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Final Report

June, 1968 Through May, 1975

211(d) International Program in Crop Production

Agronomy Department, The Pennsylvania State University

University Park, Pennsylvania 16802

211(d) Final Report

Date December 1, 1975

Title: Crop Production in India and Other Developing Nations

Grantee: The Pennsylvania State University, University Park, PA 16802

Director: Dr. Richard H. Cole (Project Leader)
Agronomy Department (119 Tyson Bldg.)

Statistical Summary:

Grant Period - June 1, 1968 to May 31, 1975 (7 years)
Grant Amount and Total Expenditures $200,000.00

Narrative Summary:

The major accomplishment of this project has been to add an international perspective to the programs of the Agronomy Department at The Pennsylvania State University. A majority of the department's professional staff (faculty and graduate assistants) have been involved in one or more aspect of the program. We have increased our international teaching, advising and consulting capabilities. Agronomists have provided major leadership in our College of Agriculture's programs in India, Argentina and The Bahamas. Cooperation within the Department of Agronomy and the College of Agriculture, and throughout The University has been fostered.

The final product has been a group of sincere and dedicated people with an interest and ability to work with international agricultural development. While the faculty have expanded their international experience, they have also obtained an understanding of the problems facing the LDC's. Former American graduate students trained in this project are now employed in three developing nations. The Indian students educated at University Park during this period have assumed leadership roles in India. Supplementing the education of undergraduates, by pointing out long-term needs and suggesting future involvement in international programs, has proved desirable.

The major benefactors of this program will be the LDC's. American and foreign graduate students can receive at PSU the training needed to do the job required in a developing nation. Consulting services and laboratory facilities are readily available for international use. Future program proposals can be evaluated rapidly and progress predicted. The need for continuing, long term, flexible programs with diversified funding has been evidenced. Areas of international excellence in Agronomy at PSU are being developed in forage crop breeding, management, and physiology; soil resources and land use; and the basic soil sciences. Other specialized international training can be developed whenever there is a need, as we have demonstrated during this granting period.

## I. GENERAL BACKGROUND AND PURPOSE OF THE GRANT

This project was one of six conducted at the universities that coordinated their work in India through CUSURDI (the Council of United Sates Universities for Rural Development in India). Each project was designed to encourage the employment of a full-time faculty member to conduct research, supervise graduate students, and carry out other activities to increase the university's competence in the international dimension of a chosen discipline. Inter-university and inter-disciplinary exchange of information and knowledge was encouraged, and joint reviews of work plans and progress were conducted by CUSURDI.

Because of the crop production needs and interests in Central India and the competence in agronomy at The Pennsylvania State University, the area of specialization ultimately selected for this project was "Crop Production." This proved to be an excellent area of specialization because it was broad enough to gain wide faculty and student support while stimulating more specialized areas of international interest in agronomy at The University.

## II. OBJECTIVES

The major objectives of the 211(d) project at The Pennsylvania State University were as follows:

1. To increase interest in and knowledge about the agricultural problems of India and other developing nations, and improve the capabilities of The Pennsylvania State University to become associated with international programs in crop production;
2. To increase the pool of scientists interested in and capable of assisting in agricultural development outside the United States;
3. To provide an opportunity for graduate students to obtain research experience in crop production involving problems relevant to India and other less developed countries;
4. To create an awareness and stimulate interest of plant and soil scientists in international assignments and careers; and;
5. To encourage youth to seek training leading to careers in international agriculture.

Many Agronomy faculty, students (graduate and undergraduate) and staff members were extremely interested and intimately involved in the Indian programs developed. An equal, short-term, interest was generated later in the Argentinian program. Both contracts were terminated earlier than planned because of circumstances beyond our control. PSU faculty and students continue to be interested and involved in the existing Bahamian program.

While increasing an interest in and knowledge about the agricultural problems of developing nations, we have increased the pool of scientists (faculty, staff and graduate students) capable of assisting in agricultural development both at home and abroad. We have also been able to create an awareness and interest in international assignments and careers, and enabled youth to seek training leading to international agricultural careers.

## III. ACCOMPLISHMENTS

A. Increasing interest in and knowledge about the agricultural problems of India and other developing nations and improving the capabilities of PSU to become associated with international programs in crop production.

