidity of the storage environment.

The hardseeded condition in soybeans was released rather rapidly under laboratory and field conditions as compared to other species with hardseededness. Nevertheless, hardseededness did prolong the emergence period and increase the chances of volunteer plants. Both situations could cause problems in use of soybean cultivars with the hardseed trait for commercial production.

Name: Varanee Chindavipard

Date of Degree: December 1988

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr Edgar R. Cabrera

Title of Study: UPGRADING SOYBEAN [*Glycine max* (L.) Merr.] SEED QUALITY WITH A COLOR SORTER

Pages in Study: 73

Candidate for Degree of Master of Science

Two separate experiments were conducted using soybean seeds. The objectives were to identify some physical and qualitative characteristics of lot components and to determine the effectiveness of an electronic color sorter in upgrading seed quality. In experiment I, Braxton soybean seeds were separated into eight categories: sound, wrinkled, etched, immature, weather damaged, stink bug damaged, mechanically damaged, and "others." Size and specific gravity distributions were determined. Standard germination and predicted germination with the ASAC-1000 seed analyzer were determined. Weather damaged seeds were the smallest in size and lightest in weight of all seed classes. There was no significant difference in the germination of sound, wrinkled, etched, immature, and stink bug damaged seeds. Mechanically damaged seeds showed the highest percentage of abnormal seedlings; whereas, weather damaged seeds exhibited the highest percentage of dead seeds and the lowest germination. In experiment II, two groups of soybean seeds encompassing 15 cultivars were used to evaluate the effectiveness of the color sorter in upgrading quality. A Geosource Model GB-103 color sorter was used. Standard germination, germination after accelerated aging, predicted germination, and chlorox soak test were used to evaluate quality of non-sorted and sorted seeds. In the first trial (group one) no significant difference in germination of sorted and non-sorted seeds was detected. Germination after accelerated aging and predicted germination were significantly higher for the non-sorted seeds when compared to sorted seeds. Prior to the second trail the color sorter was refurbished to eliminate possible mechanical malfunctions. Sorted seeds in group two germinated significantly higher than non-sorted

seeds, but did not differ in accelerated aging response and in predicted germination. This indicated that the color sorter can upgrade quality of soybean lots, but the level of improvement is most likely inconsequential, particularly when considering its high cost and low capacity.

Name: Jose A. Diaz F.

Date of Degree: December 1988

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Edgar R. Cabrera

Title of Study: REMOVAL OF BALLOONVINE (*Cardiospermum halicacabum* L.) SEEDS FROM SOYBEAN SEEDS

Pages in Study: 71

Candidate for Degree of Master of Science

The mechanical removal of balloonvine (*Cardiospermum halicacabum* L.) seeds from soybean seeds was investigated. Balloonvine plants. contaminate soybean seed production fields reducing yield and making the harvest difficult. Balloonvine is considered a noxious weed in 12 states of the United States due to the difficulty of their removal from soybean seeds.

Soybean cultivars used in this study were Davis, Centennial, Tracy-M, Leflore, Forrest, and Braxton. Seed width, length, specific gravity, and color were the physical properties determined and compared between seeds of soybean cultivars and balloonvine.

There were not sufficient differences in seed length and specific gravity to permit complete removal of balloonvine seeds from soybean seeds. Differences in width, however, allowed the removal of balloonvine seeds from 77% of the Braxton seeds with an air-screen cleaner using a bottom screen with 5.95 mm (15/64 in) diameter perforations. The portion of balloonvine-free seeds varied between to 90%, depending on the cultivar considered. The electronic 57 color sorter removed 90% to 100% of balloonvine seeds depending on the cultivar. Differences of effectiveness of removal among cultivars was related to the degree of bleeding in the hilum of the soybean seeds.

Name: Aphiya Hathayatham

Date of Degree: December 1988

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Charles E. Vaughan

Title of Study: TETRAZOLIUM EVALUATION OF CHICKPEA (*Cicer arietinum* L.) AND AUSTRIAN WINTER PEA [*Pisum sativum* v. arvense (L.) Poir] SEEDS

Pages in Study: 65

Candidate for Degree of Master of Science

One lot of chickpea and one lot of Austrian winter pea seeds were used in this study to determine the effectiveness of the tetrazolium test in evaluating seed quality and to determine the appropriate techniques for preparing and staining seeds. A secondary objective was to study the staining patterns related to the determination of viability for each crop and also to study the variation of staining patterns during 12 months storage at 20°C and 30°C.

Potential germination obtained from the tetrazolium test was generally good for Austrian winter pea seeds but was good for chickpea seeds only for specific preconditioning methods and specific treatments. Direct staining (without pre-conditioning was not a suitable procedure for either crop. Preconditioning in moist paper towels for 16 hours at 30°C was a suitable method for chickpea seeds. Both pre-conditioning in warm water for 3 hours at 30°C and pre-conditioning in moist paper towels for 16 hours at 30°C were suitable for Austrian winter pea seeds. The most appropriate procedures for chickpea seeds were 0.1%/3 hr/40°C and 0.25%/2 hr/30°C. For Austrian winter pea seeds, 1.0%/2 hr/30°C, 0.5%/2 hr/30°C after pre-conditioning in warm water at 30°C for 3 hours, and 1%/3 hr/30°C, 1%/2 hr/40°C and 0.5%/3 hr/30°C after pre-conditioning in moist paper towels for 16 hours at 30°C were the most appropriate procedures.

The staining patterns of chickpea and Austrian winter pea seeds were generally similar. However, after storage, the patterns In both crops showed a higher deterioration rate in the 30°C storage environment than at 20°C.

Name: Yupa Ratanavipulya

Date of Degree: December 1988

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Charles C. Baskin

Title of Study: EFFECTS OF CHEMICAL SEED TREATMENTS ON SORGHUM [*Sorghum bicolor* (L.) Moench] SEED GERMINATION INITIALLY AND DURING STORAGE

Pages in Thesis: 59

Candidate for Degree of Master of Science

Seeds of sorghum cultivars Funk G-522 DR and Funk HW 7380 were used to study the effects of chemical seed treatments on seed viability immediately after treatment and on life of seeds in storage. Chemical treatments consisted of fungicides, Captan and Apron; an insecticide, Heptachlor; herbicide safeners, Concep II and Screen; singly and in various combinations, comprised 18 treatments including an untreated sample of each cultivar.

Initial germination of cultivar Funk HW 7380 was not affected by any treatment, but germination of seeds of cultivar Funk G-522 DR was reduced when the systemic fungicide Apron was used in combination with other chemicals. Seed germination of both cultivars was more adversely affected when herbicide safeners Concep II and Screen were used alone than when they were used in combination with other chemicals.

Differences in seed germination among treatments were most pronounced after accelerated aging.

Germination of deteriorated then treated seeds of cultivar Funk G-522 DR was similar to that of seeds treated before deterioration.

Decline in seed germination of both cultivars stored at 30°C-75% relative humidity was similar but not as varied among treatments as in accelerated aging. There was a tendency for the treatment combinations containing Apron

to decline in germination at a more rapid rate than other treatments. Responses of treatments containing Concep II and Screen without Apron were not consistent.

Correlations among germination responses in the two cultivars were significant only after 8 weeks storage. Correlations between germination responses after accelerated aging and after storage periods were not significant for cultivar Funk HW 7380, but were significant for cultivar Funk G-522 DR after 8 and 16 weeks storage periods.

Name: Aunchalee Seneewong

Date of Degree: December 1988

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Minor: Plant Pathology

Major Professor: Dr. Charles C. Baskin

Title of Study: THE RELATIONSHIP BETWEEN GERMINATION OF GIN-RUN COTTONSEEDS AND INTERNAL DISEASE ORGANISMS

Pages in Study: 42

Candidate for Degree of Master of Science

Thirty-six samples of gin-run cottonseeds were collected from several different companies and cotton gins in Mississippi during the harvest season of 1987, without regard to variety or seed quality. Seed germination ranged from 53.0 to 94.5% and averaged 74.74%. Poor seed germination was significantly correlated with high level of dead seeds as opposed to abnormal seedlings. A tetrazolium test was conducted on 27 samples to determine germination potential. Fifteen samples had a difference of 10% or less between standard germination and germination potential in TZ. Twelve samples had a difference of greater than 12% between standard germination and germination potential in TZ. In all of these, the TZ estimate was above the standard germination test. The three greatest differences were near 25%. Although the correlation between standard germination and germination potential as estimated by the tetrazolium test was significant, it was quite low, r2 = .338. Microorganisms were isolated from inside of the seedcoats more than from the embryos of cottonseeds. Bacteria were found much more often than fungi.

Enterobacter agglomerans was the dominant bacterium and the more prevalent fungi were from the genus Fusarium. Although the number of embryos containing fungi was quite low (less than 1.4%), the presence of fungi in embryos was significantly correlated with poor germination. The number of bacteria in both inside of the seedcoats and embryos was significantly

correlated with high germination, indicating that bacteria had no adverse effect on germination. There was no significant relationship between germination potential in TZ and number of fungi or bacteria in either inside of the seedcoats or embryos of cottonseeds indicating that internal micro-organisms were not a factor in difference between standard germination and estimated germination in TZ.

Name: Ladda Viriyangkura

Date of Degree: December 1988

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Edgar R. Cabrera

Title of Study: EFFECT OF DRYING TEMPERATURE ON GERMINATION OF SORGHUM [*Sorghum bicolor* (L.) Moench] SEEDS

Pages in Study: 73

Candidate for Degree of Master of Science

The effect of drying air temperature on the germination of sorghum seeds was investigated. Seeds from the hybrid Champion were adjusted to 16%, 20%, and 24% moisture on a wet weight basis. Three replications of each moisture level were dried with 40, 45, 50, and 55°C air using an airflow rate of 10 cubic meters per cubic meter of seeds per minute. Moisture content and standard germination of seeds at the bottom of the drying bed were determined every six hours. Temperature at different levels of the drying column were monitored and recorded every 30 minutes. Seeds from all treatment combinations were stored at 30°C and approximately 45% RH for six months. Germination was assessed after two and six months in storage.

Seeds at the bottom of the seed bed with an initial moisture content of 24% germinated significantly lower than 16% and 20% moisture seeds. There was no significant difference in the germination of seeds from the entire seed bed for any treatment combination. The germination of 24% moisture seeds was significantly lower (81.49%) than 16% and 20% moisture (83.85% and 83.60%, respectively) after two months in storage. After six months in storage, however, no differences in germination were found.

Based on these results it appears advisable to avoid drying of high moisture (above 20%) sorghum seeds with temperatures higher than 45°C. It is also evident that other cultivars should be tested for their tolerance to high temperature drying before general recommendations can be drawn.

Period: 1/89 - 12/89

Name: Bashir Ahmad

Date of Degree: May 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Minor: Biological Sciences (Botany)

Major Professor: Dr. James C. Delouche

Title of Study: INFLUENCE OF ENVIRONMENTAL FACTORS AND HUSK PROTECTION ON THE QUALITY OF CORN (*Zea mays* L.) SEEDS

Pages in Dissertation: 137

Candidate for Degree in Doctor of Philosophy

The influence of weathering stress and the husk cover of corn ears on the rate of deterioration of the seeds in the field was Studied. The three corn hybrids Dekalb-Pfizer XL-80 (modified single cross), XL-72aa (single cross) and XL-72b (single cross) were used as seed parents with the Pioneer 3369A line as pollinator for production of seeds for weathering and ear treatments in 1986 and 1987.

Natural field weathering treatments were imposed by delaying harvest beyond the physiological maturity stage for periods up to 10 wk in 1986 and 12 wk in 1987 with three ear treatments: covered (ears undisturbed); naked (husks removed); and inverted (ears with husks on bent so that apical end pointed downward). Ears harvested at physiological maturity were exposed to four levels of artificial or simulated weathering in both years using the same ear treatments as for natural weathering.

The effects of weathering stress, variety and ear treatment singly and interactively on the rate and severity of seed deterioration were measured and monitored using the standard germination test and several vigor tests including field emergence.

The rate of deterioration as reflected in germination percentage and/or responses to the several vigor tests was affected by the weathering period, variety and ear treatment. Deterioration progressed as the length of the weathering period increased. Generally, the XL-72aa variety exhibited greater susceptibility to weathering stress than the other two varieties. Seeds of the naked ear treatment deteriorated most rapidly and to the greatest degree while those from the inverted ear treatment were generally least affected by weathering. There were numerous significant interactions among the main factors in their effects on the rate and extent of seed deterioration under weathering stress but they were neither surprising nor unexpected.

Conductivity measurements of steep water from individual seeds and the construction of seed population conductivity profiles provided substantial evidence that impairment of membranes with the consequence of loss of permeability control is one of the earliest deteriorative changes in seeds.

Name: Rodney W. Moncrief

Date of Degree: May 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Charles C. Baskin

Title of Study: PREDICTING STAND ESTABLISHMENT POTENTIAL OF COTTON PLANTING SEEDS

Pages in Thesis: 50

Candidate for Degree of Master of Science

A series of tests were conducted using commercial cotton seed lots that varied in quality to determine the relationship between seed performance in certain laboratory tests and field emergence. The laboratory tests used in determining the relationship were standard germination, mechanical damage, standard germination (evaluation made at 2 and 3 days), cool germination, soil cold test, hot water soak, and tetrazolium test.

In 1988, three emergence tests were planted under a range of field conditions that might be encountered by the grower. Two tests were planted on April 8, 1988 one at the Delta Branch Experiment Station, Stoneville, Mississippi, and one at the Mississippi State University Plant Science Farm, Mississippi State, Mississippi. A third test was planted at Mississippi State University Plant Science Farm on May 6, 1988. This test was allowed to grow through out the season and yield was measured.

