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Genetic studies for pod traits in soybean

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Abstract
An investigation was conducted in *Kharif* 2019 with 154 genotypes of soybean including four checks *viz*., JS 20-34, JS 20-98, JS 335 and NRC 86 to estimate genetic variability, heritability, genetic advance, pod trait, correlation coefficient and path coefficient analysis for pod and yield traits. Considerable amount of genetic variability was exhibited for all the traits under study which revealed that exploitable level of variability exists among genotypes. The highest per cent of PCV (43.97%) and GCV (39.89%) were found for one seeded pods/plant. High heritability with high genetic advance was observed for most of the traits under study. Correlation and path analyses revealed that the traits *viz*., number of seeds per plant, biological yield per plant, harvest index and 100 seed weight. Hence direct selection through these traits will be very effective for improvement and enhancement in the yielding potential of soybean genotypes. The categorization of genotypes on the basis of pod traits indicated that JS 20-66 had expressed higher number of four seeded and three seeded pods per plant, whereas JSM202, JS20-09, TS 37and NRC 76 reported higher number of four seeded pods. Hence, hybridization between these two groups may contribute profuse podding which ultimately enhance the number of seeds per plant.

Keywords: Pod traits, correlation, path, soybean

Introduction
Soybean [*Glycine max* (L.) Merrill] is one of the versatile self-pollinated legume crop because of its extraordinary quality and multiple uses. It has highest protein (42 %), rich in lysine and vitamins (A, B and D) and also contains 20 % oil, low in fat with no cholesterol (Kumar *et al*., 2015) [21]. Globally, it has acquired important ranking first among the major oilseed crops with contribution of 25% of World's vegetable oil production and two thirds of protein concentrates for livestock feeding (Anonymous, 2018) [4]. In M.P., the cultivation of soybean engross 5.51 m ha area with 6.73 m tonnes production and productivity of 1285 kg/ha (SOPA, 2020) [24]. Madhya Pradesh has played a major role ever in the development and expansion of soybean cultivation and contributes substantially by producing 50% soybean of the country in all respect, as for given the title as "Soya State". Being a successful and mega oilseed crop, productivity is still hovering around 1.2t/ha despite the yield potential of upto 3.5t/ha. Lower yield are due to the limited genetic gain as well as narrow genetic base of released varieties. The main reason behind it is, the erratic behavior of monsoon affecting all the critical stages of plant growth and development. Occurrence of uneven and inadequate rains or drought both at one or the other stages of crop growth is major factors responsible for low productivity of soybean in India. Besides this, outbreak of pest and disease plays an important role in yield reduction. The occurrence of biotic stresses triggered by different abiotic stress creates more problems and ultimate huge reduction in soybean yield.

Pod and seed number are prerequisite yield traits of soybean such as number of pods per plant; numbers of seeds per pod, number of seeds per plant and seed size, easily identifiable and contributing properties of yield. It has been observed that increased proportion of three seeded pods or four seeded pods has great influence on quantum increase in number of seeds per plant and consequently substantial enhancement in yield. There is a possibility of increasing soybean yield potential upto 27% through developing four seeded plant ideotype (Shrivastava *et al*., 2011) [22]. The degree of relatedness between important pod and seed traits is an index that can be used to predict yield response in relation to changes associate with a particular trait. To enhance the yield potential, it is necessary to study the economic traits which will enhance the efficiency of conventional breeding strategies. Efficient data of diverse germplasm lines on major economic and physiological traits and relation among them give a detail picture of pod and yield based study. To improvise the productivity and sustainability of soybean in India, it is mandatory to acquire systematic screening of well adapted, potential donors.

Material and Methods
The experimental material comprised of 154 genotypes of soybean including four checks *viz*.,JS 20-34, JS 20-98, JS 335 and NRC 86.

Experiment was laid out in augmented block design at the Seed Breeding Farm, J.N.K.V.V., Jabalpur (M.P.) during *Kharif* 2019 with plot size 0.5m × 3.0 m^2 having 3m row length and 40 cm row to row distance. Observations were recorded on the basis of five random competitive plants for the evaluation of 14 traits including two phenological traits The mean data of 5 plants were subjected to genetic variability analysis (Federer, 1956), pod trait analysis, correlation analysis given by Miller *et al*., (1958) [18] and path coefficient analysis by Dewey & Lu (1959) [10].

