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THE PENNSYLVANIA STATE UNIVERSITY

COLLEGE OF AGRICULTURE

AGRONOMY DEPARTMENT

ANNUAL TECHNICAL REPORT OF 211(d) PROJECT

1971 - 1972

211(d) Annual Report

Date September 1, 1972

Title: Crop Production in India

Grantee: The Pennsylvania State University, University Park, Pa. 16802

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

A. Statistical Summary:

Grant Period June 1, 1968 to May 31, 1975 Grant Amount $200,000.00
Expenditures for Report Year $47,930.21 Accumulated $116,738.19
Anticipated for Next Year $44,000.00

B. Narrative Summary:

Program funds have been utilized to promote the international interests in the Agronomy Department at The Pennsylvania State University and enable it to become the most internationally involved department in the College of Agriculture. Encouraged by the agronomy faculty, cooperating Penn State faculty and administrators, international agronomy students, participants in our Indian programs, and our Indian counterparts, the project has developed to the point where the international agronomic aspects of our teaching and research programs are receiving major emphasis. While problems related to Indian agricultural development have received priority, problems of other developing nations have been given significant attention. International policies have been developed and future areas of specialization identified.

Staff involvement, both faculty and student, and attitude change have been the major keys. Long-term and short-term international work; cooperative, continuous programs; stimulating discussion and seminar sessions; timely student advisement assistance; improved teaching and curriculum; program expansion; proper selection and availability of competent staff; priority evaluation; good relationships with cooperators; and home campus support have all contributed. Success in the future will be dependent on follow-through of the present work, thorough re-evaluations, and timely published materials. Greater total University effort will strengthen our program.

A continuation of our Indian program and an expansion of our Argentina program in international agronomy is essential. Excellent faculty support is expected in future years. The drastic curtailment of the total program in India and the restriction on graduate student participation will make accomplishments more difficult to obtain this project year. Plans for work in countries other than India will be dependent on the cooperation in and results of the 1972-73 project year. Use of funds to establish international areas of excellence in Agronomy at The Pennsylvania State University to attack future crop production problems in India and other developing nations was apparently justified and should serve as an example of how to commit similar educational funds in the future.

I. GENERAL BACKGROUND AND PURPOSE OF THE GRANT

This project is one of six being conducted by the universities which are coordinating their efforts in India through CUSURDI (the Council of United States 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 has been encouraged and joint reviews of work plans and progress has been 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 in India." This has proved to be an excellent area of specialization because it has been 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 are as follows:

1. To increase interest in and knowledge about the agricultural problems of India 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;

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.

For the past two years, emphasis has been placed upon objectives 1, 2 and 4. In regard to objective 3, graduate students with past international experience have been assigned applied problems that would be relevant in India or other developing nations. Their research, however, has usually not been conducted primarily in the host country. This has proved acceptable to potential employers. Youth have been encouraged to seek training leading to careers in international agriculture (objective 5) through counseling and expanding the use of international examples in our agronomy courses. A significantly greater percentage of students would be interested if adequate employment were available for B.S. and M.S. graduates.

The initial area of specialization of this project was food grain crop and seed production. Considering the competencies of our staff and the problems encountered in the rain-fed areas of Maharashtra where cooperative work was established, it appeared desirable not to limit our interest to food crops or to concentrate on seed problems that were already being studied by local agencies. Emphasis was placed on the crops presently or potentially important in the cooperative work area, including forage crops. The characterization of soil, a basic first step in improving production, was also given primary consideration.

III. ACCOMPLISHMENTS

A. Increasing interest in and knowledge about the agricultural problems of India and improving the capabilities of P.S.U. to become associated with international programs in crop production.

Contact with international students, direct involvement of faculty members, and special seminars have all played an important role. The faculty have graciously served as chairmen of graduate student committees and committee members. An effort has been made to see that all faculty are properly placed on committees. Three faculty members have been directly involved with tours in India this past year. Others have been involved as a result of their contact with students. A special seminar on Argentina was conducted during the Spring term of 1972. Those in attendance were often the same ones that had shown an interest in our Indian Agriculture seminars. An estimated 30% of the year's 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 U.S.

