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Research Communication

Productivity, profitability and quality of soybean (*Glycine max*) as influenced by sowing date and row spacing under mid-hill conditions of Himachal Pradesh

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ABSTRACT

A field experiment was conducted at Palampur, Himachal Pradesh during the rainy (*kharif*) season of 2015 on acidic silty clay loam soil, to find out the optimum sowing date and row spacing for newly developed genotypes of soybean [*Glycine max* (L.) Merr.]. The experiment was laid out in factorial randomized block design with the treatments comprising of 2 genotypes ('HIMSO 1685' and 'Harasoya'), 3 dates of sowing (last week of May, first week and second week of June) and 2 inter-row spacings (45 cm and 60 cm). The new genotype, 'HIMSO 1685', proved superior over 'Harasoya'. Significantly higher number of primary branches/plant, seeds/pod and protein and oil content were recorded in the crop sown during last week of May followed by first week of June. The highest pods/plant (85.4), seed index (208 g), seed yield (2.4 t/ha), straw yield (9.3 t/ha), net returns (₹58,108/ha) and benefit: cost ratio (1.17) were noted in the crop sown during last week of May. Inter-row spacing of 45 cm resulted in the highest seed index (202 g), seed yield (2.1 t/ha), straw yield (8.3 t/ha) and net returns (₹45,281/ha), and benefit: cost ratio (0.91). Sowing of soybean in the last week of May at 45 cm inter-row spacing were found to be the optimum agronomic practices for obtaining higher productivity and profitability, and better quality of 'HIMSO 1685' under mid-hill conditions of Himachal Pradesh.

Key words **:** Genotype, Inter-row spacing**,** Oil content, Productivity, Profitability, Protein content, Sowing time, Soybean

In India, soybean is cultivated over an area of 10.8 mha having total production of 10.4 mt with an average yield of 959 kg/ha (Anonymous, 2014). Sowing date plays a significant role in determining growth, development and yield of soybean. Crop sown at optimum time increases the yield due to suitable environment at all the growth stages. Optimal sowing dates vary with variety, cropping system, and environmental conditions. Sowing prior to or later than the optimal sowing time can greatly reduce soybean yield and quality, since photoperiodism controls not only the number of days to flowering, but also the amount of time available for vegetative plant growth and development (Berger *et al.,* 2014). Row spacing is considered to be the foremost step to achieve proper and uniform distribution of plants over cultivated area thereby better availability of above and below ground resources towards increasing seed yield and decreasing competition among plants. It influences crop yield through its influence on light interception, rooting pattern, nutrient extraction and moisture extraction pattern etc. In addition to greater light interception and yield, narrow row spacing promotes rapid canopy closure, which can effectively reduce weed seedling growth, compared with wider-row spacing (Board *et al.,* 1996). Considering the above said facts, the present investigation was undertaken to find out the optimum date of sowing and row spacing for obtaining higher productivity and profitability, and better quality of soybean.

The field experiment was conducted during the rainy (*kharif)* season of 2015 at the Research Farm, Department of Agronomy, Forages and Grassland Management, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur. The soil of the experimental site was silty clay loam with *p*H 5.4, EC 0.224 dS/m, organic carbon 0.54%, available nitrogen 125.4 kg/ha, available phosphorus 14.2 kg/ha and available potassium 159 kg/ha. The weekly maximum and minimum temperature ranged from 13.1°C to 32.4°C and 3.5°C to 21.9°C, re-

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spectively. The mean relative humidity ranged from 52.4% to 94.1% and total of 2569.5 mm rainfall received during the crop season. The mean bright sunshine hours were 1870 during the whole of the crop season. The experiment was laid out in factorial randomized block design comprising of 2 genotypes of soybean ('HIMSO 1685' and 'Harasoya'), 3 dates of sowing (last week of May, first week and second week of June) and 2 row spacings (45 cm and 60 cm). Each treatment was allocated randomly and replicated thrice. Treated seeds with bavistin were applied at the rate of 100 kg/ha. Recommended dose of nitrogen, phosphorus and potassium was applied at the rate of 20 kg N, 60 kg P_2O_5 and 40 kg K_2O/ha, respectively at the time of sowing. Pendimethalin (STOMP 30 EC) was applied at the rate of 1.5 l a.i/ha within 48 hours of sowing for the control of weeds. Other package of practices recommended for the region was also followed.

The new genotype, 'HIMSO 1685', resulted in significantly better yield attributes except seeds/pod, which was better in 'Harasoya' (Table 1). Crop sown during last week of May followed by first week of June produced significantly higher primary branches/plant and seeds/pod than the crop sown during second week of June. The highest number of pods/plant and seed index was recorded in the crop sown during last week of May (Table 1). This might be due to more favourable and sufficient growing period for vegetative and reproductive stages resulting in better yield attributes in early sowing. These results are supported by Yagoub and Hamed (2013) and Asewar *et al.* (2015). Row spacing did not influence primary branches/plant, pods/plant and seeds/pod. Inter-row spacing of 45 cm resulted in the highest seed index.