Result and Discussion

The genetic variability is the raw material of plant breeding on which selection acts to evolve superior genotypes. Thus, higher the amount of variation present for a concerned trait in the breeding materials, greater is the scope for its improvement through selection. The analysis of variance revealed that the mean squares were significant for all the fourteen traits. The estimates phenotypic coefficient of variation (4.37 to 43.97%) slightly higher than of genotypic coefficient of variation (4.18 to 39.89%) indicated less effect of environment in expression of traits (Table 1). Highest GCV and PCV were recorded for number of one seeded pods/plant followed by number of two seeded pods/plant, three seeded pods/plant, primary branches/plant, harvest index, seed yield, number of seeds/plant, biological yield/plant, and total pods/plant Whereas, plant height, 100 seed weight, number of nodes/plant and days to 50% flowering observed as moderate estimates of PCV and GCV.

Highest value of heritability were reported by days to 50% flowering followed by number of seeds/plant and harvest index. High heritability coupled with high genetic advance were observed for days to 50% flowering, plant height, number of primary branches/plant, number of nodes per plant, number of one seeded pods, number of two seeded pods, number of three seeded pods, total number of pods/plant, number of seeds/plant, biological yield/plant, 100 seed weight, harvest index and seed yield /plant. This suggested the preponderance of additive gene action with low environmental influence. Similar results were obtained by Singh *et al*. (2010) [23] for biological yield, number of pods per plant, plant height, Bharat *et al*. (2016) [6] for plant height, number of nodes per plant, number of pods per plant, harvest index, seed yield, Chandrawat *et al*. (2017) [8] for number of pods per plant, plant height, seed yield, 100 seed weight, Joshi *et al.* (2018) [13] for days to 50% flowering, plant height, number of nodes per plant, pods/plant, 100 seed weight and seed yield.

Pod Trait Analysis

In the present investigation, the distribution and frequencies of 4, 3, 2 and 1 seeded pods per plant were studied among the genotypes is presented in Table 2. Out of the 154 genotypes, the maximum number of pods per plant was exhibited by SL 1104 (90.37) followed by PK 618 (72.07), G 225 (64.10), JSM 122 (62.50) and JSM 236 (60.23), G 225, JSM 122, KBS 701, PK 618 and SL 1104 are having higher mean number of pods per plant as well as higher percentage of two seeded pods.

JS 20-66 had expressed higher number of four seeded and three seeded pods per plant with contribution of 1.57% four seeded pods and 68.01% of three seeded pods which contributes 69.58% of the total pods. Similarly, G 225 reported higher number of two seeded pods, one seeded pods as well as mean number of pods per plant. JS 20-09 had 12.61% four seeded pods with 4.33 number of four seeded pods per plant. KBS 701 had 35.33 number of three seeded pods and 8.33 number of one seeded pods with 14.13% one seeded pods which contributes important portion to the total pods. Similar findings were reported by Wayne (1945) [26], Weiss *et al.* (1970) [27], Lal *et al*. (2018) [15] that most common soybean varieties predominantly contain two or three seeds per pod, Zhu and Sun (2006) [28], Chauhan *et al.* (2007) [9], Shrivastava *et al*. (2011) [22] found that among four seeded pod cultures higher percentage frequency of pods were contributed by pods having higher number of seeds.

Correlation Coefficient Analysis

Correlations indicate the magnitude of linear association between pairs of traits and form the basis of selection index. It will help to know how the improvement in one trait will bring simultaneous changes in other traits. For a rational approach towards improvement of yield, selection has to be made for the components of yield. It helps in direct selection of associated traits for the improvement of desirable traits. Correlation coefficient (Table 3) was studied considering fourteen pod yield traits, out of which number of one seeded pods/plant, total number of pods/plant, number of seeds/plant, biological yield/plant and 100 seed weight showed highly significant positive correlation with seed yield/plant. Similar results have been reported by Badkul *et al.* (2012) [5] for biological yield, pods/plant, and number of seeds/plant, Alpna *et al.* (2015) [3] for number of pods/plant, 100 seed weight, Mishra *et al.* (2017) [5] for number of pods per plant, 100 seed weight, and biological yield/plant, Ghonbari *et al.* (2018) for biological yield, Vu *et al*. (2019) [25] for pods per plant, number of seeds per plant and 100 seed weight.