Both students and faculty have been encouraged in seminars, regular classes and counseling to study methods of development outside their home country. This area has shown steady improvement since the initiation of this project. One student has graduated and is now working in Mexico. Seventy-five percent of the faculty are available and would consider an international appointment. Approximately 20% of the year's expenditures have been used to meet this objective.

C. Providing opportunity for graduate students to obtain research experience in crop production involving problems relevant to India.

While involving 25% of this year's expenditures, this objective has been receiving less prominence as the project has progressed. Six American students have been involved this past year. The future involvement of students will depend primarily on the increased involvement of the faculty. Long-term, continuous programs are needed. One student study tour was planned and the results of his experiences will be reported in the next annual report.

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

This objective is difficult to separate from the first two objectives. Awareness and interest has been encouraged by expanding our programs in India and Argentina. While the faculty are primarily interested in Penn State programs, students are interested in career assignments. About 15% of this year's expenditures were used directly to accomplish this objective.

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

Very few graduate students have considered international employment unless they were already interested when accepted as a student. They often find themselves too specialized when they consider the opportunities

available to them. Only one Ph.D. candidate, not committed when accepted as a candidate, has decided to work in international agriculture upon completing his degree requirements. This work was primarily accomplished by personal counseling and involved about 10% of the year's expenditures.

IV. IMPACT OF GRANT

A. Development of Teaching Competence

The international teaching competence of the faculty in the Agronomy Department continues to improve because of the increased involvement of the staff in international programs. Ten faculty members accepted international assignments in 1971-72, with seven involved partially or wholly in an assignment in India. Discussion of crops and soils problems, found in developing countries throughout the world, are common in many courses.

The revision of the agronomy curriculum has been completed with virtually 100% approval of the faculty. The 211(d) professor was privileged to be a member of the curriculum revision committee. Undergraduate students from this major will be better qualified to handle international assignments or study international agriculture at the post-graduate level than previous majors.

Because of the inclusion of several of the aspects of international agronomy into the existing courses, the present thinking of the faculty is not to organize new courses specifically for students with an international interest. A single course in international agronomy available to both upper-level undergraduates and graduate students has been suggested and is expected to be considered in 1972-73. The election of this course, as well as other international courses at the University, and involvement in the international seminar for students and faculty should be sufficient to expand the international interest of students that are considering international careers.

B. Development of Research Competence

An effort has been made to significantly expand the international competence in two agronomic subject matter areas of excellence at the University in 1971-72. The forage crop improvement and management area has been expanded by the involvement of Dr. J. B. Washko in a special assignment for our AUD team in Maharashtra State. His evaluations were particularly relevant since one of the Indian participants assigned to him as a student is scheduled to return to India in the spring of 1973. Dr. J. S. Shenk has studied forage quality problems in Central America and has established cooperative relationships with scientists in several countries. The 211(d) professor and one student have initiated preliminary forage evaluation and studied likely seed programs in India.

Dr. Roger Pennock is returning to his regularly assigned position in soil characterization in August of 1972 after a five-year assignment in India. His assistance in establishing a cooperative proposal with Mahatma Phule Agricultural University, the Maharashtra Department of Agriculture, and The Pennsylvania State University was extremely helpful

to Dr. R. L. Cunningham, one of the 211(d) student advisors. While an American student cannot be involved in this project at this time, it is hoped that this work can be continued with the cooperation of the Indian faculty and students, and our Penn State soil characterization faculty.

Interest continues to exist in several supporting areas. A residual phosphorus test continues to be conducted in India with the helpful advice of Dr. D. E. Baker, advisor of one of our 211(d) Ph.D. graduates. A continued interest in the seed programs has been maintained by the 211(d) professor after the resignation of the APP Seed Specialist in January of 1972. Seed production in Maharashtra has grown from an acreage of 8,000 in 1970-71, to 26,000 in 1971-72, to an indicated 43,000 in 1972-73. Maharashtra's interest in the maize germ plasm being developed at Penn State was substantiated by Dr. R. G. Creech's trip to India in November of 1971. Requests have been obtained for dent corn, sweet corn, pop corn, special purpose maize, and genetic marker materials. Cooperative soybean work is being coordinated by the 211(d) professor and students.

