7. PROBLEMS CONFRONTING MAIZE PRODUCTION IN ASIA

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Maize was brought into Asia in the seventeenth century by Portuguese traders and was first grown as a curiousity and garden crop. It is not certain when it became an important commercial crop. It is certain, however, that maize has been the basic food crop for people in some areas of the lower Himalayas for several generations.

It is generally assumed that only two basic types were introduced during this period and further introduction apparently did not occur until many years later. There is evidence of isolated introductions in relatively recent times by missionaries.

The lack of recognition of the potential of the crop delayed any serious concern for its improvement until 1940 or slightly later. These first attempts were not very rewarding because of the lack of genetic diversity. The introductions of hybrids from the U.S. corn belt demonstrated that maize could compete favorably in yield with wheat and rice. The U.S. hybrids were not a solution, however, because the production of the parental lines was nearly impossible.

The performance of the hybrids did, however, stimulate researchers and Governments to establish or devote more effort and resources to maize improvement. The Philippines, Indonesia, India and West Pakistan started accelerated maize improvement programs at about the same time. Maize was introduced into Thailand at about this same time as a commercial crop.

From these early efforts Thailand isolated a variety Guatemalan, Indonesia selected two varieties Metro and Perta out of material very similar to Guatemalan and India, West Pakistan and the Philippines developed hybrids.

This very briefly outlines the general events that have been responsible for the increase in maize acreage and production presented in Table 1.

Nineteen sixty-five figures were used in the table for Thailand because the 1966 figures were not available, but as can be seen from the 1948–52 averages to 1966, the total acreage for the countries listed has increased a little over 4.75 million hectares. Thailand has the greatest percent increase and has about doubled the yield per hectare. Yields have gone down about 30 percent in the Philippines and up about 20 percent in Indonesia, and up 50 percent in India. Japan has reduced her acreage about 30 percent but yields have gone up about 60 percent. Japan, however, is an important maize consumer but does not contribute substantially to the total production of Asia.

Indonesia this year started an increase program on new material that is about 15 percent better than any of their previous selected material and the Philippines is in their second year of increasing and promoting several new varieties that are substantially better than their earlier hybrids. Thailand should have new varieties out within the next two years. India has quite a large number of hybrids and synthetics on the mar-

Table 1. Area and production of maize in five Asian countries.

Country	Area 1,000 hectare				Production Metric tons/hectare			
	1948–52	1965	1966	Percent increase	1948–52	1965	1966	Percent increase or decrease
Indonesia	2,020		3,186	57	0.75		0.90	20 inc.
Philippines	969		2,167	123	0.99		0.66	33 dec.
Thailand	34	562		1,552	0.91	1.81		98 inc.
India	3,349		5,061	51	0.64		0.98	53 inc.
Pakistan	393		557	41	0.97		1.05	07 inc.
Total	6,765		11,533	70	0.71		0.92	29

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ket that are and will continue to increase production. West Pakistan also has new material in the field and several items in the research program that show promise.

These data are evidence that maize is playing an important part in the agricultural economy of Asia and there is without a doubt opportunities for larger acreages and much higher yields.

I think one of the serious problems retarding advances in maize production is the lack of qualified people to conduct research and the lack of funding. To overcome the manpower shortage, we must look to every opportunity to educate and train more young scientists in all of the several disciplines. Training beyond advanced degrees is also necessary. We must bear in mind that young scientists launching into a career of research on rice or wheat have a cadre of experienced people with whom they work. The young scientist starting his career on maize, on the other hand, may have few if any experienced scientists interested in maize with whom he can work. This in part can be overcome through more regional cooperation, exchange of visits to other programs and improvement in library facilities. Through the education and training process the young scientist usually receives a good grounding in the theory of the science but has not been trained in the application of these theories. Formal training does not provide opportunities to develop the power of observation, formulation of objectives and determining order of priority within a given situation. These shortcomings must be overcome.

In some cases the researchers and Governments have not adequately defined research, extension and service. This has resulted in scientists being charged with a multitude of duties labelled research, only part of which really is research. Such arrangements greatly reduces the efficiency and consequently the accomplishments of a program.

Research should be organized to obtain the maximum accomplishment with the least possible expense and number of people. This implies very well defined objectives, with a sharp focus on the problems in production and the order of priority of these problems. It also implies in general a team approach on a crop oriented basis. The team should be made up of specialists in the disciplines of breeding, production agronomy and field physiology, soils, pathology, entomology and production oriented agricultural economists.

Diseases and insects will continue to be problems that deserve a great deal of attention. Downy mildew, *Sclerospora philippinesis* and *S. sacchari*, is probably the greatest disease hazard facing maize production in the tropics today. These two species which cause very similar symptoms are responsible for great economic loss in Taiwan and the Philippines, and to the best of my knowledge, we do not know or understand why they are not more important in Indonesia and Thailand.