Path Coefficient Analysis

Path coefficient analysis was carried out using genotypic and phenotypic correlation coefficients and taking seed yield per plant as the dependent variable in order to see the causal factor(s) and to identify the best components which are responsible for producing seed yield. The genotypic path coefficient analysis (Table 4) of different pod and yield traits on seed yield per plant revealed that number of seeds per plant and harvest index recorded considerably very high estimates of positive direct effect. Substantially higher positive direct effect were recorded for biological yield, 100 seed weight, three seeded pods/plant, days to 50% flowering and number of nodes/plant signifying a moderate amount of positive direct effect. Whereas, very high negative direct effect on seed yield/plant was observed by days to maturity followed by higher negative direct effect via plant height and one seeded pods/plant. Similar findings have also been reported by Mehmat *et al.* (2009) [17] for number of seeds/plant, Li *et al.* (2013) for 100 seed weight and three seeded pods/plant, Shivkumar *et al.* (2013) [21] and Adaby *et al*. (2013) for harvest index, Akram *et al.* (2016) [2] for number of seeds/plant and 100 seed weight, Kumar *et al.* (2018) [14] for number of seeds/plant and harvest index.

Table 1: Parameters of genetic variability for pod and yield traits in soybean genotypes

Traits	Mean	Range		GCV (%)	PCV (%)	h^2 b (%)	GA as% of mean
		Max.	Mini.				
Days to 50% flowering (Days)	42.12	30.00	53.00	11.04	11.08	99.35	22.65
Days to maturity (Days)	102.53	91.00	113.00	4.18	4.37	91.48	8.23
Plant Height (cm)	64.12	39.82	91.67	17.12	17.50	95.67	34.49
Number of primary branches/plants	2.70	00.00	5.73	32.28	35.13	84.44	60.55
Number of nodes/plants	13.60	9.33	17.73	12.08	12.86	88.23	23.25
1 seeded pods/plant	2.72	00.00	8.33	39.89	43.97	82.26	74.05
2 seeded pods/plant	30.71	9.23	69.33	36.35	38.15	90.78	71.33
3 seeded pods/plant	18.30	6.37	39.27	34.02	35.46	92.02	67.22
Total number of pods/plants	40.90	20.32	90.33	25.47	26.02	95.82	51.35
Number of seeds/plants	67.52	40.39	139.33	30.72	30.83	99.30	63.06
100SW (g)	9.90	6.70	14.73	12.69	13.58	87.29	24.33
Biological yield/plant (g)	17.74	12.24	36.78	29.06	30.33	91.75	57.31
Harvest Index (%)	41.30	16.30	63.90	33.54	33.97	97.51	68.23
Seed Yield (g)	7.81	3.86	15.14	31.03	31.19	94.51	61.50

Table 2: Distribution and frequency (%) of 4, 3, 2 and 1 seeded pods/plant in soybean genotypes