'HIMSO 1685' resulted in significantly higher seed and straw yields than 'Harasoya'. The highest seed yield was recorded in the crop sown during last week of May (Table 1). This is due to the reason that for these plants there was more time for plant growth in suitable temperature and moisture, so seed yield increasing is rational. With delayed planting the growth period becomes short, while high temperature during flowering decreases the seed yield and yield components. Early sown soybean resulted in higher seed yield (Berger *et al.,* 2014). Inter-row spacing of 45 cm yielded significantly higher seed yield. This might be due to more number of plants in closure row spacing and more light interception. Straw yield also followed the similar trend like seed yield. Harvest index remained unaffected.

The highest oil content was also recorded in 'HIMSO 1685'. Significantly higher oil content was noted in the crop sown during last week of May followed by first week of June (Table 1). This may be due to longer growth period and favourable growth conditions. Protein content was not affected by different genotypes. Significantly higher protein content was noted in the crop sown during last week of May followed by first week of June. This result proves that delayed sowing reduces yield and protein content be-

Table 1. Effect of genotype, date of sowing and row spacing on yield attributes, yield, harvest index, quality, gross returns, net returns and benefit: cost ratio of soybean

Treatment	Yield attributes			Seed index (g)	Yield		Harvest index (%)	Quality		Gross returns (× 10^3₹/ha)	Net returns (×10^3 ₹/ha)	Benefit: cost ratio
	Primary branches/ plant	Pods/ plant	Seeds/ pod		Seed yield (t/ha)	Straw yield (t/ha)		Oil content (%)	Protein content (%)			
Genotype												
'HIMSO 1685'	13.2	84.6	2.54	224	2.1	8.4	19.8	23.3	39.6	75.4	29.4	0.59
'Harasoya'	11.7	52.9	2.78	168	1.7	6.8	20.8	18.3	39.2	93.1	47.9	0.97
SEm±	0.32	3.8	0.06	1.1	0.04	0.3	0.71	0.04	0.20	1.6	1.8	0.04
CD (P =0.05)	0.90	11.3	0.19	3.1	0.12	0.8	NS	0.13	NS	4.7	5.3	0.11
Date of sowing												
Last week of May	13.2	85.4	2.75	208	2.4	9.3	20.6	21.3	39.8	104.4	58.1	1.17
First week of June	13.1	66.9	2.75	200	2.1	7.9	21.3	21.1	39.7	90.3	45.1	0.91
Second week of June	11.1	53.9	2.48	181	1.3	5.7	19.0	20.0	38.8	58.0	12.8	0.26
SEm±	0.38	4.7	0.08	1.30	0.05	0.4	0.87	0.16	0.25	2.0	2.0	0.04
CD (P=0.05)	1.10	13.8	0.23	3.82	0.14	1.0	NS	0.53	0.73	5.8	6.5	0.13
Row spacing												
45 cm	12.5	71.5	2.68	202	2.1	8.3	19.7	20.83	39.5	91.2	45.3	0.91
60 cm	12.4	66.0	2.64	190	1.8	6.9	20.9	20.74	39.3	77.2	32.1	0.65
SEm±	0.32	3.8	0.06	1.1	0.04	0.3	0.71	0.04	0.20	1.6	1.8	0.04
CD (P=0.05)	NS	NS	NS	3.1	0.12	0.8	NS	NS	0.59	4.7	5.3	0.11

cause of lower growth period. In earlier study, Zarger *et al.* (2011) reported that delayed sowing reduced yield and protein content of soybean. Significantly similar oil and protein content was recorded at different inter-row spacings.

The maximum gross returns, net returns and benefit: cost ratio were recorded in 'HIMSO 1685'. The highest gross returns, net returns and benefit: cost ratio was noted in the crop sown during last week of May (Table 1). This might be due to sufficient period for vegetative and reproductive growth of plants, which resulted in higher yield during early sowing. Tomar *et al.* (2014) reported that the early sown soybean crop gave higher gross returns and net returns. The maximum gross returns, net returns and benefit: cost ratio were noted at closure inter-row spacing of 45 cm. The highest gross and net returns and benefit: cost ratio were recorded with closure row spacing (Vyas and Khandwe, 2014).

On the basis of findings, it was concluded that 'HIMSO 1685' proved to be superior over 'Harasoya'. Last week of May and 45 cm inter-row spacing were found to be the best agronomic practices for obtaining higher productivity and profitability and better quality of soybean under mid-hill conditions of Himachal Pradesh.

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