The two April tests encountered cool soil temperatures. The Delta Branch Experiment Station test had the best correlations with "the laboratory tests. The highest correlation was with the tetrazolium test (r=.887). The April 8 Mississippi State University Plant Science Farm test did not correlate well with any laboratory test possibly because soil temperatures were a little lower than in the Delta test. This emergence test correlated best with the Soil cold test (r-.361). The May 6, 1988 field emergence test at Mississippi State University Plant Science Farm encountered a drought period delaying emergence that caused very erratic emergence. Therefore, emergence

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percentages were low. This emergence test correlated best with the soil cold test (r=.270). There was no significant difference in yield among lots.

Name: Siriya Butsayawit

Date of Degree: August 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Charles E. Vaughan

Title of Study: EVALUATION OF TECHNIQUES FOR PROLONGING THE STORAGE LIFE OF SMALL SAMPLES OF SEEDS

Pages in Thesis: 85

Candidate for Degree of Master of Science

Seeds of wheat and soybean were used to study the effects of chemical seed treatments on standard germination, seedling length, percentage infection, and presence of mycoflora immediately after treatment and after various storage intervals at 23°C-75% RH or under ambient conditions. Chemical treatments consisted of sodium hypochlorite or captan.

Prestorage germination and seedling length of soybeans were not affected by sodium hypochlorite, but germination and seedling length of seeds of wheat were reduced when sodium hypochlorite was used. Seed germination, seedling length, and infection of both crops were affected more when the seeds were stored at 23°C-75% RH, especially if treated with sodium hypochlorite. Decline in seed germination and seedling length of both crops was accelerated by longer storage periods. Germination and seedling length were reduced significantly when stored at 23°C-75% RH compared to ambient conditions.

Sodium hypochlorite or captan significantly reduced seed infection. *Gliocladium* spp. were the most prevalent fungi isolated from untreated soybean seeds stored at 23°C-75% RH.

Correlations between germination and seedling length were significant for both wheat and soybeans. However, seed infection was not significantly correlated with germination or seedling length.

Name: Mohsen Chebbi

Date of Degree: August 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. James C. Delouche

Title of Study: TITLE OF THESIS: EFFECTS OF SEED SPECIFIC GRAVITY ON GERMINATION, FIELD AND STORAGE PERFORMANCE IN WHEAT (*Triticum aestivum* L.)

Pages in Thesis: 47

Candidate for Degree of Master of Science

Seeds of the six lots/cultivars of wheat were separated into specific gravity classes ranging from <1.02 to ≥1.32 using sucrose solutions. The distribution of seed specific gravity differed among the cultivars, and it was markedly bimodal for three of the six cultivars/lots. The bimodal distributions of seed specific gravity were attributed to probable blending of remnant seeds of the same cultivar from different production locations and years to form the commercial seed lots from which portions were selected for these studies.

There was a general association of seed germinability with seed specific gravity but it was not as close or as consistent as reported by others for wheat and other cereals. Germination of three of the cultivars/lots was above 90% even for seeds in the lowest specific gravity classes.

In non-competitive spacing, individual plants from high density seeds had significantly more tillers at 8, 10 and 12 wk, and significantly higher green weight at 20 wk than those from low density seeds. The onset of anthesis was also earlier by about 1 day in the plants from high density seeds as compared to those from the low density seeds. There were no significant differences in yield, however, attributable to differences in specific gravity of the seeds planted.

The storability of the high and low density seeds was generally inferior to that of the unseparated or control seeds suggesting that the storability of the

separated seeds had been damaged in some way, possibly as a result of the separation procedures using sucrose solutions.

Name: Narisara Kamragai

Date of Degree: August 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. C. Hunter Andrews

Title of Study: A STUDY OF THE IMPERMEABLE SEED COAT CHARACTERISTIC IN SOYBEAN

Pages in Thesis: 70

Candidate for Degree of Master of Science

This study was conducted to evaluate the influence of the impermeable seed coat (ISC) characteristic of 11 breeding lines of soybean. Both non-scarified and scarified seeds were compared for their hard seed content, storage potential, and progressive release of hard seeds.

Hard seed content was evaluated by two methods to illustrate the different techniques for determining hard seeds. The 24-hour soak method revealed the hard seed content used in breeding programs, and the standard germination test revealed hard seeds in routine seed analysis work. The two methods resulted in different percentages of hard seeds. In every instance, the percentage of hard seeds was higher after the 24-hour soak as compared to hard seed percentage remaining after the 8-day germination test.

The storage potential of soybean with ISC characteristic was studied from storage conditions of 10°C-50% RH and 30°C-75% RH for 3, 6, 9, and 12 months. Storage potential of non-scarified and scarified seeds was different and also varied among lines for both storage conditions. Soybean seeds with ISC characteristic possess a greater potential to maintain higher quality during both ideal and stressful storage conditions. Also, the amount of hard seed content decreased as storage interval increased.

The progressive release of hard seeds depended upon the breeding line; those lines with higher hard seed percentages required more time to release the hard seeds than did those lines with less hard seeds.

Name: Beatriz Susana Rosso

Date of Degree: August 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Charles C. Baskin

Title of Study: EFFECT OF A CYCLOHEXANE POLYMER ON SOYBEAN [Glycine max (L.) Merrill] SEED DETERIORATION IN STORAGE AND IN THE FIELD

Pages in Thesis: 42

Candidate for Degree of Master of Science

This study was conducted to determine the potential of protecting the quality of soybean seeds in the field and in storage by application of a cyclohexane polymer, 1-methyl-4(1-methylethyl).

Seeds treated with the polymer were placed in wet rolled germination towels at 30°C, and seed moisture content was measured at two hour intervals for twelve hours. The results obtained suggest no effect of this polymer on seed water absorption. Soybean seeds coated with a polymer solution and stored under adverse environmental conditions deteriorated at the same rate as non-polymer coated seeds after two months in storage.

The same polymer was applied during the reproductive stage to three cultivars; Sparks (group IV), Forrest (group V), and Sharkey (group VI) at two different rates. Pod shattering was measured on the cultivar Sparks at ten-day intervals. Pods on treated plants shattered as much as the untreated check.

The application of the polymer did not affect the rate of pod moisture absorption in any of the cultivars, but pod water absorption decreased as the maturity group increased. Seed moisture content was similar among treatments for each cultivar at each harvest time suggesting that the application of the polymer did not prevent moisture movement into the seeds.

Seed quality generally decreased as the weathering period increased. Loss of germinability was greater for the Forrest cultivar than for the Sharkey cultivar.

The results obtained for standard germination and accelerated aging tests did not indicate that the application of this cyclohexane polymer would reduce soybean field weathering.

Name: Sarvesh Paliwal

Date of Degree: August 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Minor: Plant Breeding

Major Professor: Dr. Charles C. Baskin

Title of Study: PREDICTING FIELD EMERGENCE OF GRAIN SORGHUM [*Sorghum bicolor* (L.) Moench]

Pages in Dissertation: 134

Candidate for Degree of Doctor of Philosophy

The primary objective of this study was to predict field emergence of grain sorghum seed lots under both favorable and adverse field conditions from information obtained in laboratory studies.

Samples of 40 grain sorghum lots were obtained from three different commercial seed companies in 1986 and 1987. These were used in laboratory and field emergence tests in the 1987 and 1988 experiments. Thirty additional samples of grain sorghum were obtained from commercial sources in 1988. These were used in laboratory tests (standard germination and soil cold tests) in 1988 and field emergence tests in 1989.

The following laboratory tests were conducted: (1) standard germination, (2) NH_4Cl soak, (3) accelerated aging, (4) soil cold, (5) low temperature germination, and (6) tetrazolium vigor evaluations. Field emergence tests were conducted in favorable (1987), cold, wet (1987, 1988 and 1989), and hot, dry (1987) field conditions.

The results from these tests indicated that differences existed among the 40 and 30 seed lots in this study. These differences, however, were more evident from the results of soil cold tests and tetrazolium tests (1987) and soil cold tests (1988) than the results of the standard germination tests (1987 and 1988) and the other laboratory tests (1987).

Highest correlations were for soil cold test emergence with field emergence in favorable, cold-wet, and hot-dry soil conditions. Coefficients of correlation were .848, .811-.880, and .752, respectively.

A secondary objective of this study was to examine the anatomical structures of high quality sorghum seeds vs. low quality sorghum seeds by using scanning electron microscopy. The differences in the anatomical structures of high quality seeds vs. low quality seeds selected were due primarily to stages of maturity.

Name: Punnee Sewamontri

Date of Degree: August 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. James C. Delouche

Title of Study: EFFECTS OF THE SHELL ON FIELD EMERGENCE AND STORABILITY OF PEANUT (*Arachis hypogaea* L.) SEEDS

Pages in Thesis: 61

Candidate for Degree of Master of Science

Three separate emergence experiments were conducted during 1988 and 1989 involving up to five physical preplant treatments of the pods/seeds of the Sunrunner and Tamnut peanut cultivars. The five preplant treatments were: seeds in-shell (intact), in-shell cracked, in-shelled soaked, hand shelled and machine shelled.

The shell greatly reduced both the rate and percentage of emergence: in the two 1988 emergence tests, emergence of the in-shell (intact) and in-shell cracked treatments was negligible. In 1989, soaking the pods for 18 or 24 hr before planting greatly increased the emergence rate and percentage, but over-all performance was still inferior to that of the shelled seeds. It was recommended that longer in-shell soak treatments should be tried to determine if they could accelerate the rate of emergence up to that of the shelled seeds. The rates of emergence of the machine shelled and hand shelled seeds of the Sunrunner cultivar were similar.

Peanut seeds stored in-shell maintained their germinability better under the relatively adverse storage regimes of 25°C and 75% RH and 30°C and 75% RH than hand shelled or machine shelled (Sunrunner) seeds. The machine shelled seeds of the Sunrunner cultivar exhibited the poorest storability. The storability of the seeds in-shell or hand shelled 'in descending order by cultivar was NC-13, Sunrunner, and Tamnut. This is also the descending order of the cultivars in terms of seed dormancy. Thus, there appeared to be an association between degree of dormancy and storability of peanut seeds

even though dormancy was completely released for in-shell seeds within 2 mo. at 30°C and 75% RH.

Name: Songboon Wattiranggoon

Date of Degree: August 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Co-Major Professors: Drs. James C. Delouche and Joseph E. Cortes

Title of Study: SEED DENSITY AND QUALITY RELATIONSHIPS IN SORGHUM [*Sorghum bicolor* (L.) Moench]

Pages in Thesis: 48

Candidate for Degree of Master of Science

Seeds of the five sorghum cultivars were separated into seven specific gravity classes using sucrose solutions: <1.14, 1.14, 1.18, 1.22, 1.26, 1.30, and >1.34. The distributions of seed specific gravity differed among the cultivars. Seeds of the HW-7380 cultivar were higher in specific gravity than those of DK-50 and DK-46 which, in turn, were higher in specific gravity than those of the Cargill hybrids.

The 100-seed weights, germination and seedling growth rate as manifested in plumule and radicle growth at 5 days, total seedling length, and seedling dry weight, generally decreased as specific gravity of the seeds decreased. Except for seeds of the Cargill 1091 cultivar, which had a germination of only 64%, germination remained the same or slightly decreased from the >1.34 to the 1.22 specific gravity levels, then decreased substantially as the level of specific gravity dropped to 1.18, 1.14 and <1.14. The rate of radicle growth was more closely and consistently related to specific gravity of the seeds than the rate of plumule growth and appeared to be a more sensitive index of seed physiological status than plumule growth. The association of seedling dry weight with seed specific gravity followed a tend similar to that of radicle growth.

There were slight shifts in specific gravity distribution of the sorghum seeds toward lower levels after 4 mo. storage at 30°C and 75% RH. High specific gravity seeds maintained germinability and vigor in storage at 30°C and 75% RH better than seeds of medium and light specific gravity and the unseparated

seeds. Storage responses of the unseparated seeds and those of medium specific gravity seeds were very similar.

Name: Thammasak Thongket

Date of Degree: August 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Edgar R. Cabrera

Title of Study: EFFECT OF DRYING TEMPERATURE ON THE QUALITY OF COWPEA [*Vigna unguiculata* (L.) Walp.] SEED

Pages in thesis: 77

Candidate for Degree of Master of Science

The influence of drying temperature on the rate of moisture removal and subsequent quality of cowpea seed was studied. Seed in pods of the Pinkeye cultivar were hand harvested at three moisture levels: 20, 33, and 55% and dried with ambient, 35, 40, and 45°C air. The drying beds were filled with pods one meter deep, and an air flow of ten cubic meters per minute per cubic meter of seed was used. Air and seed temperature were recorded every 0.5 hours. Each drying period was 24 hours. The effect of drying time, air temperature, and initial seed moisture on seed quality was evaluated with the standard germination test, first count evaluation, and seedling length.

As drying time progressed, germination tended to decrease. Germination of seed with an initial seed moisture of 55% at the bottom of the drying bed was significantly lower after 12 and more hours of drying. For the most part, no significant differences in germination were observed as a result of air temperature. Germination of seed at the bottom of the bed was always lower than germination of seed at the top of the bed when dried with 45°C air. Drying 55% moisture seed with ambient and 35°C air resulted in significantly lower germination of seed at the top of the drying bed. This was attributed to high respiration as seed at the top of the drying bed remained with high moisture even to the end of the experiment.

Drying cowpea seed in the pod may be beneficial to seed quality, since the seed can be removed from the field earlier and then dried. However, regardless of

the drying temperature used, seed harvested with 20% moisture and then dried had the highest quality.