S. No.	Genotype	No. of 4 seeded pods	% of 4 seeded pods	No. of 3 seeded pods	% of 3 seeded pods	No. of 2 seeded pods	% of 2 seeded pods	No. of 1 seeded pods	% of 1 seeded pods	Mean no. of pods/ plant
1	AGS 80	0.00	0.00	13.33	27.81	32.30	67.39	2.30	4.80	47.93
2	AGS 112	0.00	0.00	22.67	63.55	10.67	29.91	2.33	6.53	35.67
3	AMS 243	0.00	0.00	13.33	27.51	33.80	69.75	1.33	2.74	48.46
4	B 327	0.00	0.00	21.67	59.14	11.67	31.85	3.30	9.01	36.64
5	BAUS 102	0.00	0.00	9.00	20.26	33.10	74.50	2.33	5.24	44.43
6	Cat 156	0.00	0.00	12.33	23.47	37.50	71.39	2.70	5.14	52.53
7	Cat 330	0.00	0.00	13.33	30.07	28.60	64.52	2.40	5.41	44.33
8	Cat 418	0.00	0.00	23.70	63.59	11.67	31.31	1.90	5.10	37.27
9	Cat 473B	0.00	0.00	31.33	66.01	13.33	28.09	2.80	5.90	47.46
10	Cat 488	0.00	0.00	10.33	32.42	17.33	54.39	4.20	13.18	31.86
11	Cat 60	0.00	0.00	8.00	19.62	30.10	73.83	2.67	6.55	40.77
12	Cat 642	0.00	0.00	9.33	24.86	25.20	67.15	3.00	7.99	37.53
13	Cat 1328	0.00	0.00	7.67	19.68	28.50	73.13	2.80	7.19	38.97
14	Cat 1843B	0.00	0.00	9.33	17.17	42.60	78.41	2.40	4.42	54.33
15	Cat 1957	0.00	0.00	11.00	24.43	31.70	70.40	2.33	5.17	45.03
16	Cat 1958	0.00	0.00	7.67	20.09	27.80	72.83	2.70	7.07	38.17
17	Cat 2059	0.00	0.00	8.00	17.08	36.50	77.94	2.33	4.98	46.83
18	Cat 2086A	0.00	0.00	11.00	32.35	21.33	62.74	1.67	4.91	34.00
19	Cat 2090	0.00	0.00	9.33	27.72	23.00	68.33	1.33	3.95	33.66
20	Cat 2127B	0.00	0.00	7.33	20.36	26.67	74.08	2.00	5.56	36.00
21	DSB 1	0.00	0.00	14.00	28.50	32.80	66.76	2.33	4.74	49.13
22	DSB 25	0.00	0.00	15.00	28.63	37.10	70.80	0.30	0.57	52.40
23	Eagle 81	0.00	0.00	9.00	19.28	35.00	74.99	2.67	5.72	46.67
24	ERS 9045	0.00	0.00	12.67	27.32	31.60	68.15	2.10	4.53	46.37
25	ERS 1344	0.00	0.00	17.30	59.04	9.67	33.00	2.33	7.95	29.30
26	EC 456647	0.00	0.00	18.33	55.55	12.00	36.36	2.67	8.09	33.00
27	GP 448	0.00	0.00	14.33	26.05	38.67	70.31	2.00	3.64	55.00
28	GP 465	0.00	0.00	9.00	22.24	29.80	73.63	1.67	4.13	40.47
29	G 225	0.00	0.00	11.00	17.16	48.30	75.35	4.80	7.49	64.10
30	Himso 1681	0.00	0.00	9.00	20.28	32.70	73.70	2.67	6.02	44.37
31	Hara soya Eagle	0.00	0.00	9.67	24.44	27.60	69.75	2.30	5.81	39.57
32	IC 313230	0.00	0.00	10.33	25.55	30.10	74.45	0.00	0.00	40.43
33	JS 71-05	0.00	0.00	12.70	27.15	33.40	71.41	0.67	1.43	46.77
34	JS 72-44	0.00	0.00	21.67	52.00	18.33	43.99	1.67	4.01	41.67
35	JS 75-30	0.00	0.00	11.00	24.23	31.40	69.16	3.00	6.61	45.40
36	JS 75-46	0.00	0.00	9.00	23.62	25.80	67.72	3.30	8.66	38.10
37	JS 97-57	0.00	0.00	21.70	57.06	14.00	36.81	2.33	6.13	38.03
38	JS 98-66	0.00	0.00	10.00	21.20	34.50	73.14	2.67	5.66	47.17
39	JS 99-77	0.00	0.00	14.33	25.81	41.20	74.19	0.00	0.00	55.53
40	JS 99-88	0.00	0.00	11.33	25.60	30.60	69.14	2.33	5.26	44.26
41	JS 20- 06	0.00	0.00	13.33	24.40	37.30	68.28	4.00	7.32	54.63
42	JS 20-15	0.00	0.00	23.67	59.67	13.33	33.60	2.67	6.73	39.67
43	JS 20-16	0.00	0.00	11.70	20.74	41.70	73.94	3.00	5.32	56.40
44	JS 20-25	0.00	0.00	12.67	24.27	38.20	73.18	1.33	2.55	52.20
45	JS 20-32	0.00	0.00	24.70	63.82	11.67	30.16	2.33	6.02	38.70
46	JS 20-55	0.00	0.00	13.33	25.82	35.30	68.37	3.00	5.81	51.63

