

1. SUBJECT CLASSIFICATION	A. PRIMARY <b>Serials</b>	Y-AF00-0000-0000
	B. SECONDARY <b>Agriculture--Plant production</b>	

2. TITLE AND SUBTITLE  
 Soil, plant, water relations; annual report, 1972/1973

3. AUTHOR(S)  
 (101) Ohio State Univ. Dept. of Agronomy

4. DOCUMENT DATE 1973	5. NUMBER OF PAGES 8p.	6. ARC NUMBER ARC 631.4072.037
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7. REFERENCE ORGANIZATION NAME AND ADDRESS  
 Ohio State

8. SUPPLEMENTARY NOTES (*Sponsoring Organization, Publisher, Availability*)  
 (Activity summary)

9. ABSTRACT

10. CONTROL NUMBER PN-AAB-885	11. PRICE OF DOCUMENT
12. DESCRIPTORS Plant physiology	13. PROJECT NUMBER
	14. CONTRACT NUMBER CSD-1928 211(d)
	15. TYPE OF DOCUMENT

CSD-1928 211(d)

631.4072.037

PN-ARB-885

THE OHIO STATE UNIVERSITY

COLLEGE OF AGRICULTURE AND  
HOME ECONOMICS

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DEPARTMENT OF AGRONOMY

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ANNUAL TECHNICAL REPORT OF 211 (d) PROJECT

CONTRACT AID/csd - 1928

July 1, 1972-June 20, 1973

Supplementary material called for in the  
AID "Guidelines" appears on p 11.

Title: SOIL-PLANT-WATER RELATIONS

August, 1973

Grantee: Agronomy Dept., The Ohio State University, Columbus, Ohio

Director: Dr. Trevor G. Arscott

A. Statistical Summary:

Period of Grant: July 1, 1968 to July 1, 1973. Amount of Grant: \$200,000.

Expenditures for Report Year: \$31,811.35. Accumulated: \$162,953.68.

Anticipated for next year: \$28,355.

B. Narrative Summary:

- (1) Three research assistants assigned to India successfully completed their theses research in India. Two assistants were assigned to the Soils Dept., Punjab Agricultural University, and the third one was assigned to the Soils Dept. at Mysore University of Agricultural Sciences. Each assistant was actively engaged in mineral nutrition of plants, and two assistants conducted fieldplot experiments.

Two members of our resident faculty became significantly involved in research on soils from that country. Our soil mineralogist is investigating the clay mineralogy of some major soil categories of India soils; and our specialist in soil genesis is making certain physical and chemical analyses of these same soils. The information being obtained by these investigators is generally lacking on soils of the developing countries.

- (2) The most significant accomplishment during the grant has been the development of expertise and capability in international agriculture in the area of soil-plant-water relations. This is being accomplished by two principal means: The first was the establishment of two professorships in international agriculture, one supported by AID 211 (d) grant funds and the other by University sources. These professors devote most time to teaching, research and administrative duties in soil-plant-water relations. The second was the increased involvement of other resident faculty members in research and teaching of the same subject area. The latter has been particularly aided in two ways. One is the AID 211 (d) project support of research assistants, who participate in research abroad under the supervision of faculty advisors. The second means is the interest in world agriculture that is generated among faculty members because of greater exposure to conditions abroad. Greater exposure has been possible because of visitations by international scholars and as a result of overseas consultantships and AID assignments.

The Department of Agronomy has strengthened its teaching program by initiating two courses on crops and soils of the tropical and subtropical regions. These represent eight quarter-hour credits for advanced undergraduate and graduate students. Student interest in these courses is high and enrollment continues to be firm. Another significant accomplishment is the continued injection of international components into our regular course offerings in crops and soils. These components are added because subject matter cannot be given a thorough treatment without them. The major incentive for course modifications is greater exposure of teaching faculty to world agriculture. Our research program has been greatly enhanced by the initiation of research on tropical soils by six of its resident faculty. Emphasis has been placed on clay mineralogy identification and on soil characterization by specialized laboratory facilities that are not readily available in developing countries.

THE OHIO STATE UNIVERSITY  
211 (d) PROJECT

SOIL-PLANT-WATER RELATIONS

I. SUMMARY

The objective of The Ohio State University program is to develop an expertise and capability in international agriculture in the area of Agronomy, specifically soil-plant-water relationships. The educational role of the University is pursued through the involvement of its faculty in research and teaching in the international sector. The College of Agriculture continues to support the 211 (d) program in soil-plant-water relations, and the University expanded its overall involvement in international activities during the year.