One 211(d) thesis was completed in 1971-72. Thesis advisor for the study was Dr. D. E. Baker, Professor of Soil Chemistry. The title of the thesis submitted by Dr. Michael L. Colegrove was as follows: Soil test to relate responses of grain sorghum to superphosphate treatments on a calcareous Indian soil, Ph.D. thesis, The Pennsylvania State University, December, 1971, 62 pages. An abstract is attached.

C. Training of Graduate Students

Six American graduate students committed to contribute their professional careers to international agronomy have been advised by the 211(d) professor in 1971-72. All except one of the students have worked at least three years in international assignments. Each has a co-advisor on the agronomy faculty primarily responsible for his research training.

Dr. Michael L. Colegrove worked as a consultant for a 6-month period following his December graduation with Sptan-Aero Ltd. in Ecuador. His duties involved the completion of a land use inventory of over one million acres in the Guayas River Basin. He is presently employed by the Rockefeller Foundation in Mexico.

Wayne L. Haag will complete a three-month work trip in India this September and expects to be employed by the Rockefeller Foundation by January 1, 1973.

Because of the present travel restrictions, Mr. A. David Wilson will not go to India this fall as planned. He has been assigned an alternate thesis problem in remote sensing. This is expected to help us expand the area of excellence in soil characterization. A fourth student totally supported by the 211(d) grant, J. Harold Stern, is studying water usage in international soils. He plans to complete the M.S. in March of 1973. Two other American students are continuing their work on other University funds. One of these students expects to be involved in a project in India for a 12- to 18-month period beginning about September, 1973.

The 211(d) professor also assisted with the advisement of 4 Indian participants in 1971-72. The Indian students and 4 other international students are being prepared to return to specific positions in their home nations.

D. Development of Competence for Consultation Services

Because of the international involvement of a large number of the faculty and graduate students and a few undergraduate students, the Agronomy Department continues to become better prepared to consider international assignments in many areas of interest. The forage crop improvement and management, and soil characterization areas continue to be the most likely for future significant international involvement.

Dr. C. S. Bryner, Extension Agronomist, has studied extension education in South Asia and the Near East during this last year. Two faculty members, Dr. D. P. Knievel and Dr. A. S. Hunter, are presently assigned to our education project in crop production in Argentina. Several short-term assignments have been filled for next year.

The international agronomy seminar has featured a study of the agriculture in Argentina, as well as having a full semester session on Indian agronomic problems.

The interests of our faculty were documented in a 1972 survey. About 75% of the agronomy faculty has indicated a definite interest in an international assignment in the future. This compares to an estimate of 10% in 1968. The greatest interest lies in future programs in Latin America. Spanish speaking countries are preferred. A majority wish to continue programs in India. The international agronomy family seminar has helped families become interested in our programs. A team effort by the Penn State faculty is preferred over individual contracts. While interest is at a high level, present programs must be continued until productive results are obtained when possible.

E. Relationships with other CUSURDI Universities

Because each 211(d) project is in different project areas and the uniqueness of the dry-farming area of Maharashtra, interaction among universities has been somewhat minimized.

Soybeans for project use in India were obtained from the University of Illinois at Urbana and Jabalpur. Project reports from the Illinois team in India have proved helpful. Cooperating Indian pathologists have communicated among states. This has involved an associate of Dr. Sinclair's, the 211(d) professor from Illinois. Dr. Poehlman's (Missouri) mungbean report has been called to the attention of Indian cooperators in Maharashtra. Several useful abstracts have been received from Dr. Brown (Tennessee). One agricultural statistical report was extensively used by the agronomy faculty. Several unofficial meetings were arranged with Dr. Arscott's students at Ohio. Dr. Lineback's cooperative grain quality work is well-inown in Maharashtra.