The original target here was to get PSU faculty and staff involved. Total administrative support was obtained to (1) encourage leaves for overseas assignments, (2) encourage participation in PSU contracts, (3) encourage short-term assignments, (4) encourage faculty to properly train international students, and (5) utilize all sources of funds available (contract, grant and personal funds) to encourage overseas work and travel. When a participant returned, arrangements were made for reports to all interested parties, including families.

Active committees interested in problems in India and the Bahamas have been maintained in the Agronomy Department. The 211(d) professor has taken major leadership roles in both programs. The department head, Dr. James L. Starling, served as coordinator of an Argentina crop production program and extension head, Prof. James H. Eakin, is presently a discipline coordinator in the Bahamian program.

It is hoped that the Indian involvement, terminated in 1973, will become modified and activated again in the future. The faculty continues to have frequent contactswith associates in India and have been encouraged by the Indians to propose programs that may become activated in the future. Several professors continue to serve on Indian graduate theses review committees and maintain contact with past participants.

Penn State's involvement in the Bahamian program has expanded rapidly over the past two years. Professional experience for applied agronomists with limited international experience has been provided through the project. This contract allowed PSU to expand its interest in international forage crop-grain crop-livestock programs. The 211(d) professor first served as chairman of the project's technical committee and later as technical coordinator of the project. Professor James Eakin, Agronomy Discipline Coordinator, has been assisted by Dr. John Baylor (Tropical Forage Specialist) and Dr. Willis McClellan (Crop Production Specialist).

By understanding the agricultural problems of India, Argentina, and The Bahamas, the PSU Agronomy faculty and staff have become more capable of becoming associated with other international programs. An estimated 30% of the total expenditures have been used to meet this objective.

B. Increasing the pool of scientists interested in and capable of assisting in agricultural development outside the United States.

The target was to provide in-depth and continuing involvement in development programs for faculty and staff. The available funds were channeled into agricultural development, not basic research. Seminars that pointed out the needs in a developing society were encouraged. Relationships with PSU economists, sociologists, animal scientists, engineers, etc. were encouraged. The need

for additional and diverse funding, and the establishment of research and development groups was often discussed.

Early in the program, it became obvious to those involved in the project that emphasis should be placed on agricultural development, not basic research. This meant that the professor's professional advancement within the U.S. universities was based on criteria not previously utilized. It was also apparent that this meant working with colleagues and students with little personal recognition. The satisfaction of a job well done, sometimes difficult to document, became an important asset.

A continuous relationship with associates in host nations is desirable. While we have been able to continue contacts with our Indian counterparts, very little contact has been maintained with our Argentinian associates. Most of the Agronomy staff participating in the Argentina program are capable of assisting in development programs, but are not presently active in existing programs.

As indicated previously, Professors Eakin, Baylor, McClellan and Cole continue to play major roles in the Bahama project. Assistance has also been received from the professors serving on the committees of the M.S. and Ph.D. candidates involved, fellow students, and technical service employees. This help and encouragement can only be considered an extra bonus.

One additional method of increasing the pool of scientists interested in and capable of assisting in agricultural development outside the USA should be stressed. This involves the adequate training of international students for employment in their home nation. This training is an ongoing task of a knowledgeable U.S. university faculty. Eventual placement, while the responsibility of a host nation, can be influenced by contact with sincere friends in nations such as India and the Bahamas. The specific manpower needs of a nation or cooperating institution should never be overlooked. An estimated 30% of the expenditures were utilized to meet this objective.

C. Providing opportunity for graduate students to obtain research experience in crop production involving problems relevant to India and other less developed nations.

To meet this objective, the target was to have U.S. graduate students complete their course work at University Park, conduct their thesis research overseas (primarily India), and submit their completed thesis at PSU. It was initially thought this procedure would help solve problems in developing nations and provide the student overseas research experience.

Based on the experience obtained in these programs (past experience in India and present involvement in the Bahamas), this procedure requires close advisor supervision and student-faculty interaction. When similar arrangements are established in the future, it would be desirable to have students associated with senior PSU faculty stationed at overseas posts.