Name: Robert Agyeibi Asuboah

Date of Degree: December 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. C. Hunter Andrews

Title of Study: THE EFFECTS OF HARVEST DATE AND STORAGE ENVIRONMENT ON CORN (*Zea mays* L.) SEED QUALITY

Pages in Thesis: 46

Candidate for Degree of Master of Science

Two corn hybrids, white and yellow, were planted in the field to generate seeds for these investigations. Maturing seeds were harvested first at physiological maturity and then at two-week intervals for a period of 6 weeks. This provided a variable field exposure interval to evaluate field deterioration. Harvested seeds were dried to 13% moisture and evaluated for seed quality by the standard germination, and first count germination test. Afterwards, seeds were stored under two environmental conditions, namely 50°F/50% RH and 86°F/75% RH, respectively, for 6 months. Seeds were evaluated for quality during storage by standard germination, first count germination, and accelerated aging tests. During storage, seed samples were taken every 2 months to evaluate the interaction effects of field deterioration with storage environment. Initial seed moisture was determined at each harvest date and after 6 months
storage.

Results clearly showed that corn seeds harvested late after physiological maturity stored well only under cold room conditions. Loss of viability and vigor in the yellow hybrid was more rapid than the white hybrid. The yellow hybrid always maintained a higher moisture content under both storage conditions when compared to the white hybrid.

Name: Jose Rolando Barillas

Date of Degree: December 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Edgar R. Cabrera

Title of Study: EFFECT OF PACKAGING MATERIALS AND MOISTURE CONTENT ON STORABILITY OF CORN (*Zea mays* L.) AND SOYBEAN [*Glycine max* (L.) Merrill] SEEDS

Pages in Thesis: 42

Candidate for Degree of Master of Science

The effect of four packaging materials and two seed moisture contents on quality of corn (*Zea mays* L.) and soybean [*Glycine max* (L.) Merrill] seeds, stored at 30°C±1°C and relative humidity that fluctuated between 60 and 80% during a 10-month storage period was studied.

The packaging containers tested were: Ziploc^R plastic bags, plastic laminated paper bags, polyethylene bags, and paper bags. The initial seed moisture contents were 9.2% and 11.75% for corn and 8.77 and 11.6% for soybean.

Seed samples were taken at the beginning of the storage period and every 2 months for 10 months. Seed quality of each treatment was evaluated by determining seed moisture content, standard germination, and germination following accelerated aging.

The experiment was arranged as a 2 X 4 factorial in a randomized complete block. Means were separated using Duncan's Multiple Range test.

Ziploc^R bags acted as good water vapor barrier and maintained moisture of both corn and soybean seeds more uniformly than the other materials tested. Germination of high moisture corn and soybean seeds stored in Ziploc^R bags decreased more rapidly and was significantly lower than the germination of seeds in other packaging materials. The germination of low moisture corn seeds stored in Ziploc^R, polyethylene, and laminated paper bags was not

statistically different throughout the study. Vigor of high moisture corn seeds decreased more rapidly and was generally significantly lower than vigor of high moisture corn in other packaging materials.

Name: Bernarda Castillo

Date of Degree: December 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. James C. Delouche

Title of Study: IMBIBITIONAL INJURY IN SOYBEAN [*Glycine max* (L.) Merr.] SEEDS

Pages in Thesis: 54

Candidate for Degree of Master of Science

The influence of seed size, seed coat color, initial seed moisture content, and imbibition temperature on imbibitional injury of soybean seeds as manifested in reduced germination and emergence was determined. Seeds of three isolines of the Lee cv. type differing in seed size (small, medium, and large), the Tracy M and Centennial cv. and black seeded mutants of each were used. Seed moisture content was adjusted to 4, 8. and 13% before imbibition at three temperatures, 10, 20 and 30°C, under two conditions of "excessive" water supply: very wet paper towels (24 hr) and water in petri dishes (12 hr). In a field study, seeds of the small and large seed size isolines and Centennial and Centennial/Black were planted with initial seed moisture contents of 4, 8 and 13% in dry soil which was then saturated with 8 cm water.

The incidence and severity of imbibitional injury were influenced by seed size, initial seed moisture content, imbibition temperature, the condition of water supply during imbibition, seed coat color, and interactions among these factors. Damage was most severe for the seeds imbibed half-submerged in water, i.e., water in petri dish condition; however, within each condition of water supply during imbibition, the incidence of injury generally increased, i.e., germination was progressively reduced, as seed size increased, and initial seed moisture content and imbibition temperature decreased. Yellow coated seeds were somewhat more susceptible to imbibitional injury than were those with black coats. The most drastic reduction in germination occurred for the large, yellow, 4% initial moisture content seeds imbibed at I0°C half submerged in water.

Additional studies were suggested to establish the effects of initial seed quality level on imbibitional injury, especially under field conditions.

Name: Marwanto

Date of Degree: December 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Charles E. Vaughan

Title of Study: RELATIONSHIPS BETWEEN LABORATORY TESTS AND FIELD EMERGENCE IN SOYBEAN SEEDS [*Glycine max* (L.) Merrill]

Pages in Thesis: 52

Candidate for Master of Science

Five laboratory tests were performed on 25 seed lots of soybeans. These consisted of standard germination, four-day germination, conductivity, accelerated aging, and seedling length. Comparisons were made among these tests with standard germination as a reference test to measure seed quality. Results from these laboratory tests were compared with field emergence to determine a correlation. All possible correlation coefficients were calculated.

Standard germination was found to provide more information in predicting seed quality. However, high germination was not necessarily associated with greatest seedling growth. Therefore, germination is inadequate as the sole criterion of seed quality. The conductivity test showed the highest significant correlation with the standard germination test followed by four-day germination test results.

Under near favorable conditions, the standard germination test was an accurate, reliable predictor for field emergence of soybean and gave the highest significant correlation with field emergence followed by the conductivity test, seedling length test, and four-day germination test. However, all r values were less than 0.80.

Name: Lucius E. Nsapato

Date of Degree: December 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Charles C. Baskin

Title of Study: SEED MATURATION AND DEVELOPMENT OF HARDSEEDEDNESS IN PINKEYE PURPLE HULL COWPEA [*Vigna unguiculata* (L.) Walp.]

Pages in Thesis: 42

Candidate for Degree of Master of Science

This study was conducted to determine if the pod color of Pinkeye Purple Hull cowpea could indicate stage of seed maturity; and to determine the age of seed at which hardseededness expresses itself, and if the hard seed frequency can be increased by selection.

Hard seed (T_1), semi-hard (T_2), and check (T_3) were planted in the field. Flowers were tagged at anthesis for age identification of the pods and seed.

Maximum length of pods and seeds was reached approximately 15 days after flowering (d.a.f.). Maximum dry weight and germination were reached at 18 d.a.f. At this time, seed reached physiological maturity.

It was observed that pods turned purple 16 d.a.f., 2 days before physiological maturity. They started wilting 19 to 20 d.a.f., and by 21 days they were dry.

There were no hard seed until the seed reached physiological maturity. In the samples harvested at respective ages from the time of flowering, highest mean hard seed percentage was obtained from T_2, 4.63%, followed by T_3, 2.52%, and T_1 had the least, 2.1%. From the final harvest, however, the highest mean percent hard seed, 0.52, was obtained from T_1, T_2 had 0.25%, and T_3 had 0.20%. No dramatic increase in hard seed frequency was demonstrated.

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A greenhouse study was conducted to determine if the hard seed frequency correlated with the hard seed percentage of the parent plant. Seed from parent plants with different hard seed percentages were used.

There was no significant difference in mean percent hard seed in any of the treatments at $P \leq .05$ level. It was concluded that selection for hardseededness in the cultivar Pinkeye Purple Hull will not be highly successful.

Name: Zaidan

Date of Degree: December 1989

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. James C. Delouche

Title of Study: DEVELOPMENT AND RELEASE OF THE HARD SEED CONDITION IN SOYBEAN [*Glycine max* (L.) Merr.] AND ITS INFLUENCE ON SEED LONGEVITY

Pages in Thesis: 35

Candidate for Degree of Master of Science

The objectives of this study were to determine the development of the hard seed condition in soybean seeds during initial dehydration, the rate of release of hardseededness under standard germination test conditions, and the influence of the hard seed condition on longevity of the seeds. Seeds of four experimental lines of seeds with the hard seed trait, two lines with the black pigmented seed coat trait, and one soft seed experimental line were used as experimental materials.

The initial expression of the hard seed condition did not occur until the whole seed moisture content decreased to below 15%. At whole seed moisture contents below 15%, the incidence of hard seeds generally increased as the moisture content decreased.

Under standard germination test conditions the hard seed condition was slowly released over a 98-day period. The incidence of hard seeds decreased from 67 to 28% during the 98-day period in one line and from 24 to 0% in 63 days in another line.

The level of hardseededness had a great influence on the longevity of the seeds stored at 30°C and 75% RH, and subjected to accelerated aging conditions of 42°C and 100% RH. There also appeared to be some variation in seed longevity at 30°C - 75% RH even among the lines carrying the hard seed trait. A 3 to 4 mo period at 30°C and 75% RH was suggested as an appropriate

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screen for use in breeding programs to improve the storability of soybean seeds.

Period: 1/90 - 12/90

Name: Cristiano Casini

Date of Degree: May 1990

Institution: Mississippi State University

Major Field: Agronomy

Major Professor: Dr. C. Hunter Andrews

Title of Study: SEED IMBIBITIONAL STUDIES RELATED TO SEEDCOAT AND SEED SIZE IN SOYBEAN [*Glycine max* (L.) Merrill] GENOTYPES WITH DIFFERENT LEVELS OF PERMEABILITY

Pages in Study: 160

Candidate for Degree of Doctor of Philosophy

Soybean seed imbibition depends on many factors and their interaction. This research places emphasis on the most relevant seed and seedcoat properties that could be related with imbibition and with the initial areas of seed imbibition. Additionally, hard seeds mechanically scarified were evaluated for soil emergence response. Basically, seeds of genotypes with different levels of seedcoat permeability were evaluated.

Results indicated that levels of permeability were not consistently related with seed sizes among genotypes. Also, inconsistency was detected within genotypes and between production years. The trend for specific seed density was manifested towards large seeds. The seedcoat:seed ratio was not found to be related to permeability. However, seedcoat:seed ratio showed a strongly inverse relationship with see size.

The anatomy of the seedcoat and thickness changes in five different areas of the seedcoat were examined. Moving from the hilum in both directions (sides and ends) of the seeds, the seedcoat thickness gradually diminished and the hourglass cells gradually disappeared. The area opposite to the hilum and the two ends of the seeds had the thinnest seedcoat, and these areas also lacked hourglass cells. The TZ + Light test resulted in an extremely useful, reliable

and objective method to illustrate the initial area of water absorption by soybean seeds. The method was designed basically taking advantage of the sensitivity that TZ has to different light intensities.

The pattern of water absorption was different for each genotype and for each year. However, no differences were observed among sizes within genotypes. The initial penetration of water into seeds occurred preferentially for the thinnest area of the seedcoat. These areas were also the preferential site of hard seed reversibility.

Seed imbibition was found to be a progressive process which was not constant for all sizes. Generally, after 72 hours the progress of imbibition was stabilized for each genotype.

Seed emergence studies revealed that good soil moisture content was critical for rapid and uniform emergence of hard seeds which were mechanically scarified. Otherwise, a more efficient scarification process should be used to release most of the hard seed in a soybean seed lot.

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Name: Alcira Susana Goggi

Date of Degree: May 1990

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. James C. Delouche

Title of Study: VARIATION IN SEED SPECIFIC GRAVITY IN SORGHUM [*Sorghum bicolor* (L.) Moench]: SOURCES, MORPHOLOGICAL BASIS, AND EFFECTS ON FIELD PERFORMANCE

Pages in Study: 89

Candidate for Degree of Doctor of Philosophy

Seeds of seven hybrid and open pollinated sorghum cultivars were separated with sucrose density solutions into four specific gravity (SG) classes for studies on the effects of seed SG on field performance. The seeds were planted at different densities to provide three levels of competition: "normal" planting density; one high and one low SG seeds in the same hill; and single seeds in widely spaced hills, no competition.

There were no differences among the high, medium-low and unseparated (control) seed SG treatments for emergence, vegetative and reproductive development for the normal density plantings. Yield, however, was significantly lower for plants of the unseparated (control) seeds as compared to the SG separated seeds. When high and low SG seeds were planted in the same hill, emergence of the high SG seeds was higher and they produced more vigorous plants that produced more tillers, matured earlier and yielded more as compared to those from low SG seeds. In the case of high and low SG seeds planted at non-competitive spacing, emergence, plant height, number of tillers and yield were higher and the number of days to panicle exsertion and anthesis were fewer for the plants from the high SG seeds as compared to those from the low SG seeds. Priming of high SG seeds did not enhance plant performance above the level of the high SG unprimed seeds.

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Seed SG was greatly affected by the degree of weathering and immaturity. As the degree of weathering or immaturity increased, the percentages of seeds in the two highest SG classes sharply declined, while those for the two lowest SG classes sharply increased. Seeds from the intense weathering treatments exhibited cavitation and profuse fungal growth in the placental sac area and in the embryo. Similar cavitation was observed in seeds from the immaturity treatments.

Differences in the speed of germination among the unweathered, mature, high SG seeds appeared to be related to differences in permeability of the pericarp to water and/or oxygen.

Name: Juan M. F. Narvaez-Melo

Date of Degree: May 1990

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. Charles C. Baskin

Title of Study: MATURATION, DETERIORATION, STORABILITY AND QUALITY EVALUATION OF SEED OF TWO SPECIES OF AMARANTH.

