Table 1. Selected thick rind collections used to form synthetics with strong stalks.

Collection	Race	Mean rind thickness(mm)
	Low altitude (hot climate) group	
Ecu. 383	Gallina	1.68
Ecu. 935	Gallina	1.63
Ecu. 685	Candela	1.67
Ecu. 337	Tuxpeño	1.75
Ecu. 978	Chococeño	1.74
Ecu. 332	Chococeño	1.69
Ecu. 964	Chococeño	1.81
Ven. 598	Tuxpeño	1.67
Ven. 692	Tuxpeño	1.60
Ven. 931	Puya Grande - Sicarigua	1.62
	Mid-altitude (medium climate) group	
Ven. 460	Chandelle	1.98
Ven. 699	Tusón	2.01
Ven. 495	Puya Grande, Blanco	1.87
Ven. 340	Común, Blanco	2.04
Ven. 914	Puya - Común	2.05
Ven. 372	Puya Grande - Costeño	2.15
Ecu. 718	Cholito Ecuatoriano	1.86
Ecu. 906	Yunquillano mixture	2.12
Ecu. 863	Yunquillano mixture	1.84
*Ecu. 890	Clavito	1.88
	High altitude (cold climate) group	
Ven. 666	Sabanero Venezolano	1.93
Ecu. 453	Mishca - Chillo	2.06
Ecu. 457	Mishca - Chillo	1.92
Ecu. 495	Mishca - Huandango	1.87
Ecu. 481	Chillo	1.89
Ecu. 602	Morochón - Cuzco	1.96
Ecu. 879	Blanco Blandito - Harinoso Dentado	1.90
Ecu. 927	Blanco Blandito - Harinoso Dentado	1.94
Ecu. 962	Blanco Blandito - Harinoso Dentado	2.08
Ecu. 901	Blanco Blandito - Mishca	1.90

* From the small cool climate group.

Thompson (3) extensively reviewed the literature relating to corn stalk breakage or lodging, the morphological bases for differences in mechanical strength, and techniques which have been used to measure stalk strength. He reemphasized the desirability of measurement techniques which are largely independent of environmental lodging forces. He concluded that the advantages of measuring stalk strength by crushing strength and rind thickness are that each plant is evaluated on a quantitative scale, genotype $\times$ environmental interactions are low, and stalk strength measurements can be obtained independently of lodging stress. In that study he found that crushing strength was correlated at 0.96 with rind thickness and that the coefficients of variability for rind thickness were approximately one-third the size of coefficients of variability for crushing strength.

All collections from Ecuador and Venezuela previously classified (1, 4) as typical of the various races and collections belonging to a complex of two specific races were included in this study except for a few which had poor germination. Composited collections representing seven races of Colombia were also measured.

The 494 collections were divided into four groups corresponding to their adaptation, determined largely by altitude and the corresponding temperature relationships. The low altitude or hot to medium-hot climate group was grown at Palmira, Colombia, and harvested in August 1964. This station has an altitude of 1,000 meters and a mean temperature of 24 C. The mid-altitude or medium climate group was grown at Medellín, Colombia, and harvested in October 1964. Medellín is at an altitude of 1,500 meters and has a mean temperature of 21 C. The small cool climate group was grown at the Rionegro station about 30 kilometers from Medellín and harvested in November 1964. This station is at an altitude of 2,200 meters and has a mean temperature of 17 C. The "cold climate" or high altitude group were grown near Bogotá, Colombia, and were harvested in January 1965. The altitude at Bogotá is 2,600 meters and the mean temperature is 14 C.

In most cases the collections were grown in 4-row plots and the second through sixth plants of the two center rows were considered a random 10-plant sample. The second internode above ground level of mature plants was cut and placed in a heated air drier at 40 C. for approximately 7 days. A portion of rind 1 or 2 centimeters wide and about 8 centimeters long was further dried for 3 days at approximately 50 C. The remaining pith cells were scraped from the inner side with a dull knife and the thickness of the rind measured to the nearest 0.05 millimeter with a hand micrometer with rounded points.

The individual collection means varied from 0.62 to 1.81 mm at Palmira, 0.97 to 2.15 mm at Medellín, and 0.90 to 2.08 mm at Bogotá.

Three new synthetics are being formed from 30 selected collections as germplasm sources of exceptional stalk strength. Their sources are shown in Table 1. It is expected that these will be available to geneticists and breeders in 1966 or 1967.

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ESTIMATES OF NATURAL CROSS-POLLINATION IN JACKSON SOYBEANS IN ARKANSAS[1]

C. E. Caviness[2]

ABSTRACT

Rather wide year-to-year fluctuations in natural cross-pollination were found to occur when the Lee and Jackson varieties were planted in adjacent rows in Arkansas during a 3-year period. Natural cross-pollination was 0.44% in 1961 and 0.03% in 1962 and 1963 when the varieties were grown in adjacent rows. With distances of more than 15 feet from the pollen source, natural cross-pollination was rare and did not vary greatly during the 3-year period in these experiments.

THE soybean (*Glycine max* (L.) Merr.) is self-fertile and self-pollinated. Pollination occurs in the advanced bud stage before the flower opens. Some natural cross-pollination has been reported under field conditions in certain areas of the United States.