The possibility of short-term (3 to 6 month) overseas study for students should not be overlooked. This could be done with the help of an international associate at a sister institution. With one student in this program, this proved quite beneficial. Another possibility is to train students with prior international experience, totally at the U.S. university, in an area that would be particularly helpful when seeking international employment.

Two Ph.D. candidates continue to obtain international experience in the College of Agriculture's Bahama Program. Mr. J. Harold Stern is conducting a forage species - soil moisture study as a portion of his work which he plans to use in his thesis. Tropical legume management is being studied by Mr. Ronald Guyton. Upon completion of their work, both will be available for international agricultural development employment.

Ms. Sandra Russo is continuing her research on the quality of tropical forage grasses at the home campus. Forage samples from the Bahama project are being utilized in her studies. She is expected to complete her thesis work during the next year and seek international employment.

One new target was to involve faculty with international and/or development experience in foreign student committees. While the 211(d) professor served on many committees, the addition of several staff members with international experience has proved very helpful. About 25% of the expenditures have been needed to meet this objective.

D. Creating awareness and stimulating interest of plant and soil scientists in international assignments and careers.

The target was to create an awareness and stimulate interest in international assignments and careers at Penn State and neighboring institutions. Many of the efforts to satisfy this objective were undertaken early in the project life. With reduced international funding, it soon became obvious that we should not continue to try to sell immediate employment, something that we could not often produce. The long term needs and future involvement was stressed.

PSU continued to have a readily available supply of agronomists seeking international opportunities. The problems faced are keeping those interested continuously involved, and fitting the job requirements to the specific specialties of the agronomists available.

The Agronomy Department has now incorporated a strong international aspect into three of its major areas of graduate training: Forage Breeding, Quality, Management and Physiology; Soil Characterization and Land Use; Basic Soil Science (with major emphasis in Soil Chemistry). As these areas of excellence become known internationally, both foreign and American students will benefit and awareness and interest in international assignments and careers will increase. Only 10% of the expenditures have been utilized to meet this objective.

E. Encouraging youth to seek training leading to careers in international agriculture.

The target here is to have students adequately trained and capable of employment in international agriculture. This has been accomplished through seminars, course work, advisement and specialized training. Students not finding international opportunities must be capable of accepting similar employment in the States.

The number of students interested in international employment continues to exceed the demand. The student is still informed that more is needed than desire for international work. One needs an applied background, experience and a speciality. Interim employment for on-the-job experience may be required.

Because of the need for overseas experience, students may be encouraged to seek their first international employment in volunteer organizations. The 211(d) professor has been continuously available for student advisement. A major problem is the need for a clearing house to list international opportunities and a lack of a continuous, consistent manpower need. Ten percent of the expenditures were used to meet this objective.

## IV. IMPACT OF GRANT ON THE UNIVERSITY

The major impact of this grant has been felt within the Agronomy Department. It has significantly improved our international teaching and advising capabilities. Undergraduates are exposed to many international crops and soils problems. International agronomy graduate students have been assigned appropriate applied problems.

Research specialists are available for a wide range of international assignments and consulting jobs. This has not been confined to the area of grain and forage crop production. Specialists have also worked in corn and alfalfa improvement, soil resources and land use management, soil analysis and fertility, crop quality analysis, weed control, crop ecology and physiology, and soil and water management.

The end of this project funding, will signal the end of the full-time position for the professor of international agronomy. Administrative details will become the responsibility of the Department Head and Coordinator of International Agricultural Programs. The former 211(d) professor is expected to continue to teach and advise international students. His total efforts will be greatly reduced, however, as he will be working primarily on research problems involving agriculture in Pennsylvania.

Funding from international sources will be sought in two specialized areas of Agronomy. Both the soil resource management and forage quality areas have been partially internationalized with help from this project. Their future potential international use appears extremely promising.

The need for cooperation with other U.S. institutions has been realized in our College of Agriculture projects in India, Argentina, Uruguay, and The Bahamas. The greater the number of institutions involved, the greater the number of productive new ideas. Recruitment of specialists from associated institutions is not difficult as they are already familiar with the programs being conducted.

The active participation of agronomists in international programs also has a stimulating effect on other disciplines within the College. Few problems can be solved by an agronomist alone. The willingness to take the leadership role and work with associates in other departments, has also encouraged cooperation on domestic projects.