Taiwan and the Philippines are engaged in a cooperative program studying host-pathogen relationships and are breeding for resistance. There is real need to accelerate and intensify investigations on downy mildew.

There are, of course, many other diseases some of which are quite well understood and the pathologists and breeders have sources of resistance. The stock rot complex is perhaps more serious than we realize and should be actively investigated.

Nematodes are an unknown factor but it is almost certain that they are serious in some areas and may be quite damaging in most of the more tropical part of the region.

Insects take their toll in every country and are particularly hard to control without mechanization. Various genera of borer are the most obvious of the insects and only very recently is there evidence of resistance to the borer in India and West Pakistan. There are several genera in the region and resistance to one is no assurance of resistance to another.

It seems rather obvious that there are a number of disease and insect problems that will require several years of very intense plant protection and breeding research to solve.

With the new varieties and hybrids that have been released and others that are on the drawing board, it appears that production or cultural practice research may be the greatest need for most of the area for the immediate future. For the most part there is inadequate data on economic fertilizer response, weed control, plant populations, seedbed preparation and a complete lack of information on the root system, soil-water-plant relationships and efficient fertilizer utilization.

There are many plant types in a collection of germplasm but the breeders have selected plant types on an accepted set of standards without looking at the possibility of more efficient types. The agronomists are equally guilty in that they have not challenged the breeders nor have they explored the relative efficiencies of the variations in plant type that they have available. Neither has there been adequate attention given to maturity as it relates to maximum production per unit area per day for the total cropping days available per year. Crop rotations and cropping patterns need much more study.

In spite of all of the problems that have been discussed, it is still possible to produce ten tons of dry shelled grain per hectare in 110 to 120 days on many experiment stations in Asia. What is the upper limit that can be produced if we solve all of the problems that have been mentioned? It would be difficult to predict but I am sure that investments in research would make substantial increases possible.

There are tremendous opportunities for improving maize through breeding to meet the various requirements of Asia. In my opinion maize breeders should be more aggressive in their use of exotic germplasm and in extending the genetic variation within the range of adaptation that is acceptable. It is understood that each program must devote a major portion of its efforts towards the immediate varietal requirements. This does not, however, eliminate the possibility of improving germplasm for the future. In fact with the right approach, germplasm can be improved in such a way that it will provide recombinations for the present and still a greater array of recombinations for the future.

The need for early maturity has restricted, and in some cases eliminated, the use of a wide range of exotic germplasm to increase genetic variation. With this restriction imposed the breeders cannot expect to make the degree of improvement that could be made if they had germplasm with a wider base. Would it not be possible to overcome this limitation? Early adapted materials could be crossed to quality germplasm of any maturity to form the composite base from which selections could be made. If this were done two objectives should be kept in mind. The objectives would be: a new variety produced very quickly, and the other would be a long range program. After crossing, the F_1 population should be planted at three dates with five days intervals. The F_2 population should be divided with a portion managed to fit each of the stated objectives. To meet the requirements of the first objective the breeders would start rather rigid selection for earliness in the population. Continued selection for earliness would eliminate many desirable gene combinations but it would shift the population rapidly toward the required maturity and still contain a portion of the desirable genes from the exotic parent. The second objective would be obtained by continuing to increase the second portion of the F_2 by planting at three dates of five day intervals for three more generations with mild selection pressure applied. By this time linkage groups should be reasonably well broken up allowing for new combinations that are early but carry a much larger portion of the exotic germplasm. Material of this kind lends itself to both population improvement and to inbreeding programs.

It is imperative that breeders shift away from the practice of excessively working and reworking the same material. We must remember that limited material has a definite limit to its potential and further working will not improve the basic source unless we add new genetic variation.

Seed production requires skills comparable to research but is not the responsibility of research. With limited qualified people I feel that most nations will make more progress if they move seed through a regional farm testing and seed plot program rather than through the more conventional seed certification system. The importance of quality seed is fully recognized but it is questionable whether seed certification programs should be started at the expense of research.

Assuming that problems of production are not greatly retarding maize yields, there is still the big task of extension or farmer education. There is no question but that the farmers of Asia are responsive to better opportunities and incentives. There is, however, a time lag between research results and farmer implementation which can be shortened with more aggressive extension work and improved communication. Acceleration of extension work will require a dramatic program of training extension workers in the improved method of cultivation and the advantages that farmers can expect.

The economics of production in most of the Asian countries is quite favorable but constant attention must be given to the relationship of input cost and value of the crop. Greater use of fertilizer, herbicides, and insecticides will add materially to the total production of maize in Asia. These commodities must, however, be available to the farmers on a timely basis and at a price that is relative to the price he can expect for his produce.