Penn State will be in a position to make a major contribution within a two-year period. The soil test - phosphorus work will be completed this karif season. The contribution of the maize germ plasm to the

Indian project is still unknown. The forage crop and soil characterization projects have just been initiated.

While not supported by 211(d) funds, Dr. Roger Pennock's APP work in soil salinity and soil moisture have contributed significantly to other projects in India. Several scientists and 211(d) students have visited the laboratories in Maharashtra. Contributions from projects of this nature are difficult to evaluate, but may become extremely significant in the future.

V. INTERNATIONAL PROGRAMS OF THE UNIVERSITY

The international work at The Pennsylvania State University is being coordinated by a newly reorganized University Committee on International Programs. This committee plans to encourage and develop programs among colleges. Members of the committee are optimistic that the programs presently being considered will be funded at an early date.

Programs in International Agriculture are presently being conducted in India, Spain and Argentina. The program in India has involved faculty from most of the departments in the College of Agriculture. In Spain, the project is in agricultural marketing involving scientists from the Agricultural Economics Department. A program in Uruguay in fruit and vegetable production is being planned with the support of the Horticulture Department. The College is cooperating with Argentina with educational programs in agricultural extension and crop production.

The Agronomy Department has taken primary responsibility in the operations of the AID supported 211(d) program in India and the Argentina programs in the crop production areas. Several faculty members have also worked in the USAID contract programs in India. Faculty and student interest in this involvement has been gratifying. An effort will be made to keep participation at a high level in future years.

VI. UNIVERSITY RESOURCES IN THE 211(d) PROGRAM

The Pennsylvania State University has provided the office, laboratory, greenhouse and field facilities as well as the supervisory, clerical and accounting services required by the project. It has also encouraged faculty not assigned to the project to contribute time freely to all aspects of the program. As the project has expanded, so has the assistance from the University increased substantially. The objectives of the project have been mutually compatible with the needs and objectives of the Agronomy Department.

The magnitude of the support from departmental funds can be seen in the estimates provided in Table 1. While 211(d) funds have been utilized to organize programs and promote international research, other funds have contributed substantially to all areas. Outside funds provided major contributions in the international teaching and consulting areas.

It should be pointed out that there has also been a substantial contribution by cooperating universities in the state of Maharashtra. Faculties of these universities have worked without questions with the four professors directly involved in 211(d) work in Maharashtra. Research facilities have been made available whenever they have been requested.

All this has been possible by the American and Indian faculty and students' sincere interest in mutually studying the crop production problems in the rain-fed areas of Maharashtra. It is anticipated that this interest will be easily maintained and the contributions continued throughout the granting period.

Table 1. Distribution of 211(d) funds and estimated contributions from other sources of funding for the period June 1, 1971 through May 31, 1972.

Activities	211(d) Funds	Non 211(d) Funding
International Teaching	$ 3,834.42	$ 5,000.00
Student Advising	7,189.53	3,000.00
International Research	11,982.55	1,250.00
International Service	7,189.53	3,750.00
International Consulting	3,355.11	5,000.00
Program Organization	11,982.55	3,000.00
Other	2,396.52	4,000.00
Total	$47,930.21	$25,000.00

VII. EXPENDITURES

The budget and expenditures for the project are reported in Table 2. Total project expenditures to date are approximately 58% of the total budget to be spent over the seven granting years. As can be seen, about 24% of this total budget was committed during the 1971-72 fiscal year.

Salaries and wages expended in 1971-72 include the full salary of the 211(d) professor (Dr. Richard H. Cole) and the salaries of five 211(d) graduate assistants. Dr. Michael L. Colegrove has graduated and Mr. James D. Bergman is continuing his work without financial assistance from the University. Assistantships are still provided for Mr. Wayne L. Haag and Mr. A. David Wilson. One new student with 5 1/2 years international experience, Mr. J. Harold Stern, was assigned to the program in January of 1972. Wages were also paid undergraduate students for part-time direct assistance of the 211(d) professor and students.