The greatest single activity during the year was the thesis studies of three research assistants assigned to India. The major objective of this activity was to provide greater faculty involvement in foreign agricultural research through the work of graduate advisees. After making prior arrangements with appropriate Indian university faculty, two assistants were assigned to the Soils Department, Punjab Agricultural University, and the third assistant was assigned to Mysore University of Agricultural Science. All three returned to the campus by September 1972. Each assistant has been actively engaged in mineral nutrition of plants, and two assistants conducted field-plot experiments with wheat. There are many indications that their programs were quite successful.

As a direct consequence of the research assistant programs in India, two of our resident faculty are significantly involved in research on soils from that country. Our soil mineralogist is making extensive investigations on the clay mineralogy of some major soil categories of India soils, and our specialist in soil genesis is making certain physical and chemical analyses on these same soils. The information being obtained by these investigators is generally lacking in soils of the developing countries, and these data can be used to properly classify the soils in accordance with known physical, chemical and mineralogical data.

We have strengthened our recently-initiated courses on "Crop Production in the Developing Countries" and "Tropical and Subtropical Soils". These two courses deal primarily with crops and soils of tropical and subtropical regions. Student interest in these courses remains high.

Perhaps the most significant (but less visible) advance in teaching competence is the continued injection of international components into our regular course offerings in crops and soils. These components are not added because of any formal effort to recognize soil and crop management in other parts of the world but because subject matter cannot be given a thorough treatment without them. The major incentive for course modifications appears to be greater exposure of teaching faculty to world agriculture. Our 211 (d) grant program assisted in bringing two eminent soil scientists to the campus for a series of lectures.

For the coming year, emphasis will be placed on completing the research studies of the research assistants in India. Guest lecturers are being invited to discuss research in lesser developed countries. A 2 year extension of the project has been approved to utilize about \$37,000 in carry over funds.

## II. OBJECTIVES

The objective of the 211 (d) program is to develop within the Ohio State University an expertise and capability in international agriculture in the area of Agronomy, specifically soil-plant-water relationships. The program encourages professional interest and involvement of appropriate faculty in foreign agriculture. The educational role of the University is pursued through the continued involvement of its faculty in research and teaching in the international sector. This involvement permits the University to acquire and disseminate new knowledge and to develop internationally-trained personnel. To fulfill its objective the University is gaining research experience in India, establishing working relationships with Indian agronomists and acquiring knowledge of the agriculture of a developing country.

## III. MAJOR ACCOMPLISHMENTS

### A. Development of Teaching Competence

1. We have continued to strengthen our recently-initiated courses on "Crop Production in the Developing Countries" and "Tropical and Subtropical Soils". These courses represent 8 quarter-hour credits for advanced undergraduate and graduate students. The courses deal primarily with crops and soils of the tropical and subtropical regions and were introduced to extend the international aspects of the Agronomy Department's instructional program. We have made valuable additions to the visual aids, including a goodly number of color slides showing crops and soils from many countries. We are also accumulating a soil monolith series to represent soils of tropical and subtropical regions.

As with all courses, the success of these also depends on the quality of instruction. We are most fortunate to have excellent teachers for these courses, and student interest remains high. The crop production course is now taught by Dr. Terry Logan, who has spent a large portion of his life in the tropics. The soils course is taught by the 211 (d) professor, who has several years research experience in Central America. Dr. L. D. Baver who formerly taught the crop production course retired at the end of last year.

2. A third course was initiated in 1971 with a considerable input of international agriculture. This is "Agroclimatology", a graduate-level, 3 quarter hour course. Much of this course is devoted to world climates and their significances in crop production and soil management. A total of 28 students registered for this course during its initial offering. A visiting climatologist from India, Dr. H. S. Mavi, was particularly helpful in gathering pertinent climatological data on monsoon areas of Asia.
3. Perhaps the most significant (but less visible) advance during the year was the continued injection of international components into our regular course offerings in crops and soils. In many instances the new component is the addition of illustrative subject matter taken from various countries. For example, the instructor in Soil Physics describes management practices on alkali-saline soils in the Punjab to illustrate the undesirable effects of high sodium and salt contents of soil. These components are not added because of any formal effort to recognize soil and crop management in other parts of the world. Rather, the additions are made because subject matter

cannot be given a thorough treatment without the international component. This is a direct result of the technological developments in the agronomic field on a world basis. Thus courses dealing with grain production would be considered incomplete without emphasis being placed on the breeding and cultural practices being performed in other countries.

