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1) New breeding lines of soybean developed at Pantnagar

The major breeding objectives of the soybean breeding project at this university have been: high seed yield, early maturity, better seed quality and resistance particularly to yellow mosaic virus, bacterial pustule, and *Rhizoctonia* aerial blight. The suitable donors have been identified and are being used in the crossing program (Ram et al., 1981).

A total of 270 newly selected breeding lines from the advanced generations derived from the crossing program (pedigree method of breeding) were evaluated in 15 different trails, each consisting of 18 new breeding lines and 2 checks, i.e., 'Alankar' and 'Bragg'. The trials were planted on June 27, 1979, in randomized block designs with 2 replications. Each plot consisted of 5 rows of 5 m, spaced 60 cm. Detailed observations were recorded on incidence of diseases and agronomic characteristics. Based on overall superiority, plant type and freedom from diseases, 90 lines (PK-412 to PK-501) were selected for further evaluation in the next season.

These 90 new breeding lines were evaluated in 5 separate trials, each comprising 18 new lines and 2 checks (Bragg and Alankar). All these trials were planted on June 28, 1980, in randomized block design with 4 replications. The planting details were as given above.

The yield differences among the lines in trial 1 were significant. The lines giving better yield than the checks were PK-412, PK-413, PK-415, PK-416, PK-422, PK-424, PK-428 and PK-429. The highest yielding line in this trial was PK-422 (2916 kg/ha). The maturity duration of these lines ranged from 117-123 days.

The lines included in trial 2 did not have significant differences for seed yield. The highest yielding line in this trial was PK-430 (2794 kg/ha). Maturity duration ranged from 113 to 118 days.

The highest yielding line in trial 3 was PK-450 (3194 kg/ha). Other superior lines in this trial were PK-448, PK-449, PK-451, PK-454, PK-455, PK-459, PK-460, PK-463 and PK-464. The maturity duration of these lines ranged from 115 to 123 days.

The lines giving better yield than the checks in trial 4 were PK-467, PK-469, PK-470, PK-471, PK-472, PK-477 and PK-478. They had a maturity range of 119-125 days. Except for 3 lines (PK-484, PK-487, PK-501), these 15 lines gave more seed yield than the checks in trial 4. The maturity duration was 118-125 days.

The performance of these selected lines is given in Table 1. Most of these lines were resistant to yellow mosaic and bacterial pustule. The resistance to yellow mosaic has come from either UPSM-534 or *Glycine formosana*. Bragg was the source of resistance to bacterial pustules. Some of these lines and a few additional ones as given below have been included in the all-India coordinated testing:

Table 1. Performance of new breeding lines of soybean during rainy season 1980 at Pantnagar

Breeding lines	Parentage	Days to flowering	Days to maturity	Plant height (cm)	Pods/ plant	Seeds/ pod	100-seed weight (g)	Seed yield (kg/ha)	Disease reaction	
									YMV	BP
1	2	3	4	5	6	7	8	9	10	11
PK-412	(M534 x S-38)	54	120	73.3	96.8	2.08	13.6	2500	M	R
PK-413	(M534 x S-38)	45	121	71.8	69.6	2.01	12.9	2326	R	S
PK-415	(M534 x S-38)	45	119	67.7	84.2	2.01	14.5	2361	M	R
PK-416	(M534 x S-38)	45	123	74.5	91.6	1.92	16.3	2465	M	R
PK-422	(M534 x S-38) Bragg	69	119	66.6	86.9	2.05	14.3	2916	M	M
PK-424	(M534 x S-38) Bragg	46	119	75.9	75.0	2.12	15.2	2412	M	R
PK-428	(M534 x S-38) Bragg	44	119	57.6	69.0	2.11	13.7	2152	M	R
PK-429	(M534 x S-38) Bragg	45	120	60.6	91.8	2.00	12.8	2761	R	M
PK-430	(M534 x S-38) Bragg	44	118	54.3	75.8	2.20	15.3	2794	R	R
PK-448	(M534 x M-91) Bragg	42	115	63.5	71.1	2.00	12.7	2639	M	R
PK-449	(M534 x M-91) Bragg	43	117	66.8	62.4	1.80	12.7	2465	M	M
PK-450	(M534 x M-91) Bragg	44	115	66.9	81.1	2.00	13.0	3194	M	M
PK-451	(M534 x M-91) Bragg	46	117	70.4	99.2	2.10	13.4	2517	R	R
PK-452	(M534 x M-91) Bragg	48	120	72.6	69.6	1.90	17.9	2690	M	R
PK-454	(M534 x M-91)	48	119	68.7	59.1	2.00	14.5	2378	R	R
PK-455	(M534 x M-91)	51	122	71.8	64.5	2.00	16.5	2326	M	R
PK-459	(M534 x M-168) Bragg	47	123	62.9	73.4	1.90	14.5	2708	R	R
PK-460	(M534 x M-168) Bragg	46	121	68.0	83.7	1.90	14.0	2430	R	R
PK-463	(Hardee x Pb-1)	55	118	83.2	86.9	2.00	13.4	2517	M	R
PK-464	(Hardee x Pb-1)	47	115	53.6	77.6	2.00	15.0	2378	M	R
PK-467	(Hardee x Pb-1)	58	120	72.7	80.5	2.05	12.80	2430	M	R
PK-469	(Hardee x Pb-1)	57	119	72.4	88.3	1.90	14.00	2430	M	R
PK-470	(Hardee x Pb-1)	57	119	72.4	74.0	2.00	13.6	2586	M	M
PK-471	(Hardee x Pb-1)	56	119	74.4	85.3	2.15	15.1	2812	M	R
PK-472	(Hardee x Pb-1)	61	125	62.5	90.1	1.95	15.7	3037	R	R
PK-477	(M534 x Pb-1)	57	124	99.3	94.2	1.95	12.2	2621	M	R
PK-478	(M534 x PK-71-39)	50	123	63.4	84.1	2.05	18.3	2430	R	M

