EFFECT OF LEAF TYPE, PUBESCENCE TYPE AND NON-NODULATING GENES ON YIELD AND QUALITY CHARACTERS IN SOYBEAN[1]

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THE purpose of this investigation was to study the pleiotropic effect of genes controlling leaf type, pubescence type and non-nodulation on yield and other quantitative characters in soybean.

MATERIALS AND METHODS

A few seeds of the near-isogenic lines in 'Harosoy' and 'Clark' 'genetic backgrounds ('narrow-leaf', 'pentafoliate', 'glabrous', 'curly', 'sparse' and 'dense' pubescence' and 'non-nodulating') as well as of pure 'Harosoy' and 'Clark' varieties were obtained from R. L. Bernard, Regional Soybean Laboratory, Urbana, Illinois and further multiplied to obtain enough seed for this experiment. The trial consisting of these 16 entries was planted on March 3, 1971 and February 20, 1972 in a randomized block design with 4 replications at the Experiment Station of this University. Each plot consisted of 10 rows which were 6 m long and 30 cm apart. Fertilizer application was done by hand placement @ 20 kg N, 100 kg P_2O_5 and 60 kg K_20 and 10 kg zinc sulphate per hectare. After emergence, the plants were thinned to maintain a plant to plant distance of 3–4 cm. Irrigations were given as per need. Observations were taken on days to 50% flowering, days to maturity on plot basis and leaf area, plant height, pods/plant, nodes/plant, branches/plant, seed/pod, 100 seed weight, yield/plant, oil content (%) and protein content (%) on 10 randomly selected plants from each plot. For estimations of plot yield, a net area of 5 m × 2·4 m from each plot, consisting of the eight middle rows of 5 m length was harvested. Protein and oil contents were determined on plot basis by Kjehldahl and Soxhlet methods, respectively.

RESULTS

The mean performance of different isogenic lines in Harosoy and Clark genetic backgrounds is presented in Table 1.

The narrow leaf type had significantly less leaf area, more number of seeds/pod and less 100 seed weight with no significant difference for yield as compared to normal. There was no significant difference between the pentafoliate and normal leaf types for any characters in both the backgrounds indicating no pleiotropic effect of this gene.

The glabrous types had significantly less leaf area, shorter plants and smaller seeds than normal types in both the backgrounds. In 'Harosoy' background, the glabrous type had significantly fewer pods/plant and less yield per hectare but in 'Clark' background the differences were not significant. This might have been due to excessive lodging in the normal Clark. The medium plant height, less

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TABLE 1

Mean performance of different near-isogenic lines

Line	Days taken to flower	Days taken to maturity	Leaf area (cm)	Plant height (cm)	Pods/ plant	Seeds/ pod	100-seed wight (gm)	Yield kg/ha	% protein	% oil
Hatosoy	37	102	108	47·4	17·3	2·18	17·74	3178	43·8	21·9
narrow leaf	37	100	85	47·2	14·3	2·24	16·95	3099	43·3	21·6
pentafoliate	37	99	121	50·8	20·1	2·23	18·10	3266	44·2	22·3
glabrous	36	94	79	36·1	12·3	2·15	15·20	2633	43·9	20·8
curly	37	99	102	45·1	14·1	2·04	17·52	3305	44·3	21·9
sparse	37	100	121	55·2	17·7	2·27	17·17	3077	44·0	21·3
dense	37	100	129	54·8	17·4	2·17	18·15	3205	44·2	22·3
non-nodulating	36	100	92	52·8	15·3	1·90	13·25	2200	34·0	24·9
Clark	39	107	136	65·4	16·2	2·41	18·29	3404	44·0	22·4
narrow leaf	38	106	91·8	60·4	11·0	2·46	17·18	3296	43·3	22·2
pentafoliate	39	109	134	64·8	14·0	2·35	17·48	3554	43·7	22·8
glabrous	39	106	83	56·8	14·0	2·30	16·28	3553	44·0	21·3
curly	39	108	120	66·9	14·1	2·40	17·48	3592	44·6	22·0
sparse	39	108	139	70·3	20·5	2·54	16·25	3602	42·5	22·0
dense	39	108	116	63·4	12·9	2·40	18·38	3653	44·3	22·4
non-nodulating	39	106	107	46·2	7·8	2·42	11·39	1414	32·6	26·8
C. D. (5%)	1·4	1·7	19·0	8·0	3·9	0·30	1·45	359	1·4	1·2

leaf area, smaller seeds and low yielding ability of glabrous type may be due to the pleiotropic effect of gene $\mathbf{P}_1$ which causes glabrousness. There was no significant difference between curly, sparse, dense and normal type for any of the characters studied.

Non-nodulating lines were poorest in yield and yield contributing characters as compared to normal lines in both the seasons and in both backgrounds. The protein content of non-nodulating line was significantly lower than normal lines but the oil content was significantly higher (Table 1). Because of non-nodulating gene **rj1**, these lines fail to utilize atmospheric nitrogen and thus suffer from nitrogen deficiency. Nitrogen being one of the main pre-requisites for most of the metabolic molecules, its deficiency badly affects all the physiological and growth processes of the plant resulting into poor vigour smaller seeds and poor yield.

Discussion

No significant differences were observed between narrow leaf and normal leaf types for yield, yield components, quality characters and growth characters except for leaf area in both the backgrounds. Apparently the narrow leaf does not have any adverse effect on the overall plant vigour. The reduction in leaf size and seed size may be desirable from agronomic stand point as it would be possible to increase plant population per unit area and small seeds would give better germination. Differences between pentafoliate and normal types were also non-significant, indicating that pentafoliate gene has no adverse effect on yield and yield contributing characters. The glabrous gene had pleiotropic effect on a number of growth and seed characters. However, the reduced stature of the plants due to this may be desirable from agronomic stand point in those areas where potato leaf hoppers are not a problem. Curly, sparse and dense pubescence types did not differ significantly to normal type for yield and yield components.

The reduction in protein content of non-nodulating lines is mainly due to lack of nitrogen. The apparent increase in oil content is only on per unit weight basis but if viewed on per seed basis, there is reduction in the oil content too. For example, the oil content in a normal seed is about 39 mg. as compared to 33 mg. in case of non-nodulating isoline. Thus, there is a net decrease in protein as well as oil synthesis. However, since, the reduction in protein is more, the percentage oil content of seed appears to be more.

Summary

The effect of qualitative genes governing characters like narrow leaf, pentafoliate leaf, glabrous, curly, sparse and dense pubescence types and non-nodulating type on yield and yield contributing characters was studied. The narrow leaf and pentafoliate leaf types were not significantly different as

compared to normal leaf type for the characters studied in both the backgrounds except for leaf area in narrow leaf type, indicating no pleiotropic effect of these genes. Medium plant height, smaller seed size and low yielding ability of glabrous type may be due to the pleiotropic effect of gene P_1. No visible pleiotropic effect of curly, sparse and dense pubescence types was observed. The non-nodulating lines gave significantly less protein, smaller seeds and more oil than the normal lines.