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USE OF IRRADIATIONS TO IMPROVE SEED YIELD AND NODULATION IN SOYBEAN VARIETY COBB

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ABSTRACT

Two dosages of X rays, 25 and 35 kR, were used to irradiate seeds of soybean variety Cobb. Eleven M_4 mutants were identified whose roots nodulated and which yielded higher than control. The mutants also revealed variation for pods/plant, seeds/pod, reproductive period, 100-seed weight, and were early maturing. The mutant P18 outyielded the parent variety Cobb by 29.9%.

Key words: Irradiation, nodulation, Rhizobium strain, specificity, reproductive periods, inoculants.

Soybean, a protein-rich legume, is being cultivated in pockets in India. In the late 1960s, it was commercially cultivated in Madhya Pradesh, Maharashtra and Uttar Pradesh. Presently, its overwhelming importance in the state of Madhya Pradesh has given new dimensions to soybean based industry in India. Soybean varieties, although rich in protein, were found poorly modulating in Indian soils [1–3]. Several studies conducted in and outside India to identify improved *Rhizobium japonicum* strains aimed at bringing improvement in nodulation [4, 5]. The present study has been taken up to evolve a suitable genotype responsive to effective rhizobia, and increase both grain yield and nodulation in soybean.

MATERIALS AND METHODS

Dry seeds of the Soybean variety Cobb were X-irradiated with 25 kR and 35 kR at the Indian Agricultural Research Institute, New Delhi. In the subsequent years, M_2 and M_3 plant progenies were raised and based on the performance of these single plant progenies, 11 M_4 mutants were selected for further trials in RBD in a plot size of 4 x 3 m with the rows 45 cm and plants 10–15 cm apart, in three replications. The data on five representative plants were recorded for plant height, branches/pod, pods/plant, seeds/pod, days to flower, days to maturity, reproductive period, 100-seed weight, and seed yield/plant. The mean values were computed and subjected to analysis of variance.

RESULTS AND DISCUSSION

MEAN GENOTYPIC PERFORMANCE

The overall performance of soybean mutants in comparison to cv. Cobb (Table 1) revealed that P6, the highest yielding mutant (30.0 g/ plant) was followed by P4 (29.9 g), P11 (25.9 g), P18 (25.8 g) against 16.6 g in cv. Cobb. P6 was earlier to Cobb by 4 days in flowering and by 1 week in maturity. The highest seed yield of this mutant may be ascribed to increase in pods/plant, 100-seed weight, and branches/ plant. The mutant P4 which was earlier in flowering and maturity to the parent cv. Cobb by 5 days and 8 days, respectively, and also produced more pods/plant, besides having higher 100-seed weight and more branches/plant. Mutant P12/2 as the second highest (153.0 pods/plant). The maximum number of pods/plant (164.5) were recorded in mutant P5 as compared to 120.7 pods/plant in cv. Cobþ. P5 followed by P1 registered the highest 100-seed weight (17.6 g and 17.2 g, respectively). The mutants P5, P12 and P17 had highest number of branches per plant (9.4, 8.1 and 8.7, respect- ively) against 6.6 branches/plant in the variety Cobb.

It can be seen from the data that the mutants were quite superior to the parent Cobb in branches per plant, pods per plant, 100-seed weight, and seed yield per plant, besides being early in flowering and maturity with slight increase in the reproductive per- iod. Kappushev et al. [6] reported that increase in seed yield, crude protein and maturity of soybean genotype was due to increase in N_2 fixed biologically.

GENOTYPE X RHIZOBIUM INTERACTION

A perusal of the data presented in Table 1 clearly depicts strain specificity for almost all the seed yield components under study. For plant height, the predominance of the Rhizobium strain 1028 over HOB was distinct in the mutants, P11, P12/2, P14, P16 and P18 and that of HOB over 1028 in P1, P4 and P5. Two mutants, P6 and P17 responded almost alike to both the inoculants for this trait. The strain 1028 showed significant increase in number of branches/plant in mutant P4 than strain HOB. In this mutant, the strain HOB maintained superiority over 1028 for pods/plant in the mutants P1, P4, P6, P14, P16 and P18. The strain HOB was found good only for the mutant P17. Mutants P4 and P12 responded almost alike for seeds/plant with both the seed inoculants. For 100-seed weight, the mutants P1, P5, P6, P14 and P18 responded alike to the seed inoculants. Almost similar genotypic response to both the Rhizobium strains was expressed by the mutants P1, P4 and P5 for days to 50% flowering, days to maturity, and reproductive period. The highest seed yield (32.1 g/plant) of P4 and 31.9 g/plant of P6 with HOB against 16.2 g in Cobb, and 29.8 g of P18 and 28.3 g of P6 with 1028 depicted significantly high response of soybean mutants to both the bacterium inoculants and the supermacy of HOB over 1028. The mutants P12/2 and P17 gave equal response to both the strains.

