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UTILIZATION OF GENETIC RESOURCES FOR MAIZE AND SOYBEAN BREEDING IN BRAZIL

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ABSTRACT

A survey was carried out among maize and soybean plant breeders from public and private institutions to evaluate the use of germplasm collections and to identify the sources of variability that are being used in breeding programs. Germplasm banks are regularly used by soybean breeders. However, they have been little used by maize breeders. The amount of information concerning available accessions in germplasm banks was considered 70% insufficient for maize and 30% for soybean. The main sources of genetic variability have been the breeder's own work collection and breeder-to-breeder germplasm exchange. It was observed that agronomically adapted breeding materials show wide enough variability to assure continuous progress through selection.

INTRODUCTION

There is growing concern about maintainance of genetic diversity of cultivated species for future work in plant breeding (Paterniani, 1988). During the 70's several conservation centres for crop germplasm, or germplasm banks were established, mainly in developing countries (Plucknett *et al.*, 1983). Consequently, at a world-wide level, an expressive volume of germplasm has been incorporated into the genetic resources system. By 1983, around 2,000,000 accessions (Holden, 1984) were incorporated. This number was considerably increased by 1992, reaching 3,200,000 accessions (Giacometti, personal communication).

The Brazilian Enterprise for Agricultural Research (EMBRAPA) has constantly expanded germplasm collections through projects coordinated by the National Genetic

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Resources and Biotechnology Research Center (CENARGEN). In 1979 there were 40 active germplasm banks maintaining 28,000 accessions. By 1983 the number reached 64, keeping 47,700 accessions. In 1992, there were 82 with more than 85,000 accessions, including 6,880 of soybean and 3,484 of maize (Kornelius and Costa, personal communication).

Genetic resource utilization is still very low. According to Brown (1975) maize breeders in the United States have concentrated their efforts on few races and less than 5% of total available germplasm has been used in breeding programs. The low usage of germplasm banks can be explained by failures in the accessions documentation and in characterization, and not enough evaluation of agronomic characters and of genetic variability (Peeters and Williams, 1984; Salhuana, 1987; Marshall, 1989).

The exchange of materials among plant breeders, as an informal process of exchanging germplasm, constitutes an efficient alternative for the extension of genetic variability in breeding programs (Duvick, 1984; Peeters and Galwey, 1988).

We decided to evaluate the level of utilization of the germplasm banks and also to identify the sources of variability employed in breeding programs of maize and soybean in Brazil.

MATERIAL AND METHODS

A survey was carried out among breeders of maize and soybeans from different regions of Brazil. These crops were chosen because of: distinct types of reproduction, considerable economic importance, distinct genetic basis and due to the reasonable number of researchers involved in the breeding programs.

The questionnaires were sent to 48 maize and 35 soybean breeders. Questions were made about size and usage of germplasm banks.

RESULTS AND DISCUSSION

Replies were received from 34 maize breeders. For soybeans 17 questionnaires were returned. For both crops the proportion of replies was 65% for the public and 35% for the private sector. In Brazil, many private institutions have maize breeding programs. However, these institutions employ fewer researchers than the public sector, which could help explain the results.

Most of the plant breeders work with a restricted number of maize and soybean accessions, not more than 100 (Table I). Since the technical significance of the term "accession" (sample representation of an individual or a set of individuals) was not defined in the questionnaires these results are suspect.

Table I - Questionnaire sent to maize (M) and soybean (S) breeders (in % response).

	M			S		
1. Number of accessions in work collection						
0 to 100	56			29		
100 to 200	6			24		
200 to 300	6			12		
300 to 500	6			0		
500 to 1,000	3			12		
> 1,000	23			23		
2. Utilize germplasm banks						
Regularly	14			41		
Rarely	68			41		
No	18			18		
3. Quality of information available on accessions						
Excellent	7			19		
Good	24			44		
Adequate	35			31		
Inadequate	34			6		
4. Quantity of information available on accessions						
More than sufficient	3			0		
Sufficient	27			69		
Insufficient	67			25		
Quite insufficient	3			6		
5. Sources for pest (P), disease (D) and other stress (S) resistance	P	D	S	P	D	S
Germplasm banks	22	14	21	35	22	21
Own breeding collection	44	50	49	19	28	24
Exchange among breeders	32	36	30	46	47	52
Other	2	0	0	0	3	3

