Report

by

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to the

N A T I O N A L B E A N P R O J E C T

S P E C I A L P R O G R A M O F A G R I C U L T U R A L R E S E A R C H

E M B R A P A

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I. Introduction

This report is a summary of impressions gained and recommendations formulated during a three-week period of travel and discussions with research workers in the central bean-producing states of Brazil. Our primary objectives throughout were:

1. to meet people engaged in bean research or extension;
2. to evaluate both their interest in cooperating with the National Project and the level of their training to perform needed research;
3. to secure from them their assessment of bean production problems and most pressing research and extension needs; and always,
4. to discuss with them the general goals, organization, and operating plan of the National Bean Project.

II. Basic Findings About People and Institutions Engaged in Bean Research

(These are generalizations and should not be read as criticisms.)

1. Many are interested in the bean plant or crop, but only a small number of persons actually devote a major share of their time to bean problems.
2. Bean workers and their institutions are widely separated geographically.
3. In the country as a whole bean workers are found in many different administrative agencies or departments--for example, the Federal Ministry of Agriculture, Federal Ministry of Education, State Secretaries of Agriculture, Federal and State Universities, State Institutes of Agronomy and Biology, and CENA.
4. Many bean workers, including those who are able to give only a small fraction of time to beans, require further training. Most of them have had the Enginheiro Agronomo degree; a very few have an advanced

degree. A very small number are now studying for an advanced degree at Vicosa, Turrialba (IICA), or Gottingen. Two individuals were noted as having commenced postgraduate studies only to discontinue after a short time.

5. Institutions are, in general, modestly equipped by American standards to carry out basic studies in bean research. However, certain institutions are well-equipped to become centers of excellence, and some of them possess certain natural advantages that could be of particular value in a comprehensive national program or in international cooperation.
6. There was a preoccupation with research and the preparation of papers and circulars, but there seemed to be little direct involvement of researchers in the extension process to growers, with one exception.

III. Some Consequences That Seem to Follow from These Findings

(Some of the items listed here weigh more heavily on the negative side; some would appear to have a positive value.)

1. The bean research tends to be focused on local problems, on subjects of indivivual preference, or on interesting but nonproblem areas.
2. There is duplication of effort among individuals at different institutions.
3. There is a lack of essential coordination among programs and very little cooperation inter se.
4. The research is of variable quality from very good to mediocre.
5. Some important problem areas are receiving no attention.
6. Some important problems are being studied but with insufficient personnel or training to solve the problems in a useful period of time.
7. Some problems of national concern have already been identified by the trained, experienced workers.

8. There seems to be a readiness of individuals and of institutions to cooperate in a national program.

9. Centers of excellence or potential excellence in particular aspects of bean research exist at Vicosa, Campinas, Piracicaba, and Ribeirao Preto.

10. A comprehensive set of bean production guidelines followed up by practical in-the-field demonstrations of these guidelines has not been forthcoming.

IV. The National Bean Project--Comments on Principal Components and Goals

1. Research Component: The aim of the research component is to solve the problems of low productiveness of the bean as a crop in Brazil. It is expected that the American scientists to be associated with the project will, by their work with cooperators and through their research training activities with students, materially strengthen this area. It may be impossible to evaluate the unique contributions of the American group in the research area as distinct from the success or failure of the total cooperative research effort.

2. Training Component: The aim of this component is to increase the research skills of individuals associated with the project, to enable them to recognize important problems in bean production and acquire the skills necessary for their solution. The American group will be involved in the training effort, and their contribution can, if necessary, be judged in terms of the number of students they have assisted and the outcome of theses and special problems completed.

3. Coordination and Cooperation Component: It is important to the success of the project that the Brazilian scientists now working with bean problems be brought into some kind of a research network, to focus a significant part of their efforts on the national goals, and

to achieve through training and shared experiences with the American scientists a greater competence in problem solving. The American group should expect to seek out numbers of Brazilian workers in the various research disciplines and to lend their counsel and communicate their skills in identifying and solving problems. I believe they will find the Brazilian workers ready to meet them halfway in any reasonable cooperative venture.

4. Communications Component: The aim here is to keep the research network informed of current events in the project and to get usable information out to all who can benefit from it. A strong tie with an extension specialist is in my judgment very necessary.

5. Goals of the project are stated in such a form as to:

   a. make known to each research task unit what is required or expected of it, and

   b. make clear the basis of evaluating the rate of progress of each task unit.

6. Priorities in the project were set at three levels, indicated by asterisks placed after each 2-digit subitem. The setting of priorities had to be done, even though we believe all of the items in the project should be worked on, because of the possibility of insufficient resources and because some items are more urgent than others. The assigning of a particular priority had to be a matter of group judgment, and unfolding circumstances in the future may require some changes. We should not be bound inexorably to the present assignments if new information suggests some revision.

V. Expectations

1. Complete sets of production packages for certain areas will be formulated

and communicated to users.'

2. Clean seed of approved varieties will become available in quantity.
3. New varieties of beans, superior to present varieties in one or more characteristics, will be produced.
4. Some present production problems will be solved.
5. A corps of scientists trained to work cooperatively in the attack upon national production problems will emerge as one of the lasting benefits of the project.