47	JS 20-63	0.00	0.00	28.00	62.64	14.00	31.32	2.70	6.04	44.70
48	JS 20- 66	0.67	1.57	29.00	68.01	11.30	26.50	1.67	3.92	42.64
49	JS 20-68	0.00	0.00	11.00	24.50	31.60	70.38	2.30	5.12	44.90
50	JS 20-72	0.00	0.00	11.33	27.24	28.60	68.75	1.67	4.01	41.60
51	JS 20- 74	0.00	0.00	27.40	59.18	15.20	32.83	3.70	7.99	46.30
52	JS 20-77	0.00	0.00	10.00	21.16	34.60	73.20	2.67	5.65	47.27
53	JS 20-81	0.00	0.00	24.33	65.23	11.30	30.29	1.67	4.48	37.30
54	JS 20- 86	0.00	0.00	11.00	27.87	27.80	70.43	0.67	1.70	39.47
55	JS 20-89	0.00	0.00	13.33	30.55	27.60	63.26	2.70	6.19	43.63
56	JS 20-91	0.00	0.00	14.67	58.52	9.40	37.50	1.00	3.99	25.07
57	JS 20- 96	0.00	0.00	27.30	68.94	10.00	25.25	2.30	5.81	39.60
58	JS 20-97	0.00	0.00	14.00	28.53	32.40	66.03	2.67	5.44	49.07
59	JS 20-100	0.00	0.00	21.67	64.11	9.33	27.60	2.80	8.28	33.80
60	JS 20- 104	0.00	0.00	12.33	26.50	32.20	69.20	2.00	4.30	46.53
61	JS 20-108	0.00	0.00	7.33	15.95	36.30	78.98	2.33	5.07	45.96
62	JS 20-109	0.00	0.00	7.33	18.93	29.70	76.68	1.70	4.39	38.73
63	JS 20-110	0.00	0.00	17.00	56.11	9.30	30.69	4.00	13.20	30.30
64	JS 20- 113	0.00	0.00	7.00	19.04	26.10	70.98	3.67	9.98	36.77
65	JS 20-03	0.00	0.00	18.00	62.13	10.30	35.55	0.67	2.31	28.97
66	JS 20-09	4.33	12.61	17.67	51.47	10.00	29.13	2.33	6.79	34.33
67	JS 20-76	0.00	0.00	6.33	15.38	31.50	76.53	3.33	8.09	41.16
68	JSM 3	0.00	0.00	18.70	53.32	12.70	36.21	3.67	10.46	35.07
69	JSM 7	0.00	0.00	20.00	63.76	9.70	30.92	1.67	5.32	31.37
70	JSM 17	0.00	0.00	15.00	73.89	9.70	47.78	2.33	11.48	20.30
71	JSM 122	0.00	0.00	16.33	26.13	43.50	69.60	2.67	4.27	62.50
72	JSM 126A	0.00	0.00	12.33	21.44	43.50	75.65	1.67	2.90	57.50
73	JSM 126B	0.00	0.00	7.33	19.36	28.20	74.48	2.33	6.15	37.86
74	JSM 127	0.00	0.00	11.30	29.35	24.60	63.90	2.60	6.75	38.50
75	JSM 139	0.00	0.00	14.00	26.17	34.50	64.49	5.00	9.35	53.50
76	JSM 155	0.00	0.00	21.33	57.60	14.70	39.70	1.00	2.70	37.03
77	JSM 170	0.00	0.00	8.00	17.53	35.30	77.36	2.33	5.11	45.63
78	JSM 188	0.00	0.00	11.33	19.72	42.80	74.49	3.33	5.80	57.46
79	JSM 202	9.00	15.53	10.67	18.42	36.60	63.17	1.67	2.88	57.94
80	JSM 203	0.00	0.00	16.33	27.62	39.10	66.13	3.70	6.26	59.13
81	JSM 224	0.00	0.00	18.33	59.71	9.67	31.50	2.70	8.79	30.70
82	JSM 226	0.00	0.00	24.67	58.32	12.30	29.08	5.33	12.60	42.30
83	JSM 227	0.00	0.00	8.33	20.52	28.60	70.44	3.67	9.04	40.60
84	JSM 228	0.00	0.00	6.33	17.72	25.20	70.53	4.20	11.75	35.73
85	JSM 230	0.00	0.00	16.00	58.76	9.90	36.36	1.33	4.88	27.23
86	JSM 232	0.00	0.00	17.33	54.74	11.33	35.79	3.00	9.48	31.66
87	JSM 236	0.00	0.00	16.33	27.11	41.60	69.07	2.30	3.82	60.23
88	JSM 259	0.00	0.00	16.00	30.89	34.50	66.60	1.30	2.51	51.80
89	JSM 265	0.00	0.00	15.00	30.51	31.50	64.06	2.67	5.43	49.17
90	JSM 276	0.00	0.00	27.00	66.45	12.30	30.27	1.33	3.27	40.63
91	JSM 284	0.00	0.00	26.33	62.80	13.90	33.15	1.70	4.05	41.93
92	JSM 285	0.00	0.00	21.67	63.12	10.33	30.09	2.33	6.79	34.33
93	JSM 287	0.00	0.00	39.27	66.29	17.30	29.20	2.67	4.51	59.24
94	JSM 288	0.00	0.00	9.67	20.06	38.20	79.25	0.33	0.68	48.20
95	JSM 298	0.00	0.00	10.33	26.79	24.90	64.57	3.33	8.64	38.56
96	JSM 301	0.00	0.00	10.33	17.93	42.60	73.96	4.67	8.11	57.60
97	JSM 302	0.00	0.00	8.33	16.83	39.50	79.80	1.67	3.37	49.50
98	JSM 310	0.00	0.00	7.67	18.95	29.80	73.63	3.00	7.41	40.47
99	JS 335 × G.Soja 2	0.00	0.00	24.00	59.26	13.80	34.07	2.70	6.67	40.50
100	KS 103	0.00	0.00	16.00	29.16	37.20	67.80	1.67	3.04	54.87
101	KBS 701	0.00	0.00	35.33	59.92	15.30	25.95	8.33	14.13	58.96
102	MACS 453	0.00	0.00	15.00	29.76	34.70	68.85	0.70	1.39	50.40
103	MACS 1442	0.00	0.00	19.33	55.66	12.60	36.28	2.80	8.06	34.73
104	MAUS 71	0.00	0.00	23.67	64.73	10.60	28.99	2.30	6.29	36.57
105	MAUS 162	0.00	0.00	17.67	58.32	9.23	30.46	3.40	11.22	30.30
106	MAUS 706	0.00	0.00	20.67	62.62	9.67	29.29	2.67	8.09	33.01
107	MAUS 1460	0.00	0.00	13.67	24.34	42.50	75.66	0.00	0.00	56.17
108	Nagaland 2	0.00	0.00	11.00	22.45	35.70	72.86	2.30	4.69	49.00
109	NRC 2	0.00	0.00	9.33	21.38	31.60	72.43	2.70	6.19	43.63
110	NRC 7	0.00	0.00	8.00	15.48	41.00	79.35	2.67	5.17	51.67
111	NRC 29	0.00	0.00	8.33	17.53	36.20	76.16	3.00	6.31	47.53
112	NRC 37	0.00	0.00	12.00	27.78	28.70	66.44	2.50	5.79	43.20
113	NRC 67	0.00	0.00	20.00	57.19	12.30	35.17	2.67	7.64	34.97
114	NRC 76	1.33	3.13	8.67	20.39	30.20	71.01	2.33	5.48	42.53
115	NRC 84	0.00	0.00	11.33	24.60	33.40	72.51	1.33	2.89	46.06