Travel and transportation costs have been much greater than predicted in the original budget. Three trips were made to India by the Penn State faculty during 1971-72 and one 211(d) student's trip was approved during this period. Dr. Richard H. Cole was in Maharashtra in May and June of 1972 at a project cost of $1,413.56 above travel expenses. His major contributions involved establishing research with alfalfa, soybeans, maize ans sorghum, and making final arrangements for future 211(d) students. Dr. Robert L. Cunningham studied the level of soil characterization technology in Maharashtra and prepared a proposal for study of a 211(d) student in Mahatma Phule Agricultural University. He also stopped for a two-day visit at the International Soil Characterization Laboratory in Bangkok. Total cost of this September 7 through October 10 trip excluding travel was $518.15. Dr. Roy G. Creech visited the plant breeders and seed industry in Maharashtra in the month of November to determine their interest in developing special purpose maizes for nutritional and industrial uses. Germ plasm has been forwarded from Penn State's corn programs. Cost excluding travel was $519.59.

Equipment purchased in 1970-71 costing in excess of $100.00 included a soybean-sorghum thresher manufactured by the Swanson Machine Company of Champlain, Illinois. Total cost was $2,443.50. This was required to thresh the crop production test materials being grown by the 211(d) graduate assistants. The remaining equipment and supply funds were required to support the research programs of the 211(d) staff.

Major items in the other direct cost category were graduate assistantship fees and computer usage costs.

Table 2. Budget and Expenditures for the 211(d) International Agronomy Project at The Pennsylvania State University.

Category	Original Five-Year Budget	Revised Seven-Year Budget	Total Project Expenditures To Date	Expenditures 6/1/71-5/31/72
Salary & Wages	$146,000.00	$136,500.00	$ 80,479.63	$32,638.23
Travel & Transportation	21,000.00	44,500.00	13,815.69	2,803.90
Travel Not Charged to Date (estimated)			11,500.00	5,500.00
Equipment & Supplies	22,000.00	13,000.00	8,226.09	5,005.31
Other Direct Costs	11,000.00	6,000.00	2,716.78	1,982.77
Totals	$200,000.00	$200,000.00	$116,738.19	$47,930.21

VIII. WORK PLAN & BUDGET FOR 1972-73

The proposed budget for the next fiscal year is as follows:

Category	1972-73 Budget
Salaries & Wages	$29,000.00
Travel & Transportation	11,000.00
Equipment & Supplies	2,500.00
Other Direct Costs	1,500.00
	$44,000.00

Under the present unsettled conditions between the United States and India it is difficult to provide a firm budget for the 1972-73 fiscal year. Since none of the 211(d) students will be permanently assigned in India during this period, and one student is expected to complete his degree by mid-year, the total budget is expected to be below last year's expenditures.

Short-term travel to India will be requested for several professors in the Department. The 211(d) professor, Dr. R. H. Cole, is expected to be in Maharashtra during January and February of 1973 to meet previous commitments and promote future work. Dr. D. E. Baker, advisor of a past 211(d) student, will present the results of this phosphorus work in India and the soil and plant analysis results obtained in the states on his visit in February. If facilities are completed, the proposed soil characterization laboratory adequately staffed, and maps of the Rahuri area made available, Dr. G. W. Petersen will go to Maharashtra in January or February to help implement a joint proposal that has been developed among Penn State, MPKV and the Maharashtra Department of Agriculture.

Other travel that will be requested in future years includes a return tour by Dr. R. L. Cunningham to assist with the characterization - land use phase of the proposed cooperative work. Dr. R. R. Hill, alfalfa breeding specialist, has consented to come to Maharashtra as soon as the forage breeding post is staffed, an official request for assistance has been obtained, and the work has progressed to a point where his efforts can be utilized. Co-workers in India have also requested that we consider returning Dr. R. Pennock, a five-year team member in Poona, to assist MPKV in establishing their soil moisture research laboratory when it is completed. Dr. J. S. Shenk has indicated an interest in cooperating with the Indian scientists involved in crop quality research. Faculty from all the Agricultural Universities in Maharashtra have indicated a desire to consider proposals of cooperative work.