Table 1. Continued

Breeding lines	Parentage	Days to flowering	Days to maturity	Plant height (cm)	Pods/ plant	Seeds/ pod	100-seed weight (g)	Seed yield (kg/ha)	Disease reaction	
									YMV	BP
1	2	3	4	5	6	7	8	9	10	11
PK-485	(M534 x PK-71-39) Bragg	47	119	123.2	97.9	1.90	15.7	2760	R	R
PK-486	(GF x Bragg) Bragg	52	119	65.3	87.6	1.90	11.2	2100	R	R
PK-488	(GF x Bragg) Bragg	52	120	70.3	76.0	2.05	13.0	2030	R	R
PK-489	(GF x Bragg) Bragg	52	120	71.1	87.4	1.90	12.7	1961	R	R
PK-490	(GF x Bragg) Bragg	52	119	66.2	91.6	1.95	13.7	2187	R	R
PK-491	(GF x Bragg) Bragg	52	119	71.0	78.4	2.00	12.0	2014	R	R
PK-492	(M534 x Lee)	52	117	55.3	74.1	2.15	17.4	2100	M	M
PK-493	(T-49 x Lee)	52	123	73.7	79.2	1.80	15.5	2378	R	R
PK-494	(T-49 x Lee)	51	119	65.9	88.2	2.15	11.2	2042	M	R
PK-495	(M726 x T-49)	61	125	76.8	85.4	1.95	12.9	1892	M	R
PK-496	(M726 x T-49)	61	123	93.8	86.7	1.85	16.3	2257	M	R
PK-497	(M726 x T-49)	61	120	86.2	84.3	2.00	17.0	1926	M	S
PK-498	(MS-2 x M534)	51	120	93.3	90.5	1.95	15.1	2621	M	R
PK-499	(M534 x S-38) Bragg	50	120	69.1	67.5	2.00	16.1	2361	MR	R
PK-500	(M534 x S-38)	57	120	58.0	87.9	1.85	20.1	2308	S	R

M 534 = UPSM 534, YMV = Yellow mosaic virus, BP = Bacterial pustule, R = Resistant, M = Moderately resistant, S = Susceptible

Northern Hill Zone - PK-415, 429, 430, 442, 444, 450.

Northern Plain Zone - PK-412, 416, 448, 451, 453, 459, 478, 486, 490.

Central Zone - PK-395, 472, 484, 493, 500.

Southern Zone - PK-398, 408, 470, 471, 485, 498.

References:

Ram, H. H., Pushpendra, K. Singh and V. D. Verma. 1981. Breeding soybean varieties for the northern India. Soybean Genet. Newsl. 8:74-78.