Pages in Dissertation: 95

Candidate for the Degree of Doctor of Philosophy

Seed of *Amaranthus cruentus* (L.) reached maximum dry weight at 14 to 19 days and seeds of *Amaranthus hypochondriacus* (L.) at, approximately 19 days after anthesis. Seed from the June 9 planting declined in germination to below 50% for both species while seeds from July 9 planting germinated over 90% when killing frost occurred on October 17, 1987. Seed from the June 20 planting, germinated above 75% when frost kill occurred on October 20, 1988.

The time required to complete a germination test was reduced to 2 days at 33^0C using 0.2% KNO_3 as a media moistening agent.

Aspiration of seed increased density, test weight, and improved the germination of seed lots of both species.

Seed from two density fractions of both species maintained germation percentage above 90% for 575 days when stored at 10^0C-50% RH and in open storage. Seed of *Amaranthus hypochondriacus* (L) germinated below 50% germination in 290 days and seed of *Amaranthus cruentus* (L) germinated below 50% after 350 days stored at 30^0C-75% RH. Medium-density seed declined in germination more rapidly than high-density seed for both species.

Seed that imbibed water for 6 hours and dried at room temperatures did not decrease in germinability when stored at room temperature up to 120 days. Seed that imbibed for 12 and dried did not decrease in germination after 7

days storage, but decreased below 50% after 30 days storage. Seed imbibed water for 18 then dried produced only abnormal seedlings after 6 hours storage. Seed imbibed for 24 hours and stored for 6 hours did not germinate. This suggests that seed planted in marginal seedbed moisture conditions then dried may not produce a stand.

Soil moisture stress has the potential to be used as a test determine differenced between lots of different quality when germination differences cannot be detected by the standard germination test. Soil moisture tension of -6 bars produced the greatest differences in emergence ofseed of different quality levels.

Name: Edilberto Possamai

Date of Degree: May 1990

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Minor: Agricultural and Biological Engineering

Major Professor: Drs. Edgar R. Cabrera and C. Hunter Andrews

Title of Study: DEVELOPMENT OF EQUATIONS FOR PREDICTING GERMINATION OF SOYBEAN [*Glycine max* (L.) Merrill] SEED STORED UNDER AMBIENT CONDITIONS AT MISSISSIPPI STATE UNIVERSITY

Pages in Study: 91

Candidate for Degree of Doctor of Philosophy

Seedsmen frequently face uncertainty in selecting seed lots for carry-over. A test or series of tests that would assist in making this decision is needed. The purpose of this study was to assess the ability of various tests in predicting viability of soybean seed stored under ambient conditions.

The standard germination, accelerated aging, and tetrazolium germination and vigor of 150 soybean seed lots were evaluated. Seed lots were separated into components according to seedcoat characteristics as follows: sound, wrinkled, stink bug damage, etched, weathered, light mechanical damage, heavy mechanical damage, and others.

First, the sample size to determine seed lot components was established. No significant differences in percentage of lot components were found among sample sizes of either 100, 200, 300, 400, or 500 seeds. Therefore, 200 seed was selected as the sample size for this study.

Thereafter, 2.5 kg of 150 seed lots were placed in open storage. Tests were conducted at the beginning of the storage period. Standard germination was evaluated monthly for the first 12 months and again at 20 months. Field emergence was conducted after nine months of storage.

Initial germination, germination after accelerated aging, TZ germination and vigor, and lot components were used to predict standard germination after three, six, nine, 12, and 20 months in storage. Results of these same tests were also used to predict field emergence after nine months.

Regression equations combining standard germination, TZ germination potential, and percentage of sound seed gave the best prediction of germination after three, six, nine, and 12 months in open storage. Regression equations combining initial germination and percentage of sound seed were identified as the most practical ones to predict germination in open storage.

Field emergence after nine months was best predicted by the combination of initial germination, TZ vigor, and percentage of sound seed. The accuracy of prediction of field emergence, however, was considerably lower than the accuracy of prediction of standard germination.

Name: Fofana Amine

Date of Degree: December 1990

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Charles E. Vaughan

Title of Study: EVALUATION OF A DEBEARDER IN REMOVING GLUMES FROM SORGHUM SEED

Pages in Study: 42

Candidate for the Degree of Master of Science

The objective of this study was to determine if a debearder could be effective in removing glumes from sorghum seed without inflicting excessive mechanical damage and lowering germination. A laboratory model debearder was used in the experiment. Speed was controlled at 500, 600, and 700 RPM. Seed subjected to these debearding speeds, along with a check, were evaluated.

Percentage of seed with glumes was reduced to 0.26% on the lot with the lowest initial seed moisture percentage (Lot C with 12.63%). In the lot with the highest initial moisture percentage (Lot A with 16-67%), 7.62% of seed still had glumes attached after passing through the debearder at 700 RPM.

As speed of the debearder increased, mechanical damage increased. Germination and vigor were also adversely affected by the action of the debearder, with the greatest loss occurring at the 700 RPM speed.

Name: Claudia L. Guevara-Gomez

Date of Degree: December 1990

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. C. Hunter Andrews

Title of Study: A STUDY OF THE RELATIONSHIP BETWEEN SOYBEAN [*Glycine max.* (L.) Merrill] SEEDCOAT CHARACTERISTICS AND THE INCIDENCE OF SEED BORNE PATHOGENS

Pages in Study: 56

Candidate for Degree of Master of Science

Soybean seeds with dark colored and/or impermeable seedcoats exhibited a relatively high level of resistance to fungi infection. Thus, viability and vigor for these genotypes were superior to commercially yellow-seeded varieties.

The Dorman Buff 5-14 exhibited the highest level of fungi at both harvest dates. Dark colored and impermeable seeds with "sound" seedcoats exhibited the lowest level of fungi at both harvest dates. Field deterioration caused by a four week delay in harvest increased fungi infection in all genotypes.

The level of infection of *Diaporthe Phaseolorum* var. *soiae* and var. *caulivora*, *Fusarium* spp., *Alternaria alternate*, and *Cercospora* spp. was reduced after the seed remained in storage for three months at 23°C - 75% RH. On the contrary, *Gliocladium* spp. and *Asipergillus* spp. level of infection were significant affecting the seed in storage.

Isoflavones determinations with HPLC were not successfully developed on either testa or whole seed samples.

Name: Peter Klinck

Date of Degree: August 1990

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. James C. Delouche

Title of Study: APPROPRIATE TECHNOLOGIES FOR MAINTAINING AND ENHANCING SEED QUALITY IN COWPEA [*Vigna unguiculata* (L.) Walp.]

Pages in Study: 72

Candidate for Master of Science

Germination of cowpea seeds subjected to mechanical abuse decreased as seed moisture content decreased below 14%, and the height of drop (force of impact) and seed size increased. Cowpea seeds packaged at 7 - 8% moisture in Ziploc^R plastic bags (25 x 25 cm x 68.6 μ thick) maintained germination above 90% for 12 months at 30°C and 75% RH, while those packaged in cloth bags were essentially non-germinable after 12 months. Several inexpensive treatments prevented bruchid infestation during 6 months of open storage in Mississippi: seeds in a clay vessel filled with sand; seeds in clay vessel covered with plastic film and sand; Ziploc^R plastic bag; and malathion applied at the recommended rate. Untreated seeds had 4 exit holes/seed and 40% weight loss after 6 months as compared to zero infestation and weight loss for effective treatments. The severity of imbibitional injury increased as initial seed moisture content and imbibition temperature decreased.

Name: Orlando Jose Moreno

Date of Degree: December 1990

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. James C. Delouche

Title of Study: EVALUATION OF COMPETITIVENESS AND DORMANCY RELEASE TREATMENTS IN RED RICES (*Oryza sativa* L.)

Pages in Study: 60

Candidate for Master of Science

Growth and development of both cultivated rices and weedy red rices were affected by competition between them. In 1:1 mixed culture biomass production was reduced for the cultivated rices and increased for the red rices. Yield and the components of yield, e.g, panicles/plant, grains/panicle, were drastically reduced for the cultivated rices in mixed culture with the red rices. Over-all, the results obtained clearly demonstrated the superior competitive ability of the red rices.

Seed dormancy for Nato and most of the red rice types was released in 5 to 10 days at 45°C, but retained for periods up to 240 days for some types at 2-5°C. Accelerated aging at 45°C and 100% relative humidity released dormancy in some rice phenotypes but not others. Similarly, a 10°C prechill treatment of fully imbibed seeds released dormancy in the Nato variety in 2 weeks but not in SHA+ even after 10 weeks.

Name: Petrus Bulan

Date of Degree: December 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. James C. Delouche

Title of Study: SOME EFFECTS OF SEED COATING AND AGING TREATMENTS ON SOYBEAN [*Glycine max* (L.) Merrill] GERMINATION AND EMERGENCE

Pages in Study: 79

Candidate for Degree of Doctor of Philosophy

Studies were undertaken to evaluate the effectiveness of several hydrophobic coatings for maintaining germinability of soybean seeds under moisture and temperature stresses, and to establish and characterize the effects of short periods of accelerated aging (AA) on the germination of soybean seeds over a range of temperatures. Three hydrophobic materials, singly and in combination with the fungicide Captan, were evaluated: lanolin, linseed oil, and silicone. The environmental stresses used for the evaluations were: abundant moisture supply favorable for imbibition injury of low moisture content seeds; flooding at intervals after planting; and soil moisture too low for germination. In the case of the studies on the effects of accelerated aging (AA) on germination/emergence of soybean, seeds were exposed to short periods of AA at 42°C after which performance was determined over a wide range of temperatures.

Germination of soybean seeds exposed to conditions favorable for imbibition injury was greatly improved by the coating treatments over a wide range of imbibition temperatures and periods. While all of the coating materials had beneficial effects, linseed oil produced the greatest and most consistent benefits.

Emergence of soybean seeds flooded at intervals after planting was substantially increased by the coatings, especially linseed oil. The detrimental effects of flooding diminished as the time between planting and flooding

increased, thus, the protective effects of the coatings were greatest when the seeds were flooded immediately after planting or within a few hours.

The retention of germinability by seeds planted in soil to low in moisture for germination and allowed to remain under such conditions for 10 days was greatly improved by the linseed oil coating and treatment with Captan fungicide. The fungicide had the greatest effect, but the linseed oil treatment enhanced retention of germinability independently of the fungicide. In a field planting under cool, wet conditions in April, linseed oil coated seeds had significantly higher emergence than the uncoated seeds.

The beneficial effects of short periods of AA on germination performance of soybean seeds were slight and ephemeral. The slight benefits were lost with storage or drying following the AA treatment.

Name: Mery Hasmeda

Date of Degree: May 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. C. Hunter Andrews

Title of Study: IDENTIFICATION AND EVALUATION OF MECHANICAL DAMAGE EFFECTS IN HYBRID CORN (*Zea Mays* L.)

Pages in Study: 39

Candidate for Master of Science

Five corn hybrids, Helena HS-97, Funks 4868, Coker 8696, Pioneer 3144-w, and Dekalb 649 were used in this study. Fast green was used to stain seeds and identify mechanical damage sites so that they could be separated into four levels of damage, no stain (no damage), stain 1 (minimum damage), stain 2 (medium damage), and stain 3 (maximum damage). The quality of seeds in each damage category was evaluated by the standard germination, accelerated aging and cold tests, and by field emergence evaluations.

Fast green facilitated separating seeds into damage categories according to four damage levels. The most severely damaged seeds performed poorly in all quality tests. Germination was reduced, abnormal seedlings increased and dead seeds increased as severity of damage increased.

Thus, damaged seeds exhibited very low quality, while seeds with little or no mechanical damage exhibited increased resistance to other stress effects which tend to lower seed quality.

Name: Bennie C. Keith, Jr.

Date of Degree: December 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. C. Hunter Andrews

Title of Study: EVALUATION OF HARDSEEDED SOYBEAN GENOTYPES FOR AGRONOMIC TRAITS, HARD SEED CONTENT AND RESISTANCE TO SEED DETERIORATION

Pages in Study: 74

Candidate for Degree of Doctor of Philosophy

Soybean varieties grown commercially today do not possess a hardseeded trait and are, therefore, susceptible to field deterioration. Hardseededness in soybean provides substantial protection against environmental pressures which cause field deterioration and subsequent loss of seed quality.

This study was conducted (a) to evaluate the agronomic properties of 11 hardseeded soybean genotypes for use as either germplasm or variety release; (b) to assess the degree of hardseededness in 11 genotypes and determine its effect on seed quality in preventing loss of seed quality; and (c) to evaluate resistance of hard seeds to field deterioration by fungi or other agents of the field environment.

Genotypes were evaluated at six locations for plant height, lodging, grain yield and hard seed content. Field deterioration evaluations were conducted at three locations using germination and hard seed percent to determine the relationship between field deterioration and hard seed content. Resistance of hardseeded genotypes to *Phomopsis spp.* invasion was evaluated at only one location to determine the relationship between incidence of fungi and hard seed content.

Results revealed that some hardseeded genotypes exhibited less field deterioration and are therefore acceptable as either germplasm or as variety release. Acceptable agronomic traits together with an appropriate level of

hardseededness are desirable in selecting genotypes for commercial release. Genotypes or varieties with hard seeds also exhibited resistance or tolerance to fungal invasion.

Hardseeded genotypes were identified which resisted field deterioration, fungal invasion and, at the same time maintained acceptable germination. These could be released to the commercial market and could have a major economic impact on soybean production.

Name: Jeffrey H. Luhanga

Date of Degree: May 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. C. Hunter Andrews

Title of Study: EVALUATION OF SORGHUM [*sorghum bicolor* (L.) Moench] GENOTYPES FOR RESISTANCE TO FIELD DETERIORATION

Pages in Study: 91

Candidate for Doctor of Philosophy

Post-maturation, pre-harvest environmental conditions adversely affect seed quality. The objective of this study was to evaluate the resistance of selected sorghum genotypes from the aluminum tolerance breeding program for resistance to field deterioration during a two-year period (1988 and 1989).