The incentives for such course modifications are varied, but the common denominator is greater exposure of faculty members to world agriculture. The University AID contract programs have made possible the direct involvement of many faculty members by overseas assignments. The AID 211 (d) grant program has been most helpful in encouraging on-campus participation in foreign agriculture. The latter program links home campus activity with overseas research by sponsoring research assistants who do most of their thesis work in a developing country; bringing foreign scientists to the campus; and by sponsoring travel of teaching faculty for study, visitation, and symposia on a foreign agriculture.

4. In the course entitled "Under-graduate Seminar", we have continued the special section to familiarize upper class undergraduates with the potentials, opportunities, requirements and rewards of international agronomy. This section is under the direction of the AID 211 (d) professor.
5. Library acquisitions pertaining to international agronomy have continued throughout the year. Emphasis had been placed on information from India. Special lists of the government of India's newly-released reports are received monthly and the appropriate publications ordered. These books and scientific articles are added to the Agronomy Library India shelf.
6. During the year, two internationally-renowned agricultural scientists have acted as visiting lecturers to the College. These scientists were able to spend time with students and faculty members and to emphasize the international aspects of their particular specialties. These were Dr. T. P. Agrol, Head, Soil Science and Agronomy Division, Central Soil Research Institute, Karnal, India and Dr. Rattan Lal, Soil Researcher with the International Institute of Tropical Agriculture, Ibadan, Nigeria.

#### B. Development of Research Competence

1. During 1972 the 211 (d) sponsored American research assistants who did thesis research in India returned to the United States. The primary objective of this activity is to provide greater faculty involvement in foreign agricultural research through the work of graduate advisees. A second objective is to accumulate greater knowledge of soil-plant-water relations in a developing country like India. Two assistants were stationed at Ludhiana (Punjab), while the remaining one was stationed at Bangalore (Mysore). The two assistants in the Punjab are primarily supported by AID rupee funds. Prior arrangements were made by the 211 (d) professor for Indian university faculty to serve as advisors during their stay in India.

Mr. Gary Alsdorf was one of the assistants in the Punjab. He was doing laboratory and field-plot research on the role of zinc in soils and plants. The Soils Department Chairman of Punjab Agricultural University, Dr. N.S. Randhawa, served as his advisor. Mr. Alsdorf has worked closely with

scientists at the Indian Central Government Salinity Institute at Karnal. He was instrumental in establishing a laboratory at Ludhiana for zinc determinations in soils and plants. A very complimentary letter has been received from the Department of Soils' Chairman concerning Mr. Alsdorf's contribution to their research program in minor elements.

The research area studied by Mr. Alsdorf is of considerable practical interest to many areas of India. Zinc deficiency in crops is merging as a major problem in the sandy-textured and alkaline soils of the Indo-Gangetic Plain. The deficiency is more prevalent where multi-cropping is practiced, suggesting that Zinc is being mined from these soils by crop removal of this element. Thus the problem is likely to advance into regions where the "green revolution" has been most successful.

Mr. Alsdorf has been investigating zinc availability to crops from different soils. Emphasis has been placed on the role of soil organic matter since much of the available zinc is associated with organic compounds. Several researchers report that a significant amount (25% at least) of zinc applied to soil organic matter is not extractable and thus not available to plants. The mechanism of this reaction has not been fully elucidated. The moisture regime in soils is important, since researchers have shown that drying of soil significantly affects zinc extraction. Mr. Alsdorf has collected soils from Punjab, Himachal Pradesh and Madhya Pradesh states. These soils represent large differences in clay mineralogy, organic content, pH and salt content. He has imposed different moisture regimes and organic matter additions to the soils and is extracting zinc with different chemical solutions. Except for occasional difficulties with instrument operations, the work is progressing very well.

Upon his return to Ohio State, Mr. Alsdorf was employed by the new Agricultural Technical Institute located at Wooster, Ohio. Plans are for him to complete requirements for his Ph.D. degree during the Summer of 1973.

