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Short Communication

Impact of different sowing time, varieties and seed rate on yield attributes and yield of soybean (*Glycine max* L.)

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Abstract

A field experiment on "Performance of soybean varieties under different sowing times and seed rates" was conducted at Research Farm of Department of Agronomy, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur during the *Kharif* 2020. Crop sown in the 2nd week of June recorded significantly more number of pods per plant, grains per pod, 1000-grain weight, grain (1982.61 kg/ha) and straw yield (3214.78 kg/ha) than other dates of sowing. Amongst the varieties, Himso1685 was significantly superior over other varieties in respect of pods per plant, grains per pod, 1000-grain weight, grain yield (1955.56 kg/ha) and straw yield (3191.0 kg/ha). Use of 100 kg seed/ ha recorded significantly higher number of pods per plant, grains per pod, 1000-grain weight, grain yield (1832.52 kg/ha) and straw yield (3123.59 kg/ha.

Key words: Variety, date of sowing, seed rate, yield attributes, grain yield.

Soybean attains special importance in India and other Asian countries because of acute shortage of proteins and fats. The United States Department of Agriculture (USDA) estimates that the World Soybean Production during 2020-2021 will be 361.00 million metric tonnes. In India, soybean crop occupied an area of 12700 thousand hectare with total production of 10450 thousand metric tonnes and yield of 0.8 tonnes/ ha (https://fas.usda.gov).

In Himachal Pradesh, it is cultivated in 0.55 thousand hectares area with an average yield of 1680 kg/ha (Anonymous, 2019). Oil and protein contents account for about 60% of dry soybean by weight (protein 40% and oil 20%). The remainder consists of 35% carbohydrate and about 5% ash. It is also very rich in vitamin A and vitamin B, fibers, potassium and iron (Hou *et al*. 2009). Soybean can also be used for making nutritious food products such as cookies, snack foods, bread, soups and pasta due to the rich protein concentration as well as balanced amino acid profile. (Silva *et al*. 2019). Sowing time plays a significant role in determining grain yield of soybean. Grain yield is generally better from earlier sown soybean due to longer duration of vegetative and reproductive growth stages. Sowing prior to or later than the optimal sowing time can greatly reduce soybean yield. Farmers tend to plant 25 per cent more seed than needed. Seeding rate is dependent on the size of the seed, width of row and the germination rate of seed among different varieties from year to year.

The field experiment was conducted during the *Kharif* season of 2020 at Research Farm, Department of Agronomy, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur. The soil of the experimental site was silty clay loam with 5.4 pH, 0.79% organic carbon, 265.2 kg/ha available nitrogen, 17.10 kg/ha available phosphorus and 222.3 kg/ha available potassium. The experiment

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comprising three dates of sowing (last week of May, 2nd week of June and 4thweek of June), three varieties (Himso1685, Harit soya and Himsoya) and two seed rates (75 kg seed/ha and 100 kg seed/ha) was laid out in factorial randomized block design with three replications. Seeds were treated with Bavistin before sowing. 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 5 L/ha within 48 hours of sowing for the control of pre emergence weeds.

Number of pods per plant: All the pods borne by the pre assigned randomly selected five tagged plants in each plot were counted and mean number of pods per plant was worked out by dividing the total number of pods by five.

Number of grains per pod: Ten pods were randomly selected from each plot. These pods were hand thrashed and grains produced by these pods were counted and on dividing by ten gave the number of grains per pod.

Test weight: 1000 seeds from each plot were taken and weighed to obtain the test weight.

Grain yield: The net plot produce was harvested and threshed. The grains were cleaned and weighed. The grain yield thus obtained was expressed in kg/ha. The grain yield of each plot recorded was divided by the biological yield of the same plot multiplied by 100 to obtain the harvest index in percent.

$$\text{Harvest index (\%)} = \frac{\text{Grain yield (kg/ha)}}{\text{Biological yield (kg/ha)}}$$

Protein content: The nitrogen content in the seeds was determined by the modified Kjeldahl's method and the protein content in the seeds was worked out by multiplying the nitrogen content with 5.71 (Thimmaiah 2006).

Soybean crop sown in 2nd week of June recorded significantly maximum pods per plant than crop sown in last week of May and 4th week of June. This might be due to more favorable conditions (i.e. rainfall, temperature, humidity and bright sun shine hours) and sufficient growing period for vegetative and reproductive stages resulting in more number of pods per plant. The results are in conformation with Rehman *et al*. (2014) and Tomar *et al*. (2014). Significantly more number of pods per plant were recorded in Himso 1685 over Harit soya and Him soya. Such variation among three varieties is expected due to their varietal characters. Similar findings were also reported by Bender *et al*. (2015).100kg/ha significantly recorded more number of pods per plant than 75kg/ha seed rate. This could be ascribed to better utilization of resources. These results are in agreement with Asewar *et al*. (2015).

Different dates of sowing influenced the number of grains per pod. Soybean crop sown during the 2nd week of June significantly recorded maximum number of grain per pod than others two sowing dates. This might be due to more favorable conditions and sufficient growing period for vegetative and reproductive stages resulting in more number of grains per pods. The results are in conformation with Junior *et al*. (2015) and Kundu *et al*. (2016). An examination of data in Table 1 revealed that different varieties had significant influence on number of grain per pod. Variety Himso 1685 produced significantly more number of grains per pod than Harit soya and Him soya. Similar findings were also reported by Jaybhaye *et al*. (2015). Seed rates did not influence number of grains per pod.

1000 seed weight was also significantly influenced by different dates of sowing. Crop sown during last week of May resulted in the highest test weight. This may be due to the result of short vegetative period of growth and comparatively long reproductive and grain filling period. These results are supported the findings of Shah *et al*. (2017). Different varieties significant influence on 1000 seeds weight. Variety Himso1685 recorded significantly higher test weight than Harit soya and Him soya. Similar findings were also reported by Parmar (2002). Different seed rates did not bring any significant difference on 1000-seed weight.

Table 2 revealed that soybean crop sown in 2nd week of June recorded significantly higher grain yield than crop sown on last week of May and 4th week of

June. Grain yield/ha (1982.61kg/ha) was obtained when crop was sown in the 2nd week of June. On an average crop sown in the 2nd week of June recorded 14.9 per cent and 28.5 per cent higher grain yield over the crop sown last week of May and 4th week of June, respectively. The latter two dates of sowing also differed significantly. This might be attributed to the favorable growth conditions leading to higher vegetative growth, contributing to more number of branches per plant, pods per pod, seeds per pod and 1000-seed weight. Similar results were obtained by Mandloi *et al*. (2003). Grain yield was significantly influenced by different varieties. Significantly highest grain yield of (1955.56 kg/ha) was obtained from Himso1685 followed by variety Harit soya (1733.39kg/ha) and significantly lowest in Him soya (1560.94kg/ha). Himso 1685 12.8 and 25.2 per cent over the varieties Harit soya and Him soya, respectively. The higher grain yield and comparatively better performance of variety Himso1685 over variety Harit soya and Him soya could be ascribed to more number of branches per plant (13.4), pods per plant (63.52), grains per pod (3.12) and 1000-grain weight (176.73 g). Significant variation for grain yield in different varieties has also been reported by Islam *et al*. (2004). Effect of seed rates on grain yield (kg/ha) was also significant.100kg/ha seed rate recorded significantly higher grain yield than 75kg/ha seed rate which was 9.9 per cent higher over 75kg/ha seed rate. Although the yield attributes like number of pods per plant were adversely affected by higher seed rate, but this was compensated by higher number of plants