In order to study the effect of deterioration on seed quality, 30 selected breeding lines were exposed to ambient conditions for a period of 30 days after physiological maturity. Deterioration is manifested in changes in seed quality attributes. Various laboratory tests were conducted to measure its effect. Attempts were also made to relate some of these tests with field emergence. Polyphenol (tannin and flavan) content was also determined, since it is associated with resistance to field deterioration in sorghum.

Post-maturation and pre-harvest ambient conditions adversely affected seed quality. This was reflected in a substantial reduction (31%) in average germination of all genotypes in the two-year study. This was aggravated with delayed exposure. In both years best quality seeds were obtained at physiological maturity. There was a differential response among genotypes with respect to field deterioration. Some genotypes exhibited a high degree of resistance. A significant (5.65%) decline in 1000-seed weight was also related to the effects of adverse environmental conditions. The results were similar to the earlier test. There was a wide variation in vigor levels among genotypes as measured by the accelerated aging test (45°C, 100% RH). The accelerated

Name: Jeffrey H. Luhanga

Date of Degree: May 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. C. Hunter Andrews

Title of Study: EVALUATION OF SORGHUM [*sorghum bicolor* (L.) Moench] GENOTYPES FOR RESISTANCE TO FIELD DETERIORATION

Pages in Study: 91

Candidate for Doctor of Philosophy

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aging results were closely correlated with: field deterioration 15 days after physiological maturity (r = 0.79); storability potential of sorghum genotypes (r = 0.94); and field emergence (r = 0.82). The germination test was also a good indicator of field emergence (r = 0.80) in both years. The polyphenol determination showed significant differences between genotypes. Tannin content was positively correlated (r = 0.90) with resistance to field deterioration. Similar results were obtained with flavan.

Field deterioration is a factor in determining seed quality, and there are inherent differences among genotypes in relation to deterioration. In this study, the following genotypes were resistant to field deterioration: 12, 13, 23, 24, 25, and 27. The accelerated aging test and polyphenol content determination can be used in screening for resistance to field deterioration in a breeding program.

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Name: Sayed Abdel Mawgood Mahmoud

Date of Degree: December 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. Edgar R. Cabrera

Title of Study: SEPARATION OF SORGHUM [*Sorghum bicolor* (L.) Moench] SEEDS WITH A FRACTIONATING ASPIRATOR, MULTI-ASPIRATOR, AND GRAVITY TABLE

Pages in Study: 57

Candidate for Master of Science

Three sorghum seed lots were conditioned by table-top fractionating aspirator, multi-aspirator, and gravity table. The effectiveness of the three machines was measured in terms of improvement made in purity, germination, vigor, weight per bushel, and weight per 100 seeds.

All three machines were capable of improving seed quality. The highest quality improvement was achieved with the gravity table, but with a greater seed loss (13.2% as compared to 2.3% for the fractionating aspirator and 4.2% for the multi-aspirator). Generally, the degree of improvement of sorghum seed quality achieved with the multi-aspirator was not significantly different from that of the fractionating aspirator. There was no difference in the size distribution of the seeds discharging from the heavy seed discharge of the three machines and the size distribution of the composite samples. Screening seeds was as effective in improving sorghum seed quality as conditioning them though the multi-aspirator or fractionating aspirator.

Name: William H. McCarty

Date of Degree: August 1991

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Title of Study: GERMINATION AND EMERGENCE OF COTTON SEED AS AFFECTED BY SEED QUALITY, SUBSTRATE TEMPERATURE AND SUBSTRATE MOISTURE CONTENT

Major Professor: Dr. Charles C. Baskin

Pages in Study: 97

Candidate for Degree of Doctor of Philosophy

Germination and emergence of cotton seed were studied in the laboratory in constant temperatures and in a Soil Temperature Simulator (STS). Variables were substrate moisture saturation, constant temperatures, cyclic temperatures and seed quality.

Seeds from commercial lots representing six varieties of cotton, *Gossypium hirsutum* L., were screened and six lots were selected to represent varying seed quality levels. These six lots were subjected to four different constant temperature treatments, 30°C, 25°C, 20°C and 15°C. Constant temperature emergence tests were conducted at four levels of substrate moisture saturation, 40, 60, 80 and 98%. Four replications of 50 seed were planted in 20 x 27 x 9.5cm plastic crispers containing non sterile builders sand. Constant temperature tests were conducted in lighted, temperature controlled rooms. After testing at constant temperatures, three lots were selected to represent high, medium and low quality seed for evaluation in the STS at cyclic temperature schemes. Cyclic temperature schemes were selected to imbibe seed at low temperatures followed by favorable temperatures and imbibing at higher temperatures then lowering temperatures.

The results of constant temperature tests indicate that: (a) low temperature stress adversely effected cotton seedling emergence regardless of quality; (b) low quality cotton seed were more adversely affected by low temperature stress than high quality seed; (c) detrimental effects of low temperatures increased

as substrate moisture saturation increased; (d) seedling emergence decreased as temperature dropped to 20°C or lower and substrate moisture saturation increased above 60%.

Results from cyclic temperature tests indicated that: (a) imbibing seed at I0°C resulted in more adverse affects than imbibing at 25°C, regardless of seed quality; (b) holding seed at 10°C for periods exceeding 24 hours resulted in reduced seedling emergence as compared to holding seed at 10°C for 24 hours then increasing substrate temperature; (c) increasing substrate temperature after 48 hours of exposure to 10°C did not reverse damaging effects of low temperatures; (d) increasing substrate moisture saturation increased sensitivity of seed to adverse effects of low temperatures; (e) high quality seed were less effected by low temperatures at all levels of moisture saturation than were low or marginal quality seed; (f) imbibing seed at 25°C reduced the adverse effects of low temperatures.

Name: Hussein Abdel Aziz Mourad

Date of Degree: Decmeber 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. Edgar R. Cabrera

Title of Study: DEVELOPMENT OF PROCEDURES FOR MOISTURE DETERMINATION IN COTTONSEED

Pages in Study: 53

Candidate for Master of Science

Seed moisture is a primary factor influencing seed quality. However, the Association of Official Seed Analysts' Rules for Testing Seeds do not include standards for moisture determination. The International Seed Testing Association does make provisions for seed moisture testing of several crops. Moreover, cottonseed is not included among those crops for which specific procedures have been outlined.

The purpose of this study was to assess the best oven procedure for determining moisture in cottonseed. Karl Fischer titration procedures for cottonseed were first developed. Moisture determination with an air-forced oven was tested at 103 and 130°C.

The oven was unable to remove all seed moisture in a 30 h period when the drying temperature was 103°C. Moisture determined with the oven was equivalent to the moisture determined with the Karl Fischer titrator when the drying temperature was 130°C, drying time was 2 h, and initial seed moisture content was 12% or higher.

Name: Eni Ratresni

Date of Degree: May 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. James C. Delouche

Title of Study: SEED DEVELOPMENT, MATURATION AND HARDSEEDEDNESS IN OKRA [*Abelmoschus esculentus* (L.) Moench]

Pages in Study: 50

Candidate for Master of Science

Pod and seed size of okra increased rapidly and attained maximum values at 12-16 days past flowering, while fresh weight peaked 4 days later. Seed dry weight increased rapidly through 18 days past flowering after which the rate of increase slowed until 36 days (White Velvet) to 38 days (LA Green Velvet) when it reached a maximum which was taken as physiological maturity. Seed moisture content at physiological maturity was 43 to 47%, and the carpels were just beginning to separate at the tip end of the pod.

A few freshly harvested seeds germinated at 25 days past flowering, but germinability did not appear to be well established until about 30 days. The hardseeded condition did not develop until whole seed moisture content dropped to 10.1% for LA Green Velvet and 9.5% for White Velvet. Soaking seeds of the LA Green Velvet cv. in concentrated sulfuric acid reduced the percent hard seeds from 62 to 6 and increased the percent germination from 36 to 92.

B-110

Name: Theodosius M. Velloza

Date of Degree: August 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. James C. Delouche

Title of Study: EVALUATIONS OF SOME INDICES OF SEED QUALITY AND FACTORS THAT AFFECT IMBIBITIONAL INJURY IN COWPEA [*Vigna unguiculata* (L.) Walp]

Pages in Study: 68

Candidate for Degree of Master of Science

Seeds of the MS Cream, MS Bunch Purplehull, MS Pinkeye, and Brown Crowder cultivars of cowpea were adjusted to 4, 8 and 12% moisture content and imbibed under two conditions of imbibition water supply, very wet paper towels and water in petri dishes, at 15, 25 and 35°C. The incidence and severity of imbibitional injury were significantly affected by cultivar, initial seed moisture content, imbibition temperature and the abundance of imbibition water supply. Damage was most severe for 4% moisture content seeds imbibed in water in petri dishes at 15°C. Seeds of the MS Cream cultivar were most susceptible to imbibitional injury while those of MS Pinkeye were least susceptible.

In associated seed aging studies, rate of germination decreased and R.Q. generally increased as aging period increased. Seed population conductivity profiles for the aging periods indicated that loss of membrane integrity and resultant leakage of electrolytes were closely associated with aging.

B-111

Name: Edson Herculano Neves Vieira

Date of Degree: December 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Charles C. Baskin

Title of Study: RELATIONSHIP BETWEEN SEED DENSITY AND QUALITY OF COWPEA [(*Vigna unguiculata* (L.) Walp] SEEDS

Pages in Study: 86

Candidate for Degree of Doctor of Philosophy

Field and laboratory experiments were conducted to evaluate the effects of seed specific gravity, and/or Seed density, on Physiological quality, storability and seedling performance Of cowpea [*Vignaunguiculata* (L.) Walp] seeds. Seed separation was accomplished by two methods: using aqueous sucrose solutions and by means of a table model fractionating aspirator.

Seeds of different specific gravity separated by sucrose solutions were compared using the standard germination test and accelerated aging test at various time and temperature combinations. Germination responses indicated that low specific gravity seeds did not perform as well as high specific gravity seeds or the unseparated sample. However, seed vigor responses expressed by the accelerated aging test indicated that the unseparated sample was higher in vigor than the respective fractions, suggesting that the use of aqueous solution may not be suitable for cowpea seed separation.

Similar results were obtained for field emergence in the 1990 planting season, although significant treatment effects were not observed in yield and yield components.

Evaluation of the relationship between seed density expressed by 100 seed weight and storability of cowpea seeds was determined in different density fractions obtained using a fractionating aspirator. Simple linear regression analyses performed for 100 seed weight and germination percentage revealed

a positive linear correlation between seed weight and germination responses after 6, 9, and 12 months in storage. Similar results were obtained for accelerated aging tests conducted after the same storage intervals. No correlation was observed between seed weight and germination or accelerated aging responses for seeds tested prior to storage.

Linear and quadratic regression analyses were conducted between 100 seed weight, radicle, hypocotyl length and total seedling length. Data best fit a quadratic equation. Coefficient of correlation indicated that hypocotyl elongation appears to be more related to seed weight than radicle length.

B-113

Name: Noris Regina de Almeida Vieira

Date of Degree: December 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. James C. Delouche

Title of Study: ENHANCEMENT EFFECTS OF PRESOWING TREATMENTS ON SEED PERFORMANCE OF RICE *(Oryza sativa L.)*

Pages in Study: 116

Candidate for Degree of Doctor of Philosophy

The objective of these studies was to evaluate the effectiveness of polyethylene glycol (PEG) osmoconditioning and gibberellin treatments in enhancing seed germination and seedling vigor in two semi-dwarf cultivars of rice, Lemont and Maybelle. For most experiments the seeds were separated into high specific gravity (> 1.18) and low specific gravity (<1.18) categories. The osmoconditioning (OC) treatment consisted of incubating the seeds on filter paper saturated with aqueous PEG adjusted to -12.7 bars osmotic potential for 7 days at 18°C. Gibberellin (GA3 was applied as a seed soak (2 hr), singly or in combination with OC prior to planting.

Final germination percentage under standard test conditions was not significantly affected by OC and GA_3. Rate of germination, however, was significantly accelerated by the treatments and there was an interactive effect of treatment and seed specific gravity.

Under stress levels of temperature, both percent and rate of germination were significantly improved by OC. maximum beneficial effects, however, were obtained when OC and GA3 were combined.

Within a temperature range from 130 to 41°C, OC not only improved the overall rate of germination but also extended the temperature range for germination. Seed performance was also improved by OC under low water potential conditions in terms of both rate and percent.

OC and GA3 treatments increased the rate of seedling elongation and the absolute length of seedling components attained in a specific period. GA3 had the greatest effect on elongation of the mesocotyl, especially in cultivar Lemont.

Enhanced germination and emergence of osmoconditioned seeds was also observed under field conditions, especially for cultivar Maybelle. Less pronounced effects were observed for Lemont.

B-115

Name: Alassane Bakhoum

Date of Degree: December 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. Charles C. Baskin

Title of Study: THE RELATIONSHIPS BETWEEN SIZE AND QUALITY OF PEARL MILLET SEED

Pages in Study: 56 Candidate for Degree of Master of Science

This study was undertaken to investigate the relationships between size and seed quality in pearl millet. Two lots of different genetic sizes were evaluated by different laboratory tests and field emergence after sizing.

Round hole screens yielded size fractions 5/64 for the large seeded lot, and 1/13 to over $7^{1/2}/64$ for the small seeded lot.

Wire mesh gave sizes 12xl2 to over 8x8 for the large seeded lot, and from 14xl4 to over 8x8 for the small seeded lot.

Hundred seeds weight within lots increased with seed size and were significantly different among fractions.

Under adverse storage conditions, seed viability declined rapidly in all lots. Within lots, the larger seeds exhibited better storability.