The flexibility of programs cannot be overlooked. The India and Argentina contracts have been terminated. New involvement must always be under consideration if we are to maintain a continuous international program. Diverse funding would be desirable. The stability of programs should receive greater importance when considering future projects.

Student training should be part of The University's future projects. Problems conducted in a foreign nation must not be a project of interest only to the student and his major professors. Local country support is essential. It is doubtful if international training can be designed without some risk of the work being suspended, but when conducted within a viable university program, problems should be minimized. Non-degreeprograms appear to have the most promise.

The experience gained through the work promoted by this grant has been very valuable. The 211(d) professor and students have been called upon to do many tasks that could not have been considered without this type of support. The placement of these funds within the Department of Agronomy has had an effect on all College programs. With this support removed, its value is expected to become more evidenced in the future. The greatest spinoff from this project is most noticeable at University Park. Cooperation within and among academic departments has been fostered. The need for cooperative programs has become recognized by research, teaching, and extension personnel.

While work in this project has been department based and administratively controlled, it has had the continuous support of the Coordinator of International Agricultural Programs. This arrangement has proved very satisfactory in administering funds and providing the administrative controls and reviews necessary in the project.

## V. UTILIZATION OF INSTITUTIONAL RESOURCES IN DEVELOPMENT

Because of the expertise developed within the Department through international assignments and study made possible by the grant, the Agronomy Department has been in a position to assume major roles in three of five of the College of Agriculture's recent international contracts. Crop production was the major subject matter area in the Indian and Argentinian contracts. Forage and grain production, alongwith soil and water management are vital to our Bahamian program.

The activities supported by this grant, i.e. seminars, student advisement, graduate study, etc., have helped to promote an interest in international development through the College. U.S. graduates are making major contributions in Rockefeller and Ford Foundation Projects. Extensive use has been made of our soil analyses and forage quality facilities. Departmental facilities are often supplemented by those of the USDA Regional Pasture Laboratory located at University Park.

In the future, contributions to international programs within the agronomic area could be increased because of the continued interest within the Department. This must not be at the expense of domestic programs. The international involvement should be self-supporting when possible.

The Pennsylvania State University has supplied the facilities as well as supervisory, technical, clerical and accounting services required by the project. It has encouraged faculty and students not assigned to this project or paid from other international contracts to contribute time freely to international projects. The Agronomy Department at PSU has been assisted by the contributions of professional associates in other nations or that of cooperating institutions. It is hoped that the Indian-American as well as the Bahamian-American associations can be maintained.

## VI. INSTITUTIONAL RESPONSE CAPABILITIES

Requests for assistance in the agricultural sciences from The Pennsylvania State University should be directed to the Coordinator of International Agricultural Programs, 240 Agricultural Administration Building, University Park, PA 16802. The Coordinator will determine the interest of the departments involved and the personnel available. A rapid response can be expected.

Students wishing to study at The University should apply through the usual route (Director of Graduate Admissions). Copies of correspondence can be sent to the Coordinator of International Agricultural Programs and the Head of the Academic Department involved. Students with outside funding (public or private) should be advised to determine the interest and expertise in their area of speciality at PSU. A limited number of PSU supported assistantships are also available. Contacts by past cooperators from former sister institutions, previously involved in PSU contracts, would be extremely beneficial for prospective candidates.

International visitors are always welcome at PSU. Contact can be made with International Agricultural Programs Office or with any associate at the University. Special programs are often arranged. When possible, the visitor is requested to present a seminar in his area of expertise.

Graduates of this institution are taking an increasing interest in agricultural development. This is true of the foreign graduate student as well as US graduates interested in foreign service or research and development. This project has helped to expand this type of involvement. Research without development will often not provide the end result required in a developing nation.

The Pennsylvania State University has active cooperative international programs with Michigan State University, Texas A & M, and the Western Institute of Science and Technology. CUSURDI relationships are still maintained with Illinois, Kansas State, Ohio State, Tennessee and Missouri. Several informal relationships are maintained between PSU and other land-grant universities.