116	NRC 99	0.00	0.00	4.33	18.04	18.00	75.00	1.67	6.96	24.00
117	NRC 116	0.00	0.00	7.33	20.10	27.33	74.96	1.80	4.94	36.46
118	NRC 124	0.00	0.00	16.00	28.84	35.80	64.54	3.67	6.62	55.47
119	NRC 2324	0.00	0.00	7.33	19.64	25.33	67.85	4.67	12.51	37.33
120	PI 204336	0.00	0.00	11.33	22.72	37.20	74.61	1.33	2.67	49.86
121	PS 7	0.00	0.00	6.67	16.48	31.80	78.58	2.00	4.94	40.47
122	PS 1423	0.00	0.00	15.00	35.13	27.70	64.87	0.00	0.00	42.70
123	PS 1569	0.00	0.00	8.33	20.45	30.10	73.90	2.30	5.65	40.73
124	PK 462	0.00	0.00	11.00	20.32	41.80	77.22	1.33	2.46	54.13
125	PK 618	0.00	0.00	18.67	25.91	50.40	69.93	3.00	4.16	72.07
126	PK 1092	0.00	0.00	11.67	22.09	39.50	74.75	1.67	3.16	52.84
127	PK 1171	0.00	0.00	7.33	20.97	26.30	75.23	1.33	3.80	34.96
128	RKS 18	0.00	0.00	19.70	61.62	9.60	30.03	2.67	8.35	31.97
129	RKS 24	0.00	0.00	6.67	13.09	41.30	81.03	3.00	5.89	50.97
130	RKS 39	0.00	0.00	18.00	58.06	9.70	31.29	3.30	10.65	31.00
131	RKS 47	0.00	0.00	7.33	19.85	27.60	74.74	2.00	5.42	36.93
132	RKS 66	0.00	0.00	9.00	20.41	32.70	74.15	2.40	5.44	44.10
133	RSC 10-70	0.00	0.00	7.00	17.93	29.33	75.15	2.70	6.92	39.03
134	RSC 10-71	0.00	0.00	15.33	29.50	34.33	66.07	2.30	4.43	51.96
135	RVS 2007-6	0.00	0.00	7.33	16.84	31.90	73.28	4.30	9.88	43.53
136	RVS 2009-9	0.00	0.00	23.00	61.07	13.33	35.40	1.33	3.53	37.66
137	RVS 2010-2	0.00	0.00	9.00	24.08	26.70	71.45	1.67	4.47	37.37
138	RVS 2011-4	0.00	0.00	10.30	23.77	31.70	73.16	1.33	3.07	43.33
139	SL 742	0.00	0.00	19.00	58.16	11.00	33.67	2.67	8.17	32.67
140	SL 1028	0.00	0.00	16.00	42.85	19.67	52.68	1.67	4.47	37.34
141	SL 1104	0.00	0.00	15.74	17.42	69.30	76.68	5.33	5.90	90.37
142	SKFSPC 11	0.00	0.00	18.00	59.46	9.67	31.95	2.60	8.59	30.27
143	SQL 31	0.00	0.00	7.00	16.32	33.50	78.09	2.40	5.59	42.90
144	SQL 32	0.00	0.00	7.67	20.79	27.90	75.61	1.33	3.60	36.90
145	SQL 89	0.00	0.00	6.33	15.29	32.40	78.26	2.67	6.45	41.40
146	TS 37	2.00	5.80	19.67	57.01	9.50	27.54	3.33	9.65	34.50
147	VLS 58	0.00	0.00	21.33	35.49	35.10	58.40	3.67	6.11	60.10
148	VLS 69	0.00	0.00	9.67	26.81	26.40	73.19	0.00	0.00	36.07
149	VLS 89	0.00	0.00	7.33	20.92	25.70	73.37	2.00	5.71	35.03
150	WT 88	0.00	0.00	11.67	21.76	40.30	75.13	1.67	3.11	53.64
151	JS 20-98*	0.00	0.00	21.50	47.41	20.53	45.27	3.32	7.31	45.35
152	JS 20-34*	0.00	0.00	17.73	46.19	17.33	45.14	3.33	8.67	38.39
153	JS335*	0.00	0.00	16.40	40.48	20.78	51.29	3.33	8.23	40.52
154	NRC-86*	0.00	0.00	19.37	40.79	23.71	49.95	4.40	9.26	47.47