In field emergence tests, four leafed seedlings and total number of seedlings increased with size within lots. Within lots, seed larger than 6½/64 or larger than 9x9 were not significantly different.

B-116

Name: Sie Vincent de Paul Da

Date of Degree: December 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. Edgar R. Cabrera

Title of Study: UPGRADING ALFALFA SEED QUALITY WITH THE COLOR SORTER

Pages in Study: 46

Candidate for Degree of Master of Science

Samples from ten commercial lots of alfalfa (*Medicago sativa* L.) obtained from the Premium Seed Company, Inc., Fairfield, Iowa were used in this investigation. Comparisons of seed quality between light- and dark-colored seeds were determined by standard germination, purity, and seedling growth rate.

The percentage of dark-colored seeds was determined by visual separation and with the Seletron M-10 color sorter. Purity analysis, standard germination, and seedling growth rate were conducted prior to and after color sorting.

Significant differences in purity and standard germination were evident for the light- and dark-colored seeds. The percentage of dark-colored seeds was higher after the color sorting. Seedling growth rate before and after color sorting was not significantly different between light- and dark-colored seeds.

The color sorter was effective in upgrading the quality of alfalfa seeds, but the effectiveness depends on the distinct difference between light- and dark-colored seeds.

Name: Gudissa Shaka Ibssa

Date of Degree: December 1991

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. C. Hunter Andrews

Title of Study: COMPARISON OF SEED QUALITY BETWEEN TWO CORN (*Zea mays* L.) INBREDS, THEIR RECIPROCAL CROSSES, AND AN OPEN-POLLINATED VARIETY

Pages in Study: 59

Candidate for Degree of Master of Science

A comparison of seed quality between two corn inbreds, their reciprocal crosses and an open-pollinated variety was designed. Inbreds SC229 and MP708 and an open-pollinated white prolific were utilized as breeding stocks. It was not possible to produce seeds of hybrid MP708 x SC229.

Differences among the seed of the four genotypes (inbreds SC229 and MP 708, their hybrid SC229 X MP 708, and an open-pollinated white prolific) were evaluated by determining variation in standard germination, cold test response, seedling growth rate, accelerated aging test, 100-seed weight, seed moisture uptake, and conductivity of seed leachates. Most of the tests, except seed moisture uptake and conductivity of seed leachates, were in agreement that the seed of the hybrid and the open-pollinated variety were superior in quality to seed of the inbred lines. Seed of inbred SC229 were also superior in quality to those of the inbred MP708.

Name: Shahid Iqbal

Date of Degree: December 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. Charles E. Vaughan

Title of Study: THE EFFECTS OF DETERIORATION OF SEEDS UPON FIELD PERFORMANCE OF SOFT RED WINTER WHEAT

Pages in Study: 56

Candidate for Degree of Master of Science

Ten samples of wheat (*Triticum aestivum L.*) seed, Coker 9323, were aged artificially for 0, 1., 1.5, 1.75, 2, 3, ..., 7 days at 42°C and 100% relative humidity (RH) to obtain different levels of seed germinability and vigor. Five different levels of germinability and vigor were selected for field studies. They were planted in the field and their performance was examined. Results showed that: (1) different levels of seed germinability and vigor had no significant effect upon field performance; (2) yield of plants produced from seed with low germinability and vigor was improved by increased tillering per plant and seed density (individual seed weight); (3) seed germinability and vigor positively correlated with field emergence, plant stand and yield; (4) yield and components of yield were also affected by plant population density.

B-119

Name: Famara Massaly

Date of Degree: December 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. James C. Delouche

Title of Study: EFFECTS OF PLANTING DATE, SEED SIZE-DENSITY, AND PLANT POPULATION ON GROWTH AND REPRODUCTION OF TWO CULTIVARS OF COWPEA

Pages in Study: 64

Candidate for Degree of Master of Science

The objectives of these studies were to establish the effects of planting date, seed size-density, and population density in cowpea on vegetative and reproductive development. The Mississippi Pinkeye and Mississippi Bunch Purplehull cultivars were used in the studies on the MAFES Plant Science Farm in 1990/91. The effects of planting date on growth and development of cowpea were primarily environmental. Variation in major environmental factors (temperature, solar radiation and water supply) among the planting dates significantly affected seedling growth and the components of yield. Large-heavy seeds were much more vigorous than small-light seeds and produced plants that yielded more those from small-light seeds. Plants in low population communities (14 plants/3 m) produced more biomass and yield than those in the high population communities (60 plants/3 m), but the difference in plant density between the low and high populations was too great for the compensatory response to equalize biomass production.

Name: Adel Ibrahim Midany

Date of Degree: December 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. C. Hunter Andrews

Title of Study: RELATIONSHIP BETWEEN SEED SIZE AND QUALITY IN SOYBEAN

Pages in Study: 47

Candidate for Degree of Master of Science

This study was conducted to determine the relationship between seed size and germination in soybean [*Glycine max* (L.) Merrill]. Seeds from fourteen cultivars (lots) of soybean were sized into two size classes. The largest seed diameter was 17/64 inches (6.75 mm). The smallest seed diameter was 15/64 inches (5.95 mm). The unsized sample was the check.

Each composite lot and its individual class components were evaluated for quality by selected laboratory tests: standard germination, accelerated aging, and electrical conductivity. Also, field emergence was conducted.

Regardless of the overall physiological quality of the composite seed lot, there was no significant difference in quality between the largest and smallest size class.

The speed of emergence and initial stand establishment from the larger seeds of a lot were not superior to that of smaller seeds of the same lot when environmental conditions are near optimal.

Name: German Amed Rodriguez

Date of Degree: December 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. C. Hunter Andrews

Title of Study: EFFECT OF SEED SIZE ON GERMINATION AND VIGOR OF CORN

Pages in Study:

Candidate for Degree of Master of Science

The effects of hybrid corn *(Zea mays* L.) seed size on germination and vigor were evaluated. Seeds of hybrids Pioneer 3144, Sunbelt 1876, DP 5750, and Rx 911 were classified as small, large, and unsized seed.

To determine differences in germination and vigor, the following tests were employed: standard germination test, accelerated aging test, cold test, and conductivity of seed leachates. The weight per 100 seed was also determined.

In two of the hybrids, DP 5750 and Rx 911, an increase in seed size was accompanied by an increase in viability. This positive correlation was not found in the other two hybrids, Pioneer 3144 and Sunbelt 1876.

All seed size classes presented similar results for germination and vigor percentage when evaluated by different tests.

B-122

Name: Yilfashewa Shiferaw

Date of Degree: December 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. Charles E. Vaughan

Title of Study: CHARACTERIZATION OF WHEAT (*Triticum aestivum* L.) CULTIVARS BY LABORATORY AND FIELD TECHNIQUES

Pages in Study: 53

Candidate for Degree of Master of Science

Substantial increases in wheat production and yield can be partly attributed to the development and release of improved cultivars. Acceleration of varietal improvement in wheat has resulted in the development of many cultivars that are genetically closely related and very similar phenotypically. This situation has created problems in seed certification and seed law enforcement programs. This has necessitated the development of applicable and accurate laboratory and field techniques for cultivar testing.

In this study, laboratory tests for seed shape, brush length, phenol test, and coleoptile color, and field tests for growth habit, blade color and pubescence, spike shape, awnedness, spike position at maturity, and beak shape were conducted to characterize 32 wheat cultivars grown in southern U.S. Most characteristics were useful in characterizing these wheat cultivars. However, blade color and pubescence were variable within the same variety.

Name: Maher Aziz Yoakim

Date of Degree: December 1991

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. James C. Delouche

Title of Study: TEMPERATURE RELATIONS OF WHEAT SEED GERMINATION

Pages in Study: 45

Candidate for Degree of Master of Science

The objective of these studies was to establish the temperature relationships in the germination of wheat (*Triticum aestivum* L.) seeds. Four seed lots were selected for evaluation at five temperatures over a 10-40°C gradient.

The rate of germination generally increased as temperature increased although there was little difference between 25 and 30°C. Germination reached 90% or more of the 8-day level in 3 days at 30°C. The percent dead seeds increased as temperature increased above 20°C with a corresponding decrease in germination percentage.

In the temperature gradient study, earliest germination occurred in the sub-range 26 to 32°C. At 34°C, just 2°C above this range, the rate and percent germination were substantially reduced. Although the initial rate of germination at 32°C was very rapid, the final germination percentage was also substantially reduced. There was no germination above 34°C. Seedling length was longest at 25°C except for the low vigor Lot W7.

Period: 1/92 - 12/92

Name: Songsakdi Chuntirapongsa

Date of Degree: December 1992

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. James C. Delouche

Title of Study: EFFECTS OF SEED COAT COLOR ON STORABILITY OF SOYBEAN SEEDS

Pages in Study: 68

Candidate for Degree of Doctor of Philosophy

Studies were undertaken to evaluate the effects of seed coat pigmentation on the rate of deterioration of soybean seeds in storage. To minimize genotypic effects, black or brown seed mutants of the Tracy M, Davis, Sharkey, Hill and Centennial varieties were used along with four black seed and two yellow seed variants of Tracy M for a total of 14 varieties and lines. Seeds for study were produced in research plots at Mississippi State, MS and hand harvested at 18-22% moisture content to ensure that they were as near their peak of physiological quality as possible. Germination of the seeds ranged from 91 to 100% in 1990 and 98 to 100% in 1991. Storage conditions of 30°C and 75% RH was selected for study so that germination would be substantially reduced in 6 mo. even for the lines with highest storability.

There were substantial and consistent differences among the lines/varieties in the rate of seed deterioration in storage. In both 1990 and 1991 seeds of Tracy/BK and TM2/BK (black seed lines) exhibited the best storability, while those of the Davis/BR brown seed line had the poorest storability. Overall, the Tracy M family of lines were the best storers with the black seed lines superior in storability to the yellow seed lines. Storability of the soybean seeds, however, was not directly related to seed coat pigmentation. Some black seed lines (Tracy/BK, TM2/BK, ATB/BK) stored very well but others (TM1/BK and Centennial/BK) did not. All of the brown seed isolines (Davis/BR, Sharkey/BR

and Hill/BR) ranked the same or lower than their yellow-seed homologues in storability.

Storability of seeds of the varieties/lines was related to level of hardseededness. The Tracy/BK line which was the best storer in both years had the highest percent hard seeds - 56% in 1990 and 40% in 1991. All Tracy M family lines had more than 16% hard seeds in both years and stored well. The accelerated aging and conductivity tests were relatively efficient in foretelling and monitoring deterioration of soybean seeds in storage.

Name: Najeeb Uddin Siddiqui

Date of Degree: December 1992

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Co-Major Professors: Drs. James C. Delouche and Edgar R. Cabrera

Title of Study: PREDICTION OF THE STORAGE VIABILITY OF CORN SEEDS IN RELATION TO SEED MOISTURE CONTENT, TEMPERATURE AND SEED VIGOR

Pages in Study: 82

Candidate for Degree of Doctor of Philosophy

The objective of this study was to develop a mathematical model to predict the storage viability of corn seeds in relation to seed moisture content, temperature of the storage environment and initial quality of the seed lot. Four seed lots of two Pioneer brand varieties, Hybrids 3378 and 3180, differing in vigor were used.

The quality coefficient for each seed lot was established by plotting the percent germination against time of rapidly aged seeds at 16% moisture content and 40°C using linear regression. The germination data of each seed lot under 12 combinations of seed moisture content (10 to 16%) and temperature (25 to 35°C), and the seed quality coefficient were used to derive the mathematical model for predicting the 50% viability period of corn seeds in storage:

$$\text{Log } p = C_0 + C_1vt - C_2mt - C_q m^2$$

where p is the 50% viability period in days, v is the initial quality of seed lot, m is the seed moisture content (%), t is the temperature (°C), C_0, C_1, C_2 and C_q are the constants with values, C_0=6.579183, C_1=0.002437, C_2=0.005882, and C_q=0.010542, and R^2=0.96.

For prediction of the percent germination at any point in time (days), the above equation can be rewritten as:

$$\text{Germ \%} = 100\text{-}P*50/10^{C_0 + C_1vt - C_2mt - C_4m^2}$$

where P=storage period in days, and other variables and constants are the same as described above.

Tests of the validity of the model using the data obtained from storage of the seeds under the different seed moisture-temperature combinations indicated good accuracy, especially for seeds above 70% germination level. There was also good agreement between predictions from the model and those derived from Harrington's rules of thumb for seed storage, which were on the conservative side.

Results from a separate experiment determining the rate of absorption of hygroscopic moisture by corn seeds at 30°C under five levels of relative humidity, 48, 58, 67, 77 and 82%, indicated that 60 to 80% of the seed moisture loss at 48 and 58% RH, respectively, occurred during the first 8 days, while most (90%+) of the moisture gains at 77 and 82% RH occurred within 8 days with equilibrium established at 8 to 24 days at 77% RH and 56 to 72 days at 82% RH.

B-128

Name: Emil Shoukry Henain

Date of Degree: December 1992

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Co-Major Professors: Dr. James C. Delouche and Dr. Edgar R. Cabrera

Title of Study: RATES OF ABSORPTION AND DESORPTION OF HYGROSCOPIC MOISTURE BY GIN RUN AND ACID DELINTED COTTON SEEDS AT 10° AND 30°C

Pages in Study: 64

Candidate for Degree of Master of Science

Equilibrium moisture content (EMC) isotherms were determined for acid delinted and gin run D&PL 20 cotton seeds over a range of relative humidity (RH) from 22 to 93% at 10°C and 30°C under static and dynamic conditions.