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2) Extent of selfing during crossing in soybean

Soybean is a strictly self-pollinated crop and crossing between two varieties is rather difficult due to small size of flowers and low pod setting (Ram et al., 1981). The crossed pods usually have reduced size and, hence, have fewer seeds/pod. The seeds obtained from the crossed pods may include some seeds that might be due to selfing while crossing. Our observations on the F_1 generations in our breeding program clearly support this possibility. We invariably encounter selfed plants in the F_1 generations. However, in this report, we intend to provide the extent of selfed seeds separately in single-seeded, double-seeded and triple-seeded crossed pods.

Seventy-five F_1s were grown on July 3, 1981. Each cross was divided into 3 groups, viz., single-seeded crossed pods, double-seeded crossed pods and triple-seeded crossed pods. The seeds were grown group-wise in single row, 2 m long, spaced 60 cm. Total F_1 plants across the 75 crosses were counted groupwise and the selfed plants were identified based on flower color, plant type, growth habit, size of leaflet, pubescence color (purple flower > white flower, indeterminate growth habit > determinate growth habit, incomplete dominance between narrow and broad leaflet, tawny pubescence > grey pubescence). The results are summarized in the following table.

Table 1. Percentage of selfed seeds during crossing in soybean

Single-seeded crossed pods			Double-seeded crossed pods			Triple-seeded crossed pods		
Total plants	Selfed plants	Selfed plants (%)	Total plants	Selfed plants	Selfed plants (%)	Total plants	Selfed plants	Selfed plants (%)
163	16	9.8	365	73	20.0	96	43	44.8

The percentage of selfed plants was lowest (9.8%) in single-seeded pods and highest (44.8%) in triple-seeded pods. Taking these values into account, it is suggested that F_1 plants should be carefully inspected and selfed plants rogued out. As far as possible, seeds from triple-seeded pods should be avoided to grow due to higher percentage of selfing in these crosses. Further crosses should be planned in such a way so that dominant phenotype comes from the male parent for successful roguing. It would be safer to grow F_2 of each F_1 plant separately in view of high level of selfing (9.8 - 44.8%) during crossing in soybean.

References

Ram, H. H., V. D. Verma, K. Singh and Pushpendra. 1981. Pod setting under standard crossing procedures in soybean. Soybean Genet. Newsl. 8:78-79.

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3) Screening for photoperiod insensitivity under natural conditions in soybean

Early varieties of soybean have been found to be less sensitive to photoperiods than late varieties (Johnson et al., 1960). Therefore, it was postulated that some of the early strains of soybean may have no photoperiod requirement and accordingly screening for insensitivity to photoperiod was carried out in 498 early lines of soybean. These germplasm lines were evaluated for days to flowering and several morphological traits under two different seasons, viz., rainy season, 1978, and spring/summer season, 1979.

The difference in delay of days to flowering between rainy season and spring season plantings ranged from -4 to 40 days. These lines were classified into different groups (Table 1) according to the degree of delay in flowering during spring/summer season following the procedure of Shanmugasundaram (1978).

Table 1. Classification of lines into different groups based on delay in days to flowering under spring planting

Delay in days to flowering	Sensitivity score	Number of lines
-4-4	0	60
5-8	1	83
9-16	2	253
17-24	3	92
25-32	4	9
33-40	5	1
		498

The lines having a sensitivity score of 0 were considered as insensitive. These lines were as follows:

UPSE 6, 7, 75, 98, 104, 158, 164, 171, 175, 204, 339, 704, 2411, 2619, 2628, 2631, 2632, 2673, 2678, 2687, 2690, 2718, 2723, 2727, 2747, 2769, 2770, 2782, 2783, 2787, 2789, 2791, 2794, 2795, 2798, 2799, 2800, 2802, 2803, 2806, 2808, 2813, 2819, 2820, 2821, 2826, 2828, 2837, 2841, 2842, 2843, 2846, 2847, 2848, 2849, 2893, 2896, 2897, 2900, 2913, 2914, 2937, 2948.

These lines may be grown throughout the country and may possibly be used as donors for photoperiod insensitivity. However, these lines when planted under Pantnagar conditions tend to flower too soon and, therefore, have low yields. Therefore, from yield point of view, these lines are inferior. Therefore, attempts are in progress to identify photoperiod insensitive, late maturing cultivars which may be utilized for breeding soybean in the tropics.

References

Johnson, H. W., H. A. Brothwick and R. T. Seffel. 1960. Effect of photoperiod and time of planting on rates of development of the soybean in various stages of life cycle. Bot. Gaz. 122:77-95.

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