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1) Analysis of variation and relationship between soybean traits in F_3 and F_4 in two cross combinations.

Qualities and traits of soybean are reported to produce a considerable variation under conditions of long-day environment (Jaranowski et al., 1980, 1983). An outline of genetic bases for soybean breeding in a latitude above 50°N calls for establishing the least environment-modified traits and relationships.

Materials and methods: This study carries a presentation of relationships and heritability of traits in early hybrid generations (F_3-F_4) from two cross combinations, i.e., a medium-early semi-determinate line (PI 238920) and a somewhat later maturity semi-determinate line (PI 180517) -- cross combination "A", in addition to a Japanese cultivar Oyachi No. 2, classified in our conditions to late semi-determinate lines -- cross combination "B".

A characteristic of parental forms from three-year field experiments is shown in Table 1.

Table 1. Values for parental forms of soybean

Traits	PI 238920	PI 180517	Oyachi No. 2
Days to maturity	135.0	143.0	164.0
Height, cm	58.0	68.0	61.0
Branch, number per plant	4.0	4.0	2.0
Seeds, number per plant	39.0	62.0	24.0
Seed weight per plant, g	7.2	11.2	6.3
Seeds, number per pod	1.5	1.6	1.6
Seed weight, g/100	18.9	17.7	21.4

For each cross combination, a separate experiment was carried out according to the randomized block design, in four replications. Plants selected for testing were characteristic of high selective value in the F_2. From the first cross combination, 25 progenies of the F_3 were grown in the first year

of experiments and 33 of the F_4 in the consecutive year. From the second cross combination, 67 progenies of the F_3 were grown. In the consecutive year, the number of progenies were reduced to 32. Plants were grown in rows spaced 0.5 x 0.2 m. For biometric analysis, 10 plants were analyzed from each plot.

Results: Relationship estimates for developmental and morphological traits in hybrid generations are likely to help determine effective criteria for selection. In the first year, the variation of morphological traits and its effect on seed yield were analyzed. The second year included the relationship among earliness, morphological traits, and yield parameters. In the F_3 and F_4 of the two cross combinations, the values for variation coefficients were relatively low in the two years of experiments. The lowest variation was noted for the number of seeds per pod (Table 2).

A relatively high genotypic effect was found with respect to: plant height, branch number, seed number per pod and weight of 100 seeds. However, the effect varied with the combination and year. It was observed that plant traits of the F_4 from the PI 238920 x Oyachi No. 2 were far more modified by the environment than those from the PI 238920 x PI 180517. Markedly low heritability coefficients were noted for earliness and yield parameters (Table 2).

Despite the equivocal genotypic and environmental determination of the set up of soybean traits in the F_3 and F_4, the heritability of yield structure elements showed higher values than the introduced forms had. Heritability coefficients of the latter for the number of seeds, seed weight, and weight of 100 seeds were estimated at 0.32, 0.33, and 0.46, respectively (Skorupska et al., 1984). The results suggest a good chance of developing genotypes with a more stable yield performance in hybrid generations and of their potential in the process of adjusting soybeans to new habitats.

Both the character and the range of correlation coefficients varied with years and cross combinations. Only a few correlations were found to occur with some regularity; e.g., in the F_3 of the two cross combinations, distinct relationship was noted for the number of branches and weight of 100 seeds. In the F_4, the height of plants was correlated with the number of seeds per plant (A: $r = 0.24$; B: $r = 0.17$) and with the number of seeds per pod (A: $r = 0.13$; B: $r = 0.16$) (Table 3). A similar relationship was recorded for earliness, branch number, and weight of 100 seeds. Earliness was negatively correlated with plant height and showed more distinctly in the experiment with F_4 plants

Table 2. Variation and heritability of traits in F_3 and F_4 in two soybean cross combinations

Traits / Cross combination	Mean		Variation coefficient		Heritability coefficient	
	A	B	A	B	A	B
	1st year of experiments					
Height, cm	55.4	73.1	9.2	11.5	0.63	0.90
Branch, number per plant	5.9	6.1	11.2	16.3	0.73	0.88
Seeds, number per plant	73.0	65.0	14.5	19.6	0.73	0.76
Seeds, number per pod	1.6	1.5	7.1	5.7	0.83	0.68
Seed weight per plant, g	9.4	10.9	11.7	18.7	0.46	0.66
Seed weight, g/100	12.8	16.5	9.7	7.7	0.91	0.62
	2nd year of experiments					
Earliness	11.0	12.1	24.1	21.4	0.76	0.16
Height, cm	75.7	98.5	9.0	11.7	0.93	0.89
Branch, number per plant	5.7	6.0	8.4	13.0	0.85	0.56
Seeds, number per plant	135.7	71.5	12.7	12.2	0.85	0.49
Seeds, number per pod	1.7	1.4	5.2	5.4	0.81	0.57
Seed weight per plant, g	20.7	12.9	13.0	10.7	0.85	0.34
Seed weight, g/100	15.3	18.2	19.4	8.5	0.94	0.89

Table 3. Phenotypic correlation coefficients in F_3 and F_4

Traits	Cross Combination "A"	1st year of experiments						Cross Combination "B"
		1	2	3	4	5	6	
1. Height of plants		1.00	0.55	0.39	0.27	0.22	-0.34	
2. Branch, number per plant		0.12	1.00	0.80	0.40	0.68	-0.21	
3. Seeds, number per plant		-0.34	-0.33	1.00	0.59	0.87	-0.27	
4. Seeds, number per pod		0.06	0.96	-0.40	1.00	0.61	0.02	
5. Seed weight per plant		-0.34	-0.33	0.82	-0.43	1.00	0.15	
6. Seed weight, g/100		0.39	-0.37	-0.31	-0.42	0.22	1.00	

	Cross Combination "A"	2nd year of experiments							Cross Combination "B"
		1	2	3	4	5	6	7	
1. Earliness		1.00	-0.20	0.19	0.21	-0.30	0.09	-0.18	
2. Height of plants		-0.45	1.00	0.41	0.17	0.16	-0.23	-0.52	
3. Branch, number per plant		0.10	0.04	1.00	0.71	-0.13	0.44	-0.48	
4. Seeds, number per plant		-0.34	0.24	0.02	1.00	-0.13	0.75	-0.55	
5. Seeds, number per pod		0.02	0.13	0.02	0.40	1.00	0.05	0.26	
6. Seed weight per plant		-0.64	0.30	0.06	0.63	-0.13	1.00	0.12	
7. Seed weight, g/100		-0.39	0.10	0.04	-0.39	-0.62	0.46	1.00	

from the PI 238920 x PI 180517 combination. Moreover, progenies of the latter exhibited that plants with a shorter growing period had a strong tendency to developing seeds with a higher weight of 100 seeds (A: r = -0.39; B: r = -0.18) (Table 3). The most distinct correlations with years and cross combinations were found between the elements of yield structure. Positive values for correlation coefficients were reported with respect to the weight of seeds and number of seeds per plant, in addition to weight of 100 seeds. Correlation values for the number of seeds and weight of 100 seeds were negative. The latter is worth mentioning in that selection for seed yield in our climate can possibly be more effective in progenies whose yield results from the number of seeds per plant rather than from the size of seeds.

References

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