EMC of the seeds increased linearly from 7.5 to 13.5% at 10°C and 5.4 to 11.8% at 30°C as RH increased from 22 to 75% under static conditions. Above 75% RH, EMC increased at a proportionately greater rate than RH. Rates of moisture absorption/desorption and EMCs were higher for acid delinted than gin run seeds due to the low hygroscopicity of residual linters on the latter. Rates of absorption/desorption increased as temperature increased from 10° to 30°C, but the EMCs decreased. Under dynamic (air movement) conditions, absorption/desorption was more rapid than under static conditions and EMCs were attained in half the time.

EMC values from the Henderson and Chung-Pfost equations agreed closely with those obtained experimentally.

201

B-129

Name: Ketty Paquiot

Date of Degree: December 1992

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. James C. Delouche

Title of Study: EVALUATION OF METHODS FOR RELEASING SEED DORMANCY IN CULTIVATED AND RED RICES

Pages in Study: 61

Candidate for Degree of Master of Science

This study was undertaken to determine the effectiveness of several treatments for releasing dormancy in seeds of the Nato cultivar and the BLKH, SHA+ and R78-8 red rice genotypes. Treatments evaluated were seed soaks in solutions of ethylene chlorhydrin, sodium hypochlorite, gibberellic acid and "water" at 40°C, acid scarification with HNO_3, H_2SO_4 and HCl, accelerated aging at 40° and 45°C and 100% RH, and mechanical treatments involving removal of the hulls and rupture of the pericarp.

All chemical soak treatments promoted germination of the dormant seeds but 0.1% ethylene chlorohydrin was most effective. Acid scarification also promoted germination of the dormant seeds with H_2SO_4 scarification for 20-25 min. the safest and most effective treatment.

Removal of the hulls increased germination but dormancy was not fully released unless the pericarp was ruptured above the embryo. Responses of the dormant seeds to accelerated aging were variable among lines and inconsistent.

30%

B-130

Name: Moustafa Abdel-naby Hassad Saad

Date of Degree: December 1992

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. Charles E. Vaughan

Title of Study: FIELD DETERIORATION OF COWPEA SEED

Pages in Study: 46

Candidate for Degree of Master of Science

Three cultivars of cowpea, Mississippi Silver, Mississippi Pinkeye Purplehull, and California Blackeye, were planted in adjacent, plots on May 21, 1991. Eight harvests were made at weekly intervals beginning August 2, 1991, to evaluate seed quality. Seed moisture content was determined for samples harvested every two days beginning July 23, 1991.

Seed harvested each week were subjected to the following quality evaluation tests; standard germination, accelerated aging, tetrazolium, electrical conductivity, and field emergence. Even though there was a loss of quality in all three cultivars with delayed harvest, seeds of California Blackeye were superior. They performed best among the three cultivars and exhibited inherent resistance to field deterioration while Mississippi Pinkeye Purplehull was very susceptible to field weathering, especially after the fourth harvest. Mississippi Silver ranked second among the three cultivars.

B-131

Name: Salah Eldin H. A. Sorour

Date of Degree: December 1992

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. James C. Delouche

Title of Study: VARIATION AMONG RICE VARIETIES AND RED RICE LINES IN INITIAL LEVEL AND PERIOD OF SEED DORMANCY

Pages in Study: 43

Candidate for Degree of Master of Science

The objectives of this study were to establish the variation in the initial level and period of dormancy in cultivated and red rices and compare the effectiveness of several dormancy releasing treatments on 26 genotypes. Panicles of each variety/line were harvested 28 days past 50% anthesis to ensure uniformity in stage of development.

The initial degree of dormancy varied from 47 to 100% among the 26 lines and the dormancy period from 5 to more than 20 days at 30°C. The red rice line R78-8 was most deeply and persistently dormant, while lines SHA- and BHR, very common red rices, had the shortest dormancy periods. Among cultivated varieties, Nato and Newbonnet were the most and least dormant, respectively. The rate of release of dormancy increased as the temperature in dry storage was increased from 10 to 40°C. The most effective treatment for releasing dormancy was a seed soak in 0.1% ethylene chlorohydrin at 40°C for 24 hr.

B-132

Name: Sukarman

Date of Degree: December 1992

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. James C. Delouche

Title of Study: PHYSIOLOGICAL QUALITY OF MUNG BEAN SEEDS AS AFFECTED BY WEATHERING AND ADVERSE STORAGE CONDITIONS

Pages in Study: 63

Candidate for Degree of Master of Science

The effects of natural and artificial weathering on the physiological quality and storability of mung bean seeds were characterized in terms of response-reactions of the seeds. Seeds harvested at harvest maturity and 2 wk later were near 100% in viability and did not significantly decrease in viability during the 6 mo. storage period. Viability, however, was significantly and progressively reduced when harvest was delayed longer than 2 wk. Viability of seeds exposed to the longer periods of weathering was reduced much more than that of seeds from the shorter weathering periods indicating that weathering had immediate and latent effects on seed quality. The latter was most evident in the accelerating aging responses which decreased rapidly as weathering period and time in storage increased. Conductivity of leachates from unweathered seeds was between 0 and 25μA and progressively increased as weathering period increased. Rate of germination and seedling growth were not sensitive indicators of deterioration.

B-133

Name: Kisma Wague

Date of Degree: December 1992

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. James C. Delouche

Title of Study: COMPARISON OF SEEDLING VIGOR AND COMPETITIVENESS IN SELECTED RED RICES AND CULTIVATED RICES

Pages in Study: 53

Candidate for Degree of Master of Science

The objectives of these studies were to compare seedling vigor of the SHA- and BLKH red rices and the Lemont and Maybelle varieties and determine the effects of season-long 1:1 competition between them on plant growth, development and yield.

Tiller number and biomass dry weight were significantly lower for the cultivated varieties in mixed culture as compared to monoculture, while that of the SHA- and BLKH plants in mixed culture was significantly higher than in monoculture at the expense of the less vigorous cultivated rices. The yield components of Lemont and Maybelle were drastically reduced in mixed culture with the consequence that grain yield was reduced by 70% for Maybelle in competition with BLKH and 69% for Lemont in competition with SHA-.

The SHA- and BLKH red rices exhibited much greater seedling vigor than the cultivated rices in terms of rate of germination and seedling growth.

Period: 1/93 - 9/30/93

Name: Pegase Banyankiye

Date of Degree: May 1993

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. James C. Delouche

Title of Study: SOME ASPECTS OF SEED DEVELOPMENT, MATURATION AND FIELD DETERIORATION IN SORGHUM

Pages in Study: 57

Candidate for Degree of Master of Science

Sorghum seed development and maturation under humid, rainfed conditions in Mississippi were studied in seven lines: Redbine 66, Wheatland, Wheatland V, TX 430, P954063, SC 475-14, and SC 175-14.

Seed moisture content decreased rather uniformly from 70-75% at 5 to 6 days past anthesis (dpa) to below 20% at 40 days and then equilibrated with environmental conditions in the field. Dry matter accumulated slowly in the developing seeds up to 10-12 dpa then rapidly to 25 days after which the rate slowed as maximum accumulation was approached. Maximum seed dry weight, or physiological maturity, was attained in 27 to 30 days for five of the seven lines and in 35 days for the other two lines. Some developing seeds became germinable at 10 dpa and maximum germination was reached at 18 - 20 days. Seed vigor manifested in seedling dry weight attained maximum values at the same time as maximum seed dry weight.

Delaying harvest after physiological maturity resulted in a substantial decrease in germination due to weathering.

B-135

Name: Juvent Baramburiye

Date of Degree: May 1993

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. C. Hunter Andrews

Title of Study: EFFECTS OF SEED SPECIFIC GRAVITY AND SEED SIZE ON VIGOR AND FIELD PERFORMANCE IN WHEAT SEED

Pages in Study: 63

Candidate for Degree of Master of Science

Coker 9835 wheat seeds were used to evaluate the effects of seed specific gravity and seed size on vigor and field performance in wheat. Three specific gravity and size classes were evaluated in the laboratory to determine seed weight, standard germination, accelerated aging response, seedling growth rate, and dry weight. Field trials included field emergence, heading time, number of heads per meter, and grain yield.

Viability and vigor was better associated with seed specific gravity than with seed size. Results from field emergence and heading studies were non-significant for all of the seed classes. However, the number of heads per meter was lower for small and light seeds. No significant differences in grain yield were observed in all seed classes, however, an increase in yield might be obtained if both the lightest and smallest seeds were removed for better uniformity of field performance and grain yield.

B-136

Name: Muhammad Qasim Khan

Date of Degree: May 1993

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Co-Major Professors: Drs. Bennie C. Keith & James C. Delouche

Title of Study: EFFECTS OF GRAVITY SEPARATION AND SEED TREATMENT ON SEED QUALITY IN WHEAT

Pages in Study: 50

Candidate for Degree of Master of Science

Studies were undertaken to evaluate the effects of gravity separation and seed treatment on three quality levels of wheat. Seeds of three quality levels of wheat, Coker 9877 (high), Arthur (medium), and Cardinal (low) were separated into three density classes by a gravity separator. Testing revealed that for all quality levels there was a direct relationship between density classes and seed quality. Germination percentages, yield response, and accelerated aging response increased as seed density increased. Seed treatment was found to be effective in improving wheat seed quality by increasing germination percentages, yield and accelerated aging response. Also, seed treatment was effective in reducing specific disease pressure. Seeds which were not treated had a higher incidence of disease in high quality seeds as compared to low quality seeds.

Field emergence revealed that the number of surviving seedlings were higher for non-treated seeds as compared to treated seeds.

B-137

Name: Ibrahim Mahamadou

Date of Degree: May 1993

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. C. Hunter Andrews

Title of Study: PERFORMANCE OF PEARL MILLET AS AFFECTED BY SEED SIZE

Pages in Study: 58

Candidate for Degree of Master of Science

A two year experiment was undertaken to evaluate the influence of seed size on the performance of two pearl millet cultivars. Seeds were sieved into three size classes in 1991 and four size classes in 1992. Laboratory studies revealed no consistent relationship between seed size and quality, but early in the imbibitional period, small seeds absorbed significantly more water than large ones. In the field there were no significant differences in emergence, but large seeds seemed less sensitive to seedbed variations. The heading pattern, however, revealed significant differences. Significant differences in yield were observed in 1992, but, even then differences in spike number and spike yield were not significant. Therefore, sizing millet seeds for the purpose of improving seed quality will be of very little or no use.

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B-138

Name: Marwanto

Date of Degree: May 1993

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Co-Major Professors: Drs. James C. Delouche and Edgar R. Cabrera

Title of Study: MOISTURE EXCHANGE AND EQUILIBRIA IN SOYBEAN SEED BLENDS

Pages in Study: 80

Candidate for Degree of Doctor of Philosophy

The main objectives of these studies were (1) to characterize and quantify the exchange of moisture among blended soybean seeds differing in moisture content in terms of rate, equilibrium moisture content (EMC), and germinability for several varieties and temperatures, and (2) to obtain information on moisture exchange between seeds of a commercial variety and those of a hard seed line and its effect on the incidence of hard seeds. High quality seeds of the Asgrow A6297, Deltapine 726 and Bragg varieties, and the D86-4565 hard seed line were used in the several studies.

Moisture exchange between low moisture (LMC) and high moisture (HMC) seeds in blends of different proportions was very rapid. At 10°C 35-45% of the moisture exchange between nominally 10 and 16% moisture seeds occurred within 6 hr, 80-90% within 2 days, and 96-100% within 5 days. Moisture exchange was more rapid at 30°C with 46-50%, 90-99%, and 100% of the exchange completed in 6 hr, 2 days and 5 days, respectively. The rate of moisture exchange was not affected by the proportions of LMC and HMC seeds in the blend or genotype.

HMC seeds attained EMC at a slightly higher moisture level through desorption than the LMC seeds did through absorption and the difference was maintained during the 90-day equilibration period. This difference in EMC was attributed to the hysteresis effect with magnitudes of 0.20 - 0.25% and 0.09 - 0.13% moisture at 10 and 30°C, respectively.

The moisture content of D86-4565 seeds blended with 14.20% moisture Deltapine 726 seeds increased from 6.52% to 9.67% in 9 wk at 10°C, then to 10.97% by the end of the 21 wk period, while the Deltapine 726 seeds decreased to 12.75% at 21 wk for a difference of 1.78%. This exchange in moisture content had a profound effect on the percent hard seeds in the D86-4565 line: the hard seeds % deceased from 25% to 6% and 2%, respectively, at 10° and 25°C. during the 21 wk period.

Seeds of the D86-4565 absorbed and desorbed hygroscopic moisture more slowly than those of the commercial varieties under alternating 18 day cycles of high and low relative humidity. The % hard seeds decreased during the high humidity cycle and increased during the low humidity cycle indicating that the hard seed condition was reversible within limits.

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B-140

Name: Boukary Hama Sambo

Date of Degree: May 1993

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Major Professor: Dr. C. Hunter Andrews

Title of Study: EFFECTS OF SEED SPECIFIC GRAVITY AND PLANT POPULATION ON SEED QUALITY, GROWTH AND DEVELOPMENT, AND YIELD OF THREE CULTIVARS OF PEARL MILLET

Pages in Study: 67

Candidate for Degree of Master of Science

Studies were undertaken to establish the effects of seed specific gravity and plant population on seed quality, growth and development, and yield. Seeds of three cultivars of pearl millet, EDS, Tift2, and Tift Experimental, were used in these studies on the MAFES Plant Science Research Center in 1991 and 1992. Seed quality was significantly affected by seed SG as reflected by higher germination, greater seedling dry weight, and a strong and consistent resistance to aging as seed SG increased. Field emergence and rate of emergence index were highest for high SG seeds. Stands from high SG seeds reached developmental stages earlier than those from low SG seeds. Yield components such as head weight, heads per plant, and head yield were strongly and positively correlated to both seed SG and seed yield. The highest plant population, P_1 and P_2, 200,000 and 150,000 plant ha^{-1}, respectively, had the highest seed yield.