Table 3: Genotypic correlation for pod and yield traits in soybean genotypes

	DFF	DM	PH	PB	NN	1SP	2SP	3SP	TP	NS	100SW	BY	HI	SY
DFF	1	0.907**	0.327**	0.246**	0.391**	0.016	0.121	-0.068	0.293**	0.134	0.125	0.093	-0.091	0.074
DM		1	0.364**	0.289**	0.364**	-0.014	0.096	-0.061	0.271**	0.176*	0.044	0.055	-0.125	0.056
PH			1	0.134	0.476**	0.150	0.051	0.016	0.197*	0.140	-0.023	0.037	-0.125	0.010
PB				1	0.119	-0.081	0.103	-0.034	0.189*	0.011	0.037	-0.002	-0.037	0.007
NN					1	0.065	0.107	-0.053	0.158	0.029	-0.036	-0.008	-0.037	-0.004
1SP						1	0.110	0.019	0.273**	0.283**	0.095	0.158	0.121	0.193*
2SP							1	-0.600**	0.400**	0.180*	0.039	0.189*	-0.197*	0.146
3SP								1	0.168*	0.184*	0.029	0.122	0.044	0.091
TP									1	0.555**	0.022	0.477**	-0.303**	0.407**
NS										1	0.016	0.470**	-0.262**	0.706**
100SW											1	0.084	0.458**	0.267**
BY												1	-0.419**	0.455**
HI													1	0.046
SY														1