This list of expectations may appear to some people as too optimistic for realization. I believe, however, that those who become fellow workers in the National Bean Project must have some vision as respects the outcome of their efforts and particularly of what should reasonably be expected from their combined efforts. In that spirit I offer the above expected outcomes as desirable and reasonable.

VI. Miscellaneous Suggestions and Recommendations

As I reviewed my notes in preparation for this report, a number of items appeared not to belong in the earlier categories. Nevertheless, we need to be mindful of them as the plans of the national project unfold; so I put them in this special Section VI.

1. Need for an extension specialist to work with the bean project. He should be responsible for putting the production packages together and communicating to area extension personnel. He should plan field days and demonstrations of practices. He should work both with the research people and the rural extensionists and growers. If ABCAR could assign an individual to this area, it might be advisable to send him to a U.S. bean production area to work closely with a bean extension specialist for one growing season.

2. A plan should be developed to solicit research proposals from researchers throughout Brazil such that one can be assured that the priority items will receive attention and that a state of balance will be maintained among the several problem areas.

3. The leadership of the project should point out clearly to all researchers who accept responsibility for a particular line item of research just how much of that individual's time is expected to be applied toward the problem. Individuals who can devote only 5 or 10 percent of their time to a high priority item should be strongly discouraged from seeking responsibility for that item.

4. Let me offer some examples of particular research problems needing attention ranging from simple to complex:

   a. Problem: Is it the soil environment or the nonsoil (climatic) environment that gives beans grown in the Patos de Minas area their superior physical quality?

      Simple Test: Grow beans of five different varieties (or more) in large pots or boxes filled with soil from Patos, from Uberaba, and from one or more additional areas known to differ in soil or climatic factors. The beans should then be grown at each of the locations from which soil has been taken. This would then make possible a comparison of main effects (soils, climates, varieties), of first order interaction effects (var x soils, var x climates, soils x climates), and of the second order interaction (var x soils x climates).

   b. Race studies in rust and anthracnose

      1. Different workers should agree to use the same set of varietal differentials.

      2. A uniform system of classifying disease symptoms should be

adopted by all workers.

c. Devise a breeding system to build self-fertilizing populations (or varieties) that are relatively uniform for seed characteristics, but that may vary within broad limits for other characteristics, but that will remain stable over several generations of seed increase.

d. Devise rust screening procedures and criteria to discriminate between specific and general rust resistance genetic factors in beans, and build varieties with acceptable levels of general (field, horizontal) resistance.

e. The Rhizobium--nodulation problem in beans. We were told repeatedly that efficient nodulation is a problem of the first priority and that the main thrust of current research is to test new strains of symbiotic bacteria. We were also told that most soils are acid and low in calcium, nitrogen and phosphorus, sometimes zinc.

Since the initial infection of bean root cells by symbiotic bacteria is a calcium and pH-dependent process, it is surprising that none of the research people dealing with nodulation and nitrogen fixation mentioned field studies on heavily limed soils. I cite here some recent papers bearing on external factors required for efficient noduation of legumes:

1. Vincent, J. M. 1965. Environmental Factors in the Fixation of Nitrogen by the Legume. In "Soil Nitrogen" W. V. Bartholemew and F. E. Clark, eds. American Society of Agronomy, Inc., Madison, Wisc.

2. ---------- 1967. Symbiotic Specificity. Austral. Jour. Sci. 29:192-197.

4. Munns, D. N. 1968. Nodulation of Medicago sativa in solution culture:

   I Plant and Soil 28:129-146

   II Plant and Soil 28:246-257

   III Plant and Soil 29:33-47

   IV Plant and Soil 29:257-262

   V Plant and Soil 32:90-102 (1970)

It is clear from these papers that low soil pH and calcium deficiency will prevent nodule formation, no matter how compatible the bacteria-legume system may be. The first thing that must be done is to supply sufficient calcium to overcome the highly acid condition of a typical bean soil and to provide available calcium to the exchange complex of that soil. Possibly then nodulation experiments can be expected to be more successful.

f. Since edaphic, climatic, and biotic factors in Brazil differ markedly from those of the U.S. and Canada, the rules concerning seed transmissibility and/or survival of Xanthomonas and Colletotrichum in soils and plant debris arrived at in the northern hemisphere may not be valid in Brazil or may need to be modified to a significant extent. Management decisions relating to clean seed production or production of beans in successive mixed plantings would be affected. It would be advisable to conduct seed transmission and survival studies for these organisms under Brazilian conditions to provide more valid guidelines for clean seed and edible bean production.

g. The production agronomists, plant physiologist, and breeder should consider carefully the bean plant types that are most suited to large scale monoculture on the one hand, and to small scale mixed planting

with corn, rice, or manioc on the other. The basic question is: "Will a single type of bean plant be equally suited to both cultural situations or are different types required?"

We were given estimates of mixed cropping ranging from 60 to 95 percent of the total bean hectarage. This is surely of sufficient magnitude that serious attention must be given to the problems of beans in associated plantings in small hectarages.

VII. I am impressed by the magnitude or scope of the problems facing the National Bean Project. Luck, untrained minds, and unskilled hands are no match for these problems. Determination, trained minds, and skilled hands applied toward these problems will solve many of them. There is no other way. Thus the problems become challenges, and the job of the National Bean Project is to accept the challenge, to tackle the problems with confidence and determination, with intelligence and skill, and the expectation that luck favors those who have the wit and the will to win.