B-141

Name: Errol Brent Turnipseed

Date of Degree: May 1993

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. James C. Delouche

Title of Study: DETERIORATIVE CHANGES IN SOYBEAN AND COTTON SEEDS

Pages in Study: 102

Candidate for Degree of Doctor of Philosophy

Studies were undertaken to identify and characterize deteriorative changes associated with aging in soybean and cotton seeds and to relate selected changes at the biochemical and physiological levels with losses in performance capability of the seeds, viz., germinability and vigor.

High quality seeds of the Mack and Tracy M cultivars of soybean and the DES 119 cultivar of cotton were adjusted to 12-13% moisture content and aged in plastic containers at 35-40°C for periods from 0 to 40 days to obtain batches of seeds with different levels of deterioration for various studies. Deteriorative changes associated with aging of the seeds were identified and characterized in terms of the results of twelve response-reactions of the seeds: standard germination, rate of seedling growth, accelerated aging response, cool germination (cotton only), hot water soak (cotton only), conductivity of seed leachates, pH of seed exudates, release of volatile aldehydes, free fat acidity, level of free amino acids, respiration, and dehydrogenase activity.

Standard germination was not significantly reduced until the seeds had been subjected to rather long periods of aging, i.e., aging levels 3 and 4, but rate of seedling growth, accelerated aging responses and cool germination (cotton only) decreased significantly very early during aging prior to any decrease in standard germination.

Increased seed permeability was also one of the earliest and most prominent deteriorative changes associated with aging. The conductivity of seed leachates

2nd

increased as aging level increased for both seed kinds. Increases in volatile aldehydes and free fat acidity indicated that degradation of the lipid fraction in seeds was a substantative change during aging and probably a major factor in the increased seed permeability. Proteins were also degraded during aging as evidenced by a consistent increase in the level of free amino acids with increased aging.

The volatile aldehydes and free amino acids assays appear to have good potential for monitoring and indexing seed quality for deterioration and vigor, while the pH of exudate assay seems to be particularly well suited for rapidly estimating the percent germination.

Name: Zaidan

Date of Degree: May 1993

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. James C. Delouche

Title of Study: ESTABLISHMENT AND RELEASE OF THE HARD SEED CONDITION IN SOYBEAN

Pages in Study: 70

Candidate for Degree of Doctor of Philosophy

Studies were undertaken to determine the relationship of whole seed moisture content and seed size to the expression of hardseededness in soybean, establish the reversibility of the hard seed condition, and evaluate some methods for the release of hardseededness. High quality seeds of the D81-9764, D81-9765, D83-4041 and D67-5677-1 (called D-1) hard seed lines of soybean and the D83-4083 soft seed line were used as experimental material.

The incidence (%) of hardseededness increased as seed size increased up to the very largest size in which it decreased. These findings were at variance with those reported by earlier workers that the expression of the hard seed coat condition in soybean and other members of *Fabaceae* increased as seed size decreased. Water impermeability of the seed coat was not established until whole seed moisture content was reduced to below 14% during initial drydown of the seeds. The incidence (%) of hard seeds generally increased as whole seed moisture content decreased down to about 5%, then decreased as moisture content was reduced below 2%. The reason(s) for the "release" of the hard seed condition with extreme desiccation below 2% whole seed moisture content could not be established by visual examination of the seeds.

The water impermeability of the seed coats of a portion of the population of seeds from each of the four hard seed lines was slowly but repeatedly reversible under long (7 to 14 days) alternating cycles of high and low relative humidity. This finding precludes mechanisms of impermeability based on specific morphological features such as the absence of pores in the seed coat,

plugs in the micropyle, and waxy deposits on the surface of the seed coat as hypothesized by different workers.

The percent of hard seeds was greatly reduced by a 2 min soak in 80°C water and completely eliminated by 1 min in concentrated H_2SO_4.
The entry of water into hard seeds softened by humidification was more generalized than specific, i.e., it was not restricted to specific areas of the seed coat.

Name: Mohamed Ibrahim El Hawary

Date of Degree: July 1993

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Co-Major Professors: Drs. Charles E. Vaughan and James C. Delouche

Title of Study: MODEL SEED LEGISLATION FOR THE WEST ASIA AND NORTH AFRICA REGION

Pages in Study: 262

Candidate for Degree of Doctor of Philosophy

These studies were undertaken to define and prepare the essential framework and components for a comprehensive seed quality control system for participant countries in the West Asia and North Africa (WANA) Seed Network. Legislation and policy pertaining to seed production and marketing in North America, Europe and many developing countries were reviewed to gather information on the philosophies and procedures of seeds control that would be most suitable for the WANA countries.

A comprehensive quality control system for seeds was developed in the form of model seeds legislation and associated decrees that set forth the regulations and standards for implementation of the legislation. The model seed law asserts the government's interest and authority to regulate commerce in seeds, enunciates public policy for the seed trade, defines the role and responsibilities of the public and private sectors in the seed industry and specifies the seed production and marketing activities that are to be regulated. It also designates the agency responsible for implementation and enforcement of the provisions of the law and the rules and regulations promulgated thereunder, and establishes a National Seeds Council to provide guidance for implementation of the legislation and development of a responsible and responsive seed industry.

Two sorts of regulations were prepared under the seed law: general seed marketing regulations and seed certification regulations. The general seed regulations specify the kinds of seeds to be regulated, the procedures that are

to be used in enforcement of the law, and minimum seed quality standards. The regulations for seed certification define and/or designate the purpose of certification, the kinds of seeds to be certified, the certified seed classes, the agency responsible for certification and operation of the system, field and facility inspection procedures, and minimum quality standards for each certified seed class.

The model seed law and regulations take into account the many common features in culture, social organization, agriculture and environment among the WANA member countries. Appropriately adapted to the specific needs and stage of development of the individual countries, the legislation could provide the policy and legal framework for reform and enhancement of crop based agriculture.

Name: Muhammad Anwar-ul Haq Hussain

Date of Degree: July 1993

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Charles E. Vaughan

Title of Study: WATER ABSORPTION BY VEGETABLE SEEDS

Pages in Study: 45

Candidate for Degree of Master of Science

Water absorption by seeds of cowpea, squash, lima bean and okra was studied. Seed coverings retarded moisture absorption and germination to varying degrees, depending on the species. Condition of the seed covering had little effect on the quantity of moisture absorbed during alternating periods at 43 and 98% RH.

The rate and quantity of moisture absorbed was influenced more by type of media than temperature. Effects of temperature were more evident during 6-12 hrs of absorption. High temperatures promoted faster rates of absorption and germination.

Seed moisture contents required for at least 50% germination of each seed kind were 47% for cowpeas, 29% for squash, 41% for lima bean, and 38% for okra seeds.

Moisture contents of all seed parts increased during the first 6 hrs and up to 72 hrs depending on the seed kind, after which time equilibrium was established. Rate of water absorption of seed coverings was slower than for the embryonic axes.

B-148

Name: Herath Lansakara

Date of Degree: July 1993

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Co-Major Professors: Drs. James C. Delouche and Edgar R. Cabrera

Title of Study: MOISTURE EXCHANGE AND HYGROSCOPIC EQUILIBRIA IN FIELD AND POP-CORN SEEDS

Pages in Study: 99

Candidate for Degree of Doctor of Philosophy

The objectives of these studies were to quantify the exchange of moisture in blends of high moisture (HMC) and low moisture (LMC) corn seeds and to establish the equilibrium moisture contents (EMC) of corn seeds under different levels of humidity at two temperatures under static and dynamic conditions. High quality seeds of the Pioneer 3378 hybrid field corn variety and the EXP 63106 (MR) pop-corn variety were used in the several studies.

Moisture exchange between LMC and HMC seeds in blends of different proportions was relatively rapid. At 10°C 50-60% of the moisture exchange between nominally 8 and 15% moisture seeds occurred within 24 hr, 80-85% within 3 days, and 90-100% within 5/6 days. Moisture exchange proceeded even more rapidly at 30°C: 40-50%, 90-95%, and 95-100% of the exchange were completed in 8 hr, 3 days and 6 days, respectively. The rate of moisture exchange was not appreciably affected by the proportions of LMC and HMC seeds in the blend or the type of seeds. The seeds in the 60% HMC:40%LMC blend equilibrated at the highest moisture contents while those in the 40%HMC:60%LMC blend equilibrated at the lowest moisture contents.

HMC seeds equilibrated at a slightly higher moisture content through desorption than the LMC seeds through absorption and the difference was maintained through the entire 120-day period. This difference in EMC was attributed to the hysteresis effect with magnitudes of 0.72 - 1.15% and 0.43 - 0.55% moisture content at 10 and 30°C, respectively.

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Under static conditions, the EMC of the corn seeds increased linearly from about 9.7 to 15.4% at 10°C and 7.9 to 13.8% at 30°C as relative humidity (RH) increased from about 22 to 75%. Above 75%, EMC increased at a rate proportionately greater than the increase in relative humidity. The rate of absorption increased as the temperature increased from 10° to 30°C, while the EMCs decreased. There was no difference in EMCs between the field and popcorn seeds. The EMCs under dynamic conditions followed trends similar to those under the static conditions, but the rate of absorption and establishment of EMC was considerably more rapid.

The Henderson and Chung-Pfost equations produced EMC values that were very close to those obtained experimentally in the present studies.

B-150

Name: Awadh Omar Mahfood

Date of Degree: July 993

Institution: Mississippi State University

Major Field: Agronomy (Seed Technology)

Co-Major Professors: Drs. Bennie C. Keith & Charles E. Vaughan

Title of Study: SEED TREATMENT OF WHEAT

Pages in Study: 41

Candidate for Degree of Master of Science

Seeds of three quality levels of wheat, Coker 9887 (high), Arthur (medium), and Cardinal (low), were used to evaluate the effect of different rates of seed treatment. The three quality levels were treated with a combination fungicide seed treatment, Vitavax 200 and LSP. Three rates of application, one half the recommended rate (.5X), the recommended rate (1X), and double the recommended rate (2X), were used. A sample with only water applied was used as a control.

Cultivars were evaluated in the laboratory for standard germination, accelerated aging response, soil emergence, and root and shoot length. Field emergence was also evaluated.

Laboratory and field emergence results revealed that the recommended rate gave the best response for all quality levels. Also, LSP had no adverse effect on the germination of wheat seeds. However, LSP must be applied accurately to avoid possible germination loss.

B-151

Name: Dennis Bernard Reginelli

Date of Degree: July 1993

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Major Professor: Dr. Charles C. Baskin

Title of Study: THE RELATIONSHIP BETWEEN SEED QUALITY, TIME OF RADICLE EMERGENCE, AND PLANT PERFORMANCE OF COTTON (*Gossypium hirsutum* L.) UNDER COMPETITIVE AND NON COMPETITIVE SITUATION

Pages in Study: 92

Candidate for Degree of Doctor of Philosophy

Growth characteristics and yield of cotton (*Gossypium hirsutum* L.) plants as related to seed quality and time of radicle emergence were studied under field conditions where plants were grown in both competitive and non competitive stands. Field tests were conducted at the Mississippi Agricultural and Forestry Experiment Station (MAFES) Plant Science Research Center, Mississippi State, Mississippi on a Marietta fine sandy loam. The cultivar examined was Deltapine 20. Seed quality and time of radicle emergence were the characteristics which were evaluated for their effects on plant growth and reproductive characteristics during 1990 and 1991. One seed lot was obtained by hand harvesting bolls at carpel cracking. Three other seed lots were from commercial seed obtain from the Delta and Pineland Co., Scott, Mississippi. Lots ranged from 78 to 100% germination and varied in time of radicle emergence when seed were germinated in wet rolled germination towels. Beginning 24 hours after planting, seeds were removed from the towels if radicles had ruptured the seed coat. This procedure was repeated at 32, 40, and 48 hours after planting. Seedlings for the non competitive field planting were planted in a 50:50 mixture of screened field soil and potting soil in paper cups located in the greenhouse. These were later transferred to the field when plants were in the 2 to 4 leaf stage. Seedlings in the competitive planting were transferred directly from the germination towel into the field and hand planted approximately 2.5 cm deep, 10 cm apart in a 12 M long plot.

The results of the non competitive planting indicated that vegetative and reproductive development of plants was not affected by seed quality or time of radicle emergence.

The competitive planting revealed that vegetative and reproductive development of plants was affected by both seed quality and time of radicle emergence. In general, as seed quality declined and as time required for radicle emergence increased, plant height, boll set, and yield declined.

B-153

Name: Ilhamuddin

Date of Degree: July 1993

Institution: Mississippi State University

Major Field: Agronomy-Seed Technology

Co-Major Professors: Drs. Bennie C. Keith and C. Hunter Andrews

Title of Study: RELATIONSHIP BETWEEN PLANTING SEED QUALITY AND FIELD DETERIORATION IN WHEAT SEEDS

Pages in Study: 53

Candidate for Degree of Master of Science

In order to study the relationship between field deterioration and seed quality in wheat, seeds produced from three quality levels of planting seeds were exposed to four intervals of field deterioration beginning at field maturity. Seeds harvested from each deterioration level were subjected to the following quality evaluation tests: standard germination, accelerated aging for both 48 and 96 hrs, tetrazolium potential, root and shoot length, and 1000-seed weight.

Seed quality levels as well as deterioration levels were significantly different. Seed quality significantly decreased as deterioration levels increased. Seeds of the medium seed quality cultivar (B) were more tolerant to field deterioration, while seeds from the low seed quality cultivar (C) showed a greater degree of deterioration. The high seed quality cultivar (A) exhibited an intermediate response. Root and shoot length and 1000-seed weight tended to decrease gradually as deterioration increased.