Mr. Thomas Stilwell was the other assistant at Ludhiana, and he conducted research on potassium release and crop uptake from soils of the Punjab. He had a distinct advantage in his assignment, since he is quite familiar with Indian culture and speaks Hindi as a result of an earlier Peace Corps stay in Uttar Pradesh. His Indian advisor has been Dr. G. S. Sekhon, Associate Chairman of the Soils Department. He initiated field-plot experiments with wheat on six different sites in Punjab state. The experimental variables were N, P and several rates of K applications. An appropriate experimental design was used for the plot layout. The wheat was harvested in all experiments and some plant samples were returned to the USA for analyses that cannot be done conveniently in India. Analysis has shown a positive wheat yield response to potassium levels at all sites.

The impetus for Mr. Stilwell's work was that many crops do not respond to potassium applications in some Punjab soils, even though these soils show low levels of this element. X-ray diffraction studies have shown these soils to be high in micas, and potassium may be weathering out during the

cropping period. Chemical and X-ray analyses of soils samples from the Punjab were previously started at the Ohio State University. In addition to various chemical analyses of the soils studied, he obtained the uptake of some 17 essential elements by wheat plants. Mr. Stilwell completed the requirements for the M.S. degree in December 1972 and is now working toward a Ph.D. degree.

The third assistant was Mr. George T. Kaiser, whose Indian advisor was Dr. N. G. Perur, Chairman of the Soils Department, Mysore University of Agricultural Sciences. Mr. Kaiser is evaluating phosphorus extraction procedures as an index for crop yields in an on-going, soil-test and plant-yield correlation study. His previous research has involved a comparison of the Mehta and the S.A.H.T. ignition methods for evaluating organic phosphorus levels. He has established several field plot experiments in India to evaluate different phosphorus levels on growth and yield of wheat. These plots have now been harvested and pertinent growth and yield data recorded. Mr. Kaiser is in the process of reporting the results of his investigations.

2. As a direct consequence of the activities of the research assistants in India, two of our resident faculty are significantly involved in research on soils from that country. Our soil mineralogist, Dr. L. P. Wilding, is currently determining the concentration of vermiculite, kaolinite, montmorillonite, and illite minerals in soils of this country. These soils were previously selected by Indian soil scientists and the 211 (d) professor to represent some major soil categories. They include sites from Punjab, Himachal Pradesh, Madhya Pradesh and Mysore states. This type of information is generally lacking in soils of the developing countries, and these data will be of particular value to Indian soil scientist. These findings will give much insight into proper fertilization and management of these soils, since research data on similar soils at different world locations can be utilized more effectively.

Our specialist in soil genesis, Dr. N. Holowaychuk, is studying various chemical and physical analyses of the same soil samples. He is currently making such determinations as particle (grain) size analysis, pH, sodium and total salt contents, organic matter and exchangeable ions. A primary use of these data is to properly classify the soils in accordance with known physical, chemical and mineralogical data. Again, a correct soil classification will permit use of data collected on similar soils throughout the world.

3. Publications. A master of science thesis was published on Potassium relations in soil. This publication is as follows: Thomas C. Stilwell M.S., 1972, The Ohio State University. Characterization of the Response to Potassium Fertilization of Three Punjab (India) Soils.

#### C. Training of Graduate Students

(Covered under A and B)

#### D. Development of Competence for Consultation Service

1. The 211 (d) professor continues active participation in the College's International Affairs Advisory Committee. This committee works in concert with the University's Office of International Agricultural Affairs. The 211 (d) professor is called upon frequently to contribute his knowledge in the international area and serves as a subcommittee chairman on group study tours in the crop and soil science areas.
2. The 211 (d) professor returned from an assignment in Brazil in October 1972. During his assignment in Brazil he was the Chief of Party for the AID sponsored institution building contract with the Agricultural College of the University of Sao Paulo located at Piracicaba, Sao Paulo. Upon his return to the Ohio State University campus he has, in addition to assuming his 211 (d) duties, been named the campus coordinator for the above mentioned contract.

Since January 1973 the 211 (d) professor has made two trips to Brazil in conjunction with the existing institution building contract and the proposed Education Loan Program which should be initiated in 1974 when the present contract program terminates in December 1973.

The Brazilian experience has helped to broaden the international experience of the 211 (d) professor, in a country that is developing at a very fast rate.

#### E. Interactions with Other CUSURDI Institutions (Council of United States Universities for Rural Development in India)

During the year interactions with other CUSURDI Institutions was minimal due to the late return of the 211 (d) professor from Brazil and the inability of the 211 (d) professor to attend the annual meeting in Fall, 1972.