Informal relationships have been maintained between PSU and our sister institutions in India, The Bahamas and other nations. The relationships have been established through past involvement in contracts or through former students, both foreign and American, employed at institutions throughout the world. This has been of major value in evaluating student records and making recommendations, providing a contact for traveling scientists, and serving as a sounding board for determining needs of a nation or region. These linkages are not easy to maintain except on a personal basis. This often becomes the

responsibility of a single individual or family. A continuous active program, funded both in the developing nation and the U.S. institution, is needed to maintain productive linkages. It is hoped this can be further developed with new funding in the future.

The international capabilities developed will be utilized in several diverse ways in the future. The Agronomy Department will be readily available to support international agricultural programs developed through The Pennsylvania State University. Faculty-student groups will be encouraged to seek international support for proposed programs. Short-term involvement of staff in international programs will be sought whenever a need exists. Foreign and American students committed to work in developing nations in research and/or development will be encouraged to study and be supported at The Pennsylvania State University in appropriate areas of their interest whenever possible. All students will be able to familiarize themselves with the importance, needs, and problems of the third world. Greater utilization of both staff and facilities is predicted.

## VII. PERSONNEL AND PUBLICATIONS

Soon after this project was initiated in June of 1968, Dr. Robert P. Pfeifer, Associate Professor of Small Grains Breeding, of the University Faculty, was assigned as the project leader. Following his first trip to India in the fall of that year, he resigned the position (February 14, 1969) to return to his former teaching and research assignments at University Park.

Following a national search for a project leader, Dr. Richard H. Cole, Associate Professor of Crop Science at the University of Delaware, was selected as project leader (January 1, 1970). He was formerly Assistant Professor of Agronomy and, for a three-year period, Chairman of the Department of Agronomy and Agricultural Engineering at Delaware. His past experience included teaching the basic courses in Crop Production, Plant Breeding and Crop Ecology. A portion of his work involved the advisement of eleven graduate students. Dr. Cole's research included projects in Soybean Breeding and Development, Corn Improvement, Soybean Seed Quality, Corn and Soybean Management, and Weed Ecology and Control of Weeds in Corn and Soybeans. When offered the position, he was on leave, working on a special assignment with Geigy Agricultural Chemicals.

Following the awarding of the grant, a national and international search for qualified American graduate students was conducted by the Agronomy Department through its national societies. The students employed and paid through 211(d) project funds were as follows:

1. Dr. Michael L. Colegrove (completed Ph.D.) Formerly with Peace Corps in Africa. Dr. Dale E. Baker (Soil Chemist)-Thesis Advisor. Employed as Soil Scientist in Ecuador following graduation. Presently with Ford-Rockefeller in Tanzania.

2. Dr. Wayne L. Haag (Completed Ph.D.) Formerly with Peace Corps in Latin America and Michigan State International Graduate Study in Costa Rica. Dr. Richard R. Hill (Plant Breeder)-Thesis Advisor. Employed as Corn Breeder by CYMMYT following graduation. Presently project leader in same project in Egypt.

3. Mr. James Bergman (Completed M.Ag. requirements but not final paper). Formerly Special Forces (U.S. Army) Vietnam. Dr. John B. Washko (Forage Management)-Advisor. Employed as Area Extention Specialist. Offered but did not accept international assignments. Presently vocational agricultural teacher in Miami area.

4. Mr. A. David Wilson (Completed Ph.D. requirements but did not submit thesis). Formerly Peace Corps in India and with Montana State University Graduate Study in Afghanistan. Dr. Gary W. Petersen (Soil Resources)-Advisor. Presently farm operator in Montana.

5. Mr. J. Harold Stern (Completed M.S. and working on Ph.D.) Formerly Christian Farm Mission Work in Africa. Dr. Robert L. Cunningham (Soil Resources)-Thesis Advisor. Presently Research Assistant in the Bahamas Project.

6. Ms. Sandra Russo (working on M.S.) Formerly international teaching in Latin America. Dr. John S. Shenk-(Crop Quality) Thesis Advisor. Presently Graduate Assistant at University Park.

The students that have been associated with the International Agronomy Project, but did not receive 211(d) funds, were as follows:

1. Mr. Ronald F. Guyton (working on Ph.D.) Formerly Scientific Aide at University Park. Dr. John B. Washko (Forage Management)-Thesis Advisor. Presently Research Assistant in the Bahamas Project.

