STRATEGY OF GRAIN LEGUME AGRONOMY RESEARCH AT IITA

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The major function of the grain legume agronomy sub-program at the International Institute of Tropical Agriculture is to integrate advanced knowledge of cultural practices and crop management applied to newly developed cultivars of tropical grain legumes, especially to cowpeas, soybeans, pigeon peas and lima beans. Because of this broad function, a close cooperation is maintained not only with GLIP scientists but also with scientists from other programs, particularly Farming Systems. At present the emphasis of the sub-program is placed on the following three major areas.

a. To determine optimum cultural practices for growing grain legumes in the lowland humid tropics,

b. To assist breeders in identifying widely adapted, high yielding cultivars and in assessing the effect of genotype environment interaction on crop yield, and

c. To evaluate the effect of management levels on the performance of elite cultivars found in b.

CULTURAL PRACTICES

Basic information is needed on how best to grow grain legumes in different soils and climatic conditions of the lowland humid tropics. In these studies cultural practices which significantly affect seed yield and quality are first identified and ranked according to their importance. Each aspect is then studied by keeping all other factors at the optimum level. These experiments are therefore distinguished from management experiments in which several factors are studied simultaneously.

The research areas on cultural practices are listed below according to crops.

Cowpea

Response to plant densities. Optimum plant densities of cowpea vary with growth habit, length of growing season, daylength and perhaps soil fertility. Many experiments have been conducted during the last three years to answer some of the basic questions on optimum densities of different plant types of cowpeas (erect, semi erect, semi prostrate and climbing). Further research is needed to determine plant morphology most compatible with either low or high plant densities, and to determine the effect soil fertility level in cowpea response to plant densities.

Response to fertilizers and seed inoculation. Cowpea generally does not respond to seed inoculation but its nodulation is often poor even under good management. Varietal differences in the ability to produce large and copious nodules are identified but more work is needed to improve nodulation and nitrogen fixation in cowpea. Cowpea generally does not respond to fertilizers in newly-cleared soils or on soils of moderate to high fertility levels, but significant responses to nitrogen and phosphorus have been obtained in poor soils and in soils continuously cropped without fertilizers. The addition of phosphorus in the form of superphosphate was found to improve nodulation and yield as well as seed sulphur content in sandy soil in the Savannah region of Nigeria. A network of fertilizer experiments have been established involving scientists from the University of Nigeria (Nigeria), Soils Research Institute (Ghana), Njala University College (Sierra Leone) and Institute of Agricultural Research (Tanzania) to further determine nutrient requirements of cowpea in different soils varying in pH, fertility status and cropping history.

Frequency of harvest of indeterminate cowpea. Most cowpeas are indeterminate and present harvesting and seed quality problems when maturation occurs during the rainy season. Studies conducted since 1973 show that frequency of harvest affects seed yield, quality and viability of indeterminate cowpeas. Further studies are needed to determine whether indeterminate cowpeas differ in their susceptibility of weathering. Preliminary experiments suggests that this possibility is worth exploring.

Tillage methods. Soils in West Africa are charactized by structural instability and are susceptible to erosion. Studies have been conducted since 1972 to determine whether cowpea and soybean can be grown satisfactorily with little or no tillage. Results indicate that satisfactory yields can be obtained in both crops under zero tillage even when fertilizers are broadcast on the soil provided weeds are adequately controlled. Minimizing tillage and leaving stubble on the soil also improve soybean seedling emergence in the first rainy season. This experiment will be phased out since Farming Systems has a much larger program on minimum and zero tillage.

Seed coating with fertilizers. On acid soils liming can improve growth, nodulation and yield of grain legumes but this practice may not be economic in the tropics. Screening of cowpea for acid tolerance is being carried out by Dr. D. G. Edwards. Our interest, however, is to determine whether simple techniques by coating seeds with different combinations of rock phosphate, calcium carbonate, basic slag, calcium silicate and molybdenum can improve nodulation and yield of cowpea and soybean in acid soils. Results from Nigeria and Sierra Leone indicate that rock phosphate with or without molybdenum looks promising. Dr. S. Danso found that coating seed with some of these fertilizers, particularly rock phosphate, appears to increase the survival of introduced rhizobium in soybean on acid Nsukka soil.

Cowpea-maize intercropping. Cowpeas are primarily grown as an intercrop in Africa. Therefore, it is important to identify cowpea cultivars most adapted for intercropping. A screening method for shade tolerance using maize as a companion crop is being developed with the cooperation of GLIP and cereal physiologists. Erect cowpea type was found to be more affected by

shading than semi-erect and climbing types. However, the latter cultivar reduced light interception as they climb over the maize plants.