#### F. Involvement of Other University Resources

The funds provided by the 211 (d) grant are important but are not adequate to cover a complete program in International soil-plant-water relations. Many other parts of the Ohio State University provide either direct or indirect support to the program during the past year.

Administrative services and coordination were provided by the Office of International Affairs of the College of Agriculture and Home Economics. This provided for logical tie-in and complimentary relationships with other international agricultural programs. The University business offices handled all of the financial services for the program. The regular administrative structure of the Department of Agronomy, the College, and the University provided services, without reimbursement for their costs.

All of the facilities of the Ohio State University, including offices, classrooms, laboratories, greenhouses, and equipment were provided by the University.

Considerable extra financial support was provided directly for the field of International Soil-Plant-Water Relations through the Department of Agronomy by the College of Agriculture and Home Economics, and the Ohio Agricultural Research and Development Center, particularly for faculty salaries, visiting professors, graduate research assistants, research funds, secretarial help, teaching materials, office supplies, and equipment. This direct support to the program was estimated to amount to \$25,000 during the last year.

#### IV. INTERNATIONAL PROGRAMS OF THE OHIO STATE UNIVERSITY

The Ohio State University continues to develop the international dimension throughout the University. Generally, emphasis is given to area study programs, and study abroad, especially study tours. Encouragement is given to the various units in the University for faculty to engage in research and study abroad.

The College of Agriculture and Home Economics, through its Office of International Affairs, administers many international programs and works with all departments of Agriculture and Home Economics and Natural Resources in the development of international programs and the international competence of the faculty.

In the last year the College has continued programs supported by US/AID, mainly in Foreign Agricultural University development in India, Brazil and Uganda.

The Department of Agricultural Engineering continued a program in India supported by Ford Foundation. This consisted of sending a few OSU faculty abroad and bringing some to OSU from India for study.

The Department of Agricultural Economics and Rural Sociology has an AID supported research project on Capital Formation in Agriculture, with the center of work being Brazil, and this has involved a number of OSU faculty.

The 211 (d) program in Soil-Plant-Water relations is in the Department of Agronomy. In the last year, it has involved at least two faculty members and 3 graduate students directly, but it benefits the entire department and the college.

The College has had a Peace Corps (ACTION) intern training program during the last year with emphasis on Tunisia.

A number of the OSU faculty in Agriculture have been consultants in foreign countries for various agencies or have participated in international meetings in foreign countries during the last year.

About 15 courses on International Agriculture and Rural Development have been developed in the College. The College offers a curriculum for undergraduates in International Agriculture. A number of graduate students from the United States in the various professional areas have tailored programs of study preparing them for an international career.

The College has developed a program of graduate students studying abroad during the last few years. During the last academic year, two undergraduate students were studying in India and three in Brazil.

Last year the College programmed many foreign visitors from many countries in Agriculture in Ohio.

About 140 foreign graduate students were enrolled in the College of Agriculture and Home Economics during the last year.

The College has an International Advisory Committee of faculty with all departments, schools, and units of the teaching, Research, and extension represented.

#### V. EXPENDITURES

The expenditures for each year of the grant through June 30, 1973 are shown in the table on the following page. Total expenditures as of June 30, 1973 were \$162,953.68. The expenditure for 1972-73 was \$31,811.32.

The salaries and retirement category represents the full time salary of the 211 (d) professor for three and one half months and two thirds salary of the 211 (d) professor for the remaining eight and one half months. The graduate students' expenditure of \$10,344.35 is the stipend paid research assistants. Three research assistants received payment through the grant for about two months of the year at which time Mr. Alsdorf's stipend was discontinued. The other two research assistants received their stipends through March 1973 at which time Mr. Kaisers stipend was discontinued. Mr. Stilwell's will be continued until 1975.

The total travel expenditure was \$3,307.44 and includes the return passage from India and per diem in India of one research assistant.

The miscellaneous category includes honorariums for Drs Abrol and Lal as well as an approximate honorarium of \$194.00 for CUSURDI services.

#### VI. WORK PLAN AND BUDGET FOR 1973-74

The 211 (d) professor will continue to teach courses on tropical soils and to teach courses on tropical soils and to coordinate work under the grant. Additional soil monoliths will be procured to assist in teaching.

The remaining research assistant will be supported by the grant through the '73-'74 year to complete his Ph.D. degree.

The 211 (d) professor will be partially supported by the grant for at least six months out of the year..

Five hundred dollars in the miscellaneous and equipment categories will be used to support visiting lecturers and the one remaining research assistant.