2. Mr. Robert Rosenblum (qualifying for M.S.) Formerly Peace Corps in Africa. Dr. Richard H. Cole (Crop Management)-Advisor. Presently in Law School.

Six Indian students have been involved over the life of the project. Dr. D.S. Chaugale completed his Ph.D. in Plant Breeding (Dr. Harold G. Marshall, Advisor) and is presently Head of the Department of Botany at Kokan University, Dapoli, Maharashtra State. Dr. S. N. Desai is leader of a national forage project at Mahatma Phule University in Rahuri. His Ph.D. work at University Park was under the direction of Dr. John B. Washko. Both B. B. Patil and R. B. Somawanshi completed a major portion of their course work at PSU and conducted their Ph.D. thesis work at IARI in India. Two non-participants are presently studying for their Ph.D.'s in the Agronomy Department with local funding, Himanshu Pandya and S. G. Setty.

Several students from other developing nations have received or are receiving training at University Park. The major objective is to train them for work in their home country. No participants were involved in our agronomy program in Argentina. Two Bahamian students are or will soon be working toward undergraduate degrees in Agronomy.

The usual effort was made to recruit U.S. citizen minority personnel and women to the project. To our knowledge, there were no Black Americans, Spanish Americans, American Indians or American Orientals who applied for work on the project. One woman was supported by project funds. In the future, similar

international projects should make a special effort (such as a recruiting trip) to find such individuals. Since a personal interview may be necessary to determine if a male applicant is a member of such an ethnic group, this practice should be followed in the future.

Several PSU faculty and students received international travel support from 211(d) funds. The project leader, Dr. Richard H. Cole was in India on four tours of up to two months. Drs. Robert L. Cunningham (Soil Resources) and Roy G. Creech (Corn Improvement) were both involved in project work in India. Dr. Cunningham continues as an active PSU student advisor at PSU, while Dr. Creech is Head of the Department of Agronomy at Mississippi State University. Drs. Robert Cunningham and Roger Pennock, Jr. (a former advisor on the production team in India) were sent on a soil resource study trip to Mexico and the Bahamas. A forage quality tour to Central America was supported for Dr. John S. Shenk, Leader of our Crop Quality Group. Two students (Colegrove and Haag) studied in India on project funds.

The members of the PSU agronomy faculty that have worked or studied in India on contract or their own funds include Dr. Roger Pennock, Jr. (Soil and Water Management, 5 year term), Dr. Clarence Bryner (Crop and Seed Improvement, 2 year term), Dr. John B. Washko (Forage Management), Dr. John E. Baylor (Forage Management), and Dr. Walter I. Thomas (Research Administration).

Indian faculty from Maharashtra State intimately involved in the 211(d) work include Drs. V. S. Khuspe (Agronomy Graduate Study), N. D. Patil (Soil Science), B. D. Khot (Crop Science), and P. N. Kalbhor (Crop Science - the 211(d) professor's immediate associate). Not enough can be written about the help obtained from those participating. The involvement of Rajat De, IARI - Delhi, was also appreciated.

The PSU faculty involved in the Argentine program include Dr. James L. Starling (Department Head and Program Coordinator), Dr. David P. Knievel (2 year assignment in Crop Physiology), Dr. Albert S. Hunter (1 year assignment in Soil Fertility) and short termers Drs. Robert Cunningham, Richard Hill, Nathan Hartwig and Guy McKee. Faculty members prepared to participate but not utilized in the program included Drs. Gerald Jung, Gary Petersen and John Washko.

Faculty members presently involved in the Bahamas program are Prof. James H. Eakin (Head of Agronomy Extension Section, Discipline Coordinator of Agronomy), Dr. John E. Baylor (Forage Specialist) and Dr. Willis L. McClellan (Crop Production Specialist). Ronald Guyton and J. Harold Stern, Research Assistants, are both serving on two-year contracts at Andros Island.