When different varieties were planted in adjacent rows, Woodworth (4) observed 0.04% natural cross-pollination in Wisconsin and Garber and Odland (2)

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Table 1. Extent of natural cross-pollination in Jackson soybeans, Stuttgart, Arkansas, 1961-63.

Year	Sample distances from pollen source*	No. plants evaluated	No. natural crosses	% natural crossing
1961	3 feet	2,066	9	0.44
	9 to 15 feet	4,561	1	0.02
	21 to 27 feet	4,982	0	0.00
	33 to 51 feet	10,360	1	0.01
1962	3 feet	2,864	1	0.03
	9 to 15 feet	5,287	3	0.06
	21 to 27 feet	6,026	1	0.02
	33 to 51 feet	12,324	0	0.00
1963	3 feet	7,525	2	0.03
	9 to 15 feet	14,475	1	0.007
	21 to 27 feet	14,130	0	0.00
	33 to 51 feet	25,540	1	0.004

* Test varieties were Lee and Jackson with Lee the pollen source.

observed 0.07 and 0.18%, respectively, in successive years in West Virginia. Culter (1) obtained an average of 1.10% natural crossing with alternate 3- to 4-inch spacing of different varieties within the row in Indiana. Weber in Iowa and Hanson in Maryland (3) obtained approximately 1.0% natural crossing when plants were grown in close contact. It has been reported that small insects probably cause cross-pollination by their movement from one flower to another.

Information is limited on the extent of natural cross-pollination in the southern production area, especially when the pollen source is located at varying distances from a particular variety. Experiments to determine the extent of natural cross-pollination in the adapted southern varieties, 'Jackson' and 'Lee,' were conducted on a Crowley silt loam soil at the Rice Branch Experiment Station, Stuttgart, Arkansas, during the 3-year period, 1961 to 1963. These varieties possess excellent marker genes to determine the amount of natural cross-pollination. The experimental area consisted of 35 rows of the Jackson variety which was bordered on both sides by 2 rows of Lee. Planting was during mid-May and at the rate of 1 viable seed per inch in rows 3 feet apart.

A composite sample of seed from a 20-foot section of alternate rows of the Jackson variety was harvested and planted in the field the following year to determine the extent of natural cross-pollination. Hybrid plants were easily detected because the genes for purple flowers and tawny pubescence of the Lee variety are dominant to those for white flowers and gray pubescence of Jackson. Percent natural cross-pollination was calculated from the actual number of hybrid plants observed in the Jackson variety only. Because of equal chances for reciprocal crossing this could be doubled.

The data in Table 1 indicate that seasonal differences caused rather wide fluctuations in the amount of natural cross-pollination. When the varieties were grown in adjacent rows the 1961 season was more favorable for cross-pollination, as indicated by 0.44% natural crossing, than the 1962 and 1963 season when only 0.03% was recorded.

Natural crossing generally was reduced with increased distances from the Lee variety, although 0.06% natural cross-pollination occurred during 1962 when plants of the Jackson variety were located 9 to 15 feet from the Lee variety. An occasional natural cross was found at distances of 21 to 27 feet and 33 to 51 feet from Lee, but in general the actual percent of natural cross-pollination was low at these distances. Seasonal differences did not appear to affect the natural crossing percentage when the pollen source was separated by more than about 15 feet. These data further indicated that it was not possible to completely eliminate natural cross-pollination by distances as great as 33 to 51 feet. One natural cross was found in 1961 when the pollen source was at a distance of 33 feet and one in 1963 when it was 45 feet.

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TROPICAL ENVIRONMENT OF PUERTO RICO USEFUL FOR STUDYING DAY-LENGTH SENSITIVITY IN PEARL MILLET[1]

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CLIMATIC conditions of temperature zone agriculture often constitute a formidable barrier to use of genetic diversity found in short-day sensitive germ plasm of many field crops. Breeders of field crops such as corn, sorghum, and millet are often unable to make field pollinations between plants that differ widely in their response to photoperiodism. Genotypes that require less than a 12-hour day to initiate floral primordia frequently fail to reach anthesis or mature seed in temperate zone environments. Crosses between plants with different photoperiodic responses often can be made in the greenhouse and the F_1 plants can be grown under the same conditions. But because of space limitations the greenhouse is not practical for producing and studying advanced generations.

The inconveniences involved in working with short-day plants have caused most research workers in temperate areas to concentrate on using available sources of long-day germ plasm. However, these sources are rapidly being exhausted. If research workers are to continue to improve varieties and hybrids, new sources of germ plasm will be useful. Therefore, methods should be developed so that short-day germ plasm can be made available in a useful form to research workers in both tropical and temperate areas.

This article presents the results of a study on pearl millet which describes how climatic conditions in Puerto Rico are well suited for: research dealing with the nature of photoperiodism in field crops; for increasing seed of daylength sensitive varieties; and for the rapid advancement of genetic and breeding studies. It also illustrates the usefulness of cooperative re-

[1] Cooperative investigation of the Crops Research Division, ARS, USDA, Mayaguez, Puerto Rico, and Coastal Plain Experiment Station, Tifton, Georgia. Received Sept. 3, 1965.

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