Soybean

Seed viability and seedling emergence. Poor seeding emergence has been a major problem in growing soybean in West Africa. This problem is partly associated with high soil temperature and low water holding capacity of the soils in this region, and partly with poor storage conditions. A series of experiments have been conducted in cooperation with the GLIP physiologist and soybean breeder to identify factors affecting soybean viability and emergence and to find ways to improve seedling emergence. Since poor germination can occur right from the time soybeans are harvested and appears to be related to seed and varietal characteristics, research is now underway to develop screening methods for tolerance to adverse climatic conditions during harvest and to high soil temperature at planting.

Response to fertilizers and seed inoculation. Experiments conducted since 1972 indicate that soybean generally requires seed inoculation and the addition of 20 to 40 kg nitrogen and 20 to 40 kg phosphorus per ha for its optimum growth. No seed inoculation is found necessary when soil has been cropped 4 to 5 times with well-nodulated soybean. Seed inoculation and nitrogen and phosphorus fertilization increase seed protein content of soybean, but not of cowpea.

Response to plant densities. Branching habit, plant height and lodging characteristics determine the response of soybean to plant density. When lodging does not occur, seed yield up to 3.5 ton/ha can be obtained at densities ranging from 300 to 500 thousands plants per ha. However, because of the poor emergence of most soybean cultivars, this yield is seldom achieved in the uniform yield trials unless seeding rates are doubled or tripled. Unlike some cowpeas, leaving 2 to 3 plants per hill is not detrimental to soybean yields.

Pigeon Pea

Response to plant densities. Dwarf pigeon peas developed at IITA differ in their branching habit and plant height. 3D-8102, which is characterized by a few or no branches, can be grown at densities as high as 300,000 plants/ha. CITA 4 and similar genotypes yield better at lower densities. Weed control is a big problem if plant density is below optimum because of the slow initial growth of pigeon pea.

Pruning method. Indeterminate, dwarf pigeon peas such as CITA 4 can be pruned in different ways to increase their productivity in the humid tropics. Seed yield of 3464 kg/ha was obtained when CITA 4 was planted in May and pruned in September, and harvested twice in September and January. Research is continued to evaluate the effect of dates of planting and pruning on pigeon pea yield.

Lima bean

Response to plant densities. Experiments on this aspect have not yielded meaningful results because of the susceptibility of lima bean to virus and Cercospora leaf spot. Virus resistant cultivars and a range of plant types are needed for such a study.

Method of trellises. The GLIP breeder has found that climbing lima bean has an extremely high yield potential under Ibadan conditions. Unfortunately, it requires support for obtaining such high yield. Different methods of trellises using local materials and live plants are being tested.

MULTILOCATION YIELD TESTING

Last year 154 sets of uniform yield trials were distributed all over the world to evaluate the performance of promising lines of cowpea, soybean and pigeon pea in different environments. The agronomist coordinates this large multilocation yield testing, though the recommendations for conducting these trials are made by all the GLIP scientists. In last years's trials TVu 1977-OD, Jupiter and 3D-8111 (CITA 1) were highest yielders in cowpea, soybean and pigeon pea respectively.

MANAGEMENT EXPERIMENTS

One of the criticisms of the uniform cultivar trials is that they are often conducted under the best possible management practices, which may not be economic or practical at the farm level. The elite cultivars generated from the yield trials should therefore be reevaluated in selected locations under several levels of management practice ranging from no fertilizers, no insect and no disease control to adequate fertilization, insect and disease control. There are three objectives of this experiment:

a. To evaluate the performance of elite lines under different levels of crop management practice at selected environments,

b. To determine the response of elite lines to a given input (insecticide, fungicide, fertilizers etc.)

c. To assess the economics of grain legume production under varying levels of management practices.

This is a cooperative experiment with the GLIP entomologist and pathologist, and Farming Systems production economist. At present the management study is done only on cowpeas. Hopefully,scientists from different countries will also participate so that the elite cultivars can be tested in wider range of soils and climatic conditions throughout the world.

FUTURE RESEARCH

The GLIP agronomy sub-program is only about 3 years old. We have been attempting to identify problems and to find cooperators to help us solve some of these problems. It is important that the agronomist works closely with other members of GLIP so that research results from different sub-programs can be integrated into a unified package of practices as quickly as possible. However, the questions which an agronomist faces at IITA are these: Which grain legumes are really adapted to the lowland humid tropics, and should we develop management practices for sole cropping or intercropping, or both? Unless these questions are resolved, problem identification and setting priorities will not be easy tasks.