The 211(d) professor will continue to cooperate with his Indian counterparts in an effort to improve production in soybeans, maize, and forage crops (primarily alfalfa), and continue to encourage the rapid development of quality seed in the State. A 211(d) graduate assistant will be assigned in the fall of 1973 if permitted.

Since Indian participants will no longer be coming to the United States under our AID contract, departmental funds will be utilized to admit one student each year from Maharashtra. A similar agreement to the one presently in effect will be established so the student knows he will be given acceptable employment on his return to India. Transportation and some other assistance will be furnished by a Rupee fund developed by the professors in the agronomic area (Agronomy, Soil Science and Plant Breeding). Acceptance will be dependent upon approval of the participating departments and the university involved. An effort will be made to send those students that can be expected to expand new areas of speciality in Maharashtra.

Seminars, courses, and international program participation will be encouraged as in the past. Because of our recent involvement in Argentina, an effort will be made to study the agriculture of southern South America and learn to speak Spanish. Publication of papers and reports of international interest will be encouraged. A substantial proportion of Dr. Roger Pennock's time will be available for him to produce technical reports of his work in India.

One graduate assistant will complete his Ph.D. prior to January 1, 1973, after his return from India in September. Two others will be continuing their work throughout the 1972-73 fiscal year. Both continuing students have considerable international experience and will not be adversely affected by the present restraints on program participants. A fourth student, scheduled to be involved in the fall of 1973, would require long-term study in India. Final judgment on his involvement will be determined in the future.

IX. PLAN FOR THE SUBSEQUENT TWO YEARS

While the plan for 1972-73 is somewhat definite because of previous commitments, alternate plans are being made for subsequent years. If Penn State continues to have a major interest and has an opportunity to work in India, the 211(d) staff can be expected to cooperate with Indian scientists in the dry-farming areas of Maharashtra. This is an excellent location because the needs in the State correspond favorably with our areas of specialization in (a) forage crop improvement and management, and (b) soil characterization and land use. There are several scientists in both countries that have established an excellent mutual working relationship. Because this area of India has many of the problems common to the developing world, it is also an excellent location for students and faculty to become involved.

If Penn State will not be involved in future programs in India, an alternate Latin American country will be selected. The selection will be based on the likelihood of obtaining future cooperative agreements in that country and a considering of our areas of international specialization.

Greater emphasis will be placed on cooperative publication of results than in previous years. Faculty and students from the Agronomy Department who have worked in India can be expected to report significant results and pertinent observations. This effort will undoubtedly be reduced if a country change becomes necessary in the project.

The objectives of this project appear to be as sound today as they were when the proposal was accepted in 1968. Because of the late start at The Pennsylvania State University, the initial funds are apparently enough for a full program through the first six years of the granting period. In the seventh year, the final student funded by the project should be returning from India and a major effort will be made to evaluate the effects of the program on the faculty, students and administrative units involved. It can be expected that the Department will continue to be involved in international programs and the international professors of agronomy will be responsible to promote participation.

February, 1972

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Summary of the thesis by Michael L. Colegrove

"Soil tests to relate responses of grain sorghum to superphosphate treatments on a calcareous Indian soil"

This investigation was undertaken to study the response of sorghum to phosphorus (P) applications, and fixation and availability of P on a calcareous soil in India. Alternate soil analysis procedures were compared with the standard techniques utilized in India.

The Olson method, now in use in India, appeared to be a satisfactory technique for determining the availability of P in the Indian soil studied. Sorghum yield increases of about 70% were common with broadcast P application of 90 Kg./Ha. When extremely high rates were applied, yield increases were greater than 100%. Fixation in soils was rapid, however, indicating the need for seasonal applications. Future tests would likely be most productive when P is supplied in a band treatment adjacent to sorghum rows.

This work was supported by USAID in a grant to The Pennsylvania State University. The information and conclusions in the thesis do not necessarily reflect the position of AID or the U.S. Government. Advisors for this study were Dr. D. E. Baker, Professor of Soil Chemistry, and Dr. R. H. Cole, Associate Professor of International Agronomy.