The research assistant is working on a problem involving the "Cerrado" soils of Brazil and his passage will be paid to Brazil for him to observe and collect soil samples for his research. For this reason about \$1500.00 is budgeted for his passage and per diem.

EXPENDITURES  
CONTRACT AID/CSD - 1928 (OHIO)

Category	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75
Salaries & Retirement	16,238.86	19,402.62	21,776.24	18,375.70	17,365.59	19,500.00	2,000.00
Graduate Students	-----	11,700.00	12,600.00	7,550.00	10,344.35	5,700.00	5,700.00
Travel & Transport	1,159.02	1,394.28	2,366.52	12,166.63 2,800.00*	3,307.44	2,155.00	200.00
Equipment	-----	-----	812.51	861.56	264.28	500.00	200.00
Miscellaneous	35.30	269.81	244.74	1,388.47	529.66	500.00	591.32
Annual Totals	\$17,433.18	\$32,766.71	\$37,800.01	\$43,142.36	\$31,811.32	\$28,355.00	\$8,691.32
Cumulative Totals	\$17,433.18	\$50,199.89	\$87,999.90	\$131,142.36	\$162,953.68	\$191,308.68	\$200,000.00

\* Cost for International Travel not yet billed to project (Estimated).

## Supplementary Material Required by "Guidelines"

### VII. OTHER RESOURCES FOR GRANT-RELATED ACTIVITIES

- a. One faculty member devotes essentially full time to courses on tropical crops and soils and on a course in world climates. This member is in addition to the 211 (d) professor. The value of this contribution to the teaching program is approximately \$20,000.
- b. Some ten faculty members in the Department of Agronomy advise foreign students on research and course curricula that are pertinent to tropical crops and soils. The value of faculty time devoted to these activities is estimated at \$10,000.
- c. The University sponsors many visiting scholars, who have spent considerable time in the developing countries. Library acquisitions of research periodicals from different world regions are also made available. Faculty from departments other than Agronomy advise foreign students on subjects pertinent to tropical crops (Horticulture Department), to mechanization in developing countries (Agricultural Engineering) and to marketing and credit in the lesser developed nations (Agricultural Economics). The approximate contribution is \$5,000.
- d. The University gives direct support to the 211 (d) program by providing at no expense the following: office space, telephone service, laboratories, secretarial help, teaching materials, office supplies and equipment. The University Business Office administers, without charge, all 211 (d) funds, processes requisitions, etc., and keeps all pertinent records. The estimated value of these services is \$25,000.

TABLE I

Distribution of 211 (d) Grant Funds and Contributions From Other Sources of Funding\*

Review Period July 1, 1972 to July 1, 1973

List all grant related activities	211 (d) Expenditures				Non 211 (d) Funding Amount
	Period Under Review	Cumulative Total	Projected Next Year	Projected to end of Grant	
e.g. Research	\$23,000	\$56,000	\$12,000	\$81,000	\$10,000
Teaching	12,000	50,000	12,500	75,000	20,000
Consultation and Public Services	4,000	17,000	2,000	26,000	5,000
Other					
Library					
Honorarium	1,500	8,000	2,000	12,000	25,000
Miscellaneous					
<b>TOTAL</b>	<b>\$40,500</b>	<b>\$131,000</b>	<b>\$28,500</b>	<b>\$200,000</b>	<b>\$60,000</b>

\* These figures are our best estimates

ABSTRACT

Stilwell, T. C. MS Thesis entitled " Characterization of the Response to Potassium Fertilization on Three Punjab (India) Soils. 1972, The Ohio State University.

This work has demonstrated the following conclusions concerning wheat grown on low K soils. (1) There is a definite and profitable response in wheat yield when the minimum recommended rate of potash is applied to soils testing low in exchangeable K. (2) Split application at high rates of potash does not result in significant yield increases. (3) Use of either calcium ammonium nitrate or ammonium sulfate does not significantly affect wheat yields or wheat response to potassium. (4) Banding of fertilizers does result in higher overall yields but does not affect wheat response to potassium application. (5) The presence of calcium and magnesium do not appear to be limiting K uptake. (6) There is a large amount of slowly available K which provides potassium in amounts adequate for plant growth under reduced yield conditions.

The present Punjab Agricultural University Soil Testing guidelines for potash application on K deficient soils seem to be valid for the soil types tested. Prospects for increasing wheat yields on K deficient soils by potash applications are quite good.