One cannot go through this exercise without missing the names of several of our faculty that have performed minor roles but made major contributions. These are also some who have had roles that have not been talked about in detail. For example, Dr. Baker, Dr. Shenk, Dr. Hill, Dr. McKee, Dr. Cunningham, Dr. Petersen and others have made their laboratories continuously available for international analyses. Faculty of sister departments have provided many services as needed and when requested. Because of our interest in international seminars, faculty with international visitors have encouraged their participation

while at the campus. Travel programs, such as those by Dr. Henry R. Fortmann and family (Regional Research Director), were reported and enthusiastically received by the staff and students.

Of the two P's in this section, the emphasis has been on personnel. The other P, publications, equally important in the scientific community, did not receive as much attention as desired in such a project.

The reports available, other than the annual 211(d) reports, are as follows:

1. Colegrove, M. L. 1971. Soil tests to relate responses of grain sorghum to superphosphate treatments on a calcareous Indian soil. Ph.D. Thesis. Pennsylvania State University. 62 p.

2. Haag, W. L. 1973. A comparison of selection methods for disease resistance in alfalfa. Ph.D. Thesis. Pennsylvania State University. 54 p.

3. Stern, J. H. 1973. The effect of median and trickle irrigation - fertilizer regime on the growth of chrysanthemum. M. Thesis. Pennsylvania State University. 39 p.

4. Stern, J. H., J. W. White, R. L. Cunningham and R. H. Cole. 1973. Trickle irrigation of media effects on growth of Chrysanthemum morifolium Ramat. Int. Soc. Hort. Sci. 38:1975-1982.

5. Hill, Jr., R. R. and W. L. Haag. 1974. Comparison of selection methods for autotetraploids. I. Theoretical. Crop Sci. 14:587-590.

6. Haag, W. L. and R. Hill, Jr. 1974. Comparison of selection methods for autotetraploids. II. Selection for disease resistance in alfalfa. Crop Sci. 14:591-593.

7. Stern, J. H., J. W. White, R. L. Cunningham and R. H. Cole. 1975. Relationship among irrigation-media regimes and plant growth. Plant and Soil 43:433-441.

## VIII. BUDGET AND EXPENDITURES

The budgets and expenditures for the project are reported in Table 1. The project expenditures for salary and wages were about as projected in the initial budget. With the change of emphasis to more graduate student support, and more student and faculty travel, expenditures in the other budget categories were best projected in the revised budgets established after costs were known and the program revised. About 72% of the expenditures were for salaries and wages and 17% for travel and transportation. Only 11% was spent for equipment, supplies and other direct costs.

As can be easily seen, the emphasis in the project was on program and people, and not equipment and facilities. This was as planned and in keeping with the spirit of the grant. It is estimated that about equal financing was required and furnished by the University as supporting funds.

Table 1. Initial and revised budgets, and expenditures for the 211(d) International Agronomy Project at The Pennsylvania State University.

| Category | Initial Budget | Revised Budget | Project Expenditures |
|---|---|---|---|
| Salary and Wages | $146,000.00 | $144,057.13 | $143,894.09 |
| Travel and Transportation | 21,000.00 | 34,320.46 | 33,103.68 |
| Equipment and Supplies | 22,000.00 | 14,827.61 | 14,416.75 |
| Other Direct Costs | 11,000.00 | 6,794.80 | 8,585.48 |
| Totals | $200,000.00 | $200,000.00 | $200,000.00 |

## IX. PLAN FOR THE FUTURE

There is very little likelihood that the position of Professor of International Agronomy will or should be continued upon completion of this granting period. State funds are available to keep the instructional phases active. If federal funds become available at a later date, they might best be utilized to internationalize other departments, support interdisciplinary projects involving several professors, or internationalize areas of expertise within a college department.

The director of this project served more as a coordinator than as a project leader. The Agronomy Department, before this grant was awarded, was not committed to support international programs. The Department had to be internationalized. With this phase passed, we would now be interested in expanding our areas of expertise in the soil resources and forage quality disciplines. We would also be interested in being included in an interdisciplinary project involving scientists from several college departments. Because of our past experiences, we hope to continue to be involved in the future.

Experience has improved our international student instruction and advisement. These aspects will both continue to improve as we gain more experience in the future. Experience has improved our consulting abilities. The Department will look with interest to programs that utilize our areas of expertise and faculty strength.

Future programs will be generated through the usual departmental processes with the assistance of the Department Head, Coordinator for International Agricultural Programs, and the College and University Administration.