**Significant at 1%
*Significant at 5

Table 4: Path Coefficient Analysis for pod and yield traits in soybean genotypes

	DFF	DM	PH	PB	NN	1SP	2SP	3SP	TP	NS	100SW	BY	HI
DFF	0.0612	-0.1009	-0.0187	0.0048	0.0120	-0.0003	-0.0024	0.0049	0.0086	0.0915	0.0144	0.0219	-0.0232
DM	0.0555	-0.1113	-0.0208	0.0056	0.0112	0.0002	-0.0019	0.0043	0.0079	0.1202	0.0049	0.0129	-0.0321
PH	0.0200	-0.0405	-0.0571	0.0026	0.0147	-0.0023	-0.0010	-0.0011	0.0058	0.0956	-0.0027	0.0085	-0.0321
PB	0.0150	-0.0321	-0.0075	0.0195	0.0038	0.0013	-0.0020	0.0022	0.0056	0.0087	0.0043-	0.0002	-0.0094
NN	0.0239	-0.0405	-0.0272	0.0024	0.0308	-0.0010	-0.0021	0.0039	0.0046	0.0182	-0.0043	-0.0024	-0.0093
1SP	0.0011	0.0015	-0.0084	-0.0016	0.0019	-0.0158	-0.0021	-0.0014	0.0080	0.1928	0.0112	0.0371	-0.0304
2SP	0.0074	-0.0107	-0.0029	0.0020	0.0033	-0.0017	0.0194	0.0429	0.0117	0.1231	-0.0043	0.0444	-0.0502

3SP	-0.0042	0.0068	-0.0009	-0.0006	-0.0017	-0.0003	0.0116	0.0715	0.0049	0.1253	0.0035	0.0289	-0.0114
TP	0.0179	-0.0301	-0.0113	0.0037	0.0048-	0.0043	-0.0078	-0.0120	0.0293	0.3787	0.0027	0.1122	-0.0776
NS	0.0082	-0.0196	-0.0080	0.0002	0.0008	-0.0045	-0.0035	-0.0131	0.0163	0.6828	0.0019	0.1106	-0.0670
100SW	0.0075	-0.0046	0.0013	0.0007	-0.0011	-0.0015	0.0007	-0.0021	0.0007	0.0113	0.1175	0.0203	0.1169
BY	0.0057	-0.0061	-0.0021	-0.0002	-0.0003	-0.0025	-0.0037	-0.0088	0.0140	0.3210	0.0102	0.2353	-0.1072
HI	-0.0055	0.0139	0.0072	-0.0007	-0.0011	0.0019	0.0038	0.0032	-0.0089	-0.1785	0.0536	-0.0984	0.2562
Yield	0.738	0.0568	0.0103	0.0095	-0.0030	0.1938	0.1456	0.0905	0.4063	0.7053	0.2676	0.4556	0.0466

Residue= 0.6087

Conclusion

It is concluded that genotypes had sufficient genetic variability for pod and yield associated traits and could be utilized in the broadening of existing genetic base of soybean genotypes. The selection of number of seeds per plant, biological yield per plant, harvest index and 100 seed weight would be useful in further yield improvement of existing soybean varieties. In pod trait analysis JS 20-66 had expressed higher number of four seeded and three seeded pods per plant, whereas JSM202, JS20-09, TS 37and NRC 76 reported higher number of four seeded pods. G 225, JSM 122, KBS 701, PK 618 and SL 1104 are having higher mean number of pod per plant as well as higher percentage of two seeded pods. Hence, hybridization among these genotypes would contribute profuse podding which ultimately enhance the number of seeds per plant.

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