Continued

Table I - Continued

	P	D	S	P	D	S
6. Type of material used for resistance breeding						
Wild	5	2	2	14	8	29
Trad. cultivar/landraces	21	17	28	18	25	24
Experimental lines	15	14	15	36	22	24
Advanced cultivar/elite	59	67	55	32	45	43
7. Sources for yield increase						
Germplasm banks		18			19	
Own breeding collection		40			33	
Exchange among breeders		37			45	
Other		5			3	
8. Type of material for yield increase						
Wild		2			5	
Trad. cultivar/landraces		14			22	
Experimental lines		17			30	
Advanced cultivar/elite		67			43	

Germplasm banks were used more by soybean breeders than maize breeders (Table I, item 2). Probably this is not due to the type of reproduction of this crop. The results can be better explained by the greater level of characterization and evaluation of available accessions in soybeans. Despite the great quantity of genetic materials existing in germplasm banks in the world, 80% of available accessions are not characterized and 95% have no evaluation data (Peeters and Williams, 1984).

The quality of information was considered sufficient for both crops (Table I, item 3). On the other hand, the quantity of information did not satisfy 70% of the maize breeders necessity (Tabel I, item 4). A similar survey conducted among european barley and garlic breeders, indicated that the quantity of information was also the main problem for germplasm utilization (Peeters and Galwey, 1988).

The sources of genetic variability are shown in Table I, item 5. The types of materials that are frequently being used to get pest and disease resistance, and other environmental stresses are given in Table I, item 6.

Maize breeders used their working collection most frequently, while breeder-to-breeder exchange of materials constitutes the main accession source for soybeans (Table I, item 5). Peeters and Galwey (1988) also found little utilization of germplasm banks. They emphasized that breeders often maintain substantial working collections and they have an efficient reciprocal exchange of materials to find a solution for their problems.

For both crops, elite adapted materials were the most important and widely used sources for specific programs for resistance (Table I, item 6). Experimental lines were considered very important for pest resistance in soybean breeding. Landraces have been frequently used in breeding for pest, disease and environmental stresses. Duvick (1984) observed a significant contribution of landraces towards broadening of the genetic basis of five crop breeding programs in the United States.

When yield was considered the plant breeder's own working collection and the breeder-to-breeder exchange materials were the main sources of accessions used by maize and soybean researchers (Table I, item 7). The elite adapted cultivars were the best material for increase in grain yield (Table I, item 8).

These results show that plant breeders often find sufficient genetic variability among agronomically advanced materials to attend their necessities. Similar surveys were carried out in the United States (Duvick, 1984), in Europe (Peeters and Galwey, 1988), in Brazil and in other countries (Paterniani, 1987), showing similar trends.

The majority of the respondents concentrated their breeding programs to well defined and limited geographical areas, probably due to the genotype x environmental interaction.

The main suggestions presented by plant breeders concerned actions to improve the quality and the quantity of characterization and evaluation data, improvement of the catalogues for maize and soybean germplasm, as well as to organize similar catalogues for other crops. They also suggested the establishment of data bases to allow available information to be utilized fast and efficiently.

The low utilization of germplasm banks is not restricted to Brazil or to countries in development. It is common around the world. Genetic resource activities have a high cost and a long term return. Certainly, close cooperation between institutions and breeders will increase the knowledge about available germplasm and the extensive genetic variability of different species.

RESUMO

Foi realizado um levantamento entre melhoristas de milho e soja, envolvendo os setores público e privado, a fim de avaliar o nível de utilização dos bancos de germoplasma e identificar as fontes de variabilidade empregadas nos programas de melhoramento genético dessas culturas. A utilização regular dos acessos disponíveis nos bancos de germoplasma é baixa entre os melhoristas de milho e alta entre os melhoristas de soja. A quantidade de informações sobre os acessos foi considerada insuficiente por 70% e 30% dos melhoristas

de milho e soja, respectivamente. A coleção própria de trabalho e a troca de materiais entre melhoristas foram apontadas como as principais fontes de variabilidade genética. Os resultados indicaram que os materiais avançados de melhoramento e agronomicamente adaptados, apresentam variabilidade genética suficiente para atender a demanda atual dos programas de melhoramento genético de milho e soja.

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