Table 1. Effect of *Rhizobium* strains on mean seed yield and its components in the soybean mutants compared with the parent variety Cobb

Character	Rhizobium strain	P1	P4	P5	P6	P11	P12	P12/2	P14	P16	P17	P18	Variety Cobb	Varietal mean
Plant height (cm)	1028	46.2	41.8	44.0	45.4	51.5	42.6	56.7	49.4	57.2	44.2	53.4	46.4	48.2
	HOB	54.1	46.2	46.2	45.9	40.7	40.6	46.7	46.7	53.6	44.3	49.0	40.9	46.2
	Mean	50.1	44.0	45.1	45.6	46.1	41.6	51.7	48.0	55.4	44.2	51.2	43.6	47.2
	CD 5%	V=4.6; C=13.1; VxC=7.9												
Branches per plant	1028	8.5	7.0	10.8	9.0	10.4	9.8	7.6	7.8	7.7	9.7	7.7	7.5	8.6
	HOB	6.4	8.0	8.0	7.6	6.2	8.5	8.6	7.3	8.0	7.8	6.8	5.8	7.4
	Mean	7.4	7.5	9.4	8.3	8.3	9.1	8.1	7.5	7.9	8.2	7.2	6.7	8.0
	CD 5%	V=0.05; C=0.8; VxC=1.9												
Pods per plant	1028	105.5	88.0	141.0	113.0	164.0	124.5	158.5	111.0	114.0	136.5	143.0	120.5	126.6
	HOB	149.5	131.5	88.0	164.5	103.0	122.0	147.5	123.0	124.0	128.0	146.5	120.0	129.0
	Mean	127.5	109.7	114.5	138.7	133.5	123.2	153.0	117.0	119.0	132.2	144.7	120.2	127.8
	CD 5%	V=5.9; C=2.6; VxC=12.6												
Seeds per pod	1028	1.9	2.1	2.1	2.1	2.1	2.0	2.0	2.1	2.3	2.3	2.0	2.1	2.1
	HOB	2.0	2.1	2.1	2.1	1.9	2.1	2.0	2.0	2.2	2.4	2.2	2.0	2.1
	Mean	1.9	2.1	2.1	2.1	2.0	2.0	2.0	2.0	2.2	2.3	2.1	2.0	2.1
	CD 5%	V=NS; C=NS V x C=NS												
100-seed weight (g)	1028	17.2	17.7	17.5	17.0	17.3	7.4	15.7	16.4	16.5	17.8	16.5	12.4	16.6
	HOB	17.2	15.6	17.6	16.7	16.4	15.9	16.2	16.4	15.1	15.7	16.0	11.8	15.9
	Mean	17.2	16.6	17.5	16.8	16.8	16.6	16.0	16.4	15.8	16.7	16.2	12.1	16.2
	CD 5%	V=1.8; C=0.7; VxC=2.5												
Days to flowering	1028	58.6	57.3	58.1	59.3	57.9	60.3	60.5	59.7	58.7	59.3	58.5	62.4	59.2
	HOB	59.0	57.7	58.7	57.3	61.6	57.7	59.1	57.4	56.7	58.5	60.0	63.1	58.9
	Mean	58.8	57.5	58.4	58.3	59.7	59.0	59.8	58.5	57.7	58.9	59.2	62.7	59.0
	CD 5%	V=4.0; C=0.2; VxC=1.8												
Days to maturity	1028	96.0	94.2	97.7	99.3	97.8	100.2	100.6	99.0	99.1	99.5	102.4	104.1	99.2
	HOB	102.8	98.1	100.4	98.6	97.0	100.6	99.1	99.7	99.0	101.2	102.4	105.3	100.3
	Mean	99.4	96.1	99.0	98.9	97.4		99.8	99.3	99.0	100.3	102.4	104.7	99.7
	CD 5%	V=2.9; C=1.8; VxC=4.1												
Reproductive period (days)	1028	37.4	36.9	39.6	40.0	39.9	40.8	40.1	39.3	40.4	40.2	43.9	41.7	40.0
	HOB	43.8	40.4	41.7	41.3	35.4	42.5	40.0	42.3	42.3	42.7	42.4	42.2	41.4
	Mean	40.6	38.6	40.6	40.6	37.7	41.6	40.0	40.8	41.4	41.4	43.6	42.0	40.7
	CD 5%	V=1.9; C=3.6; VxC=5.4												
Yield per plant (g)	1028	27.2	27.7	22.4	28.2	22.1	22.7	20.2	19.3	16.6	25.1	29.8	17.1	23.2
	HOB	19.6	32.1	16.3	31.9	29.7	17.6	20.1	21.1	18.5	24.0	21.7	16.2	22.4
	Mean	23.4	29.9	19.4	30.0	25.9	20.1	20.1	20.2	17.5	24.5	25.7	16.7	22.8

Note. V stands for varieties, C for culture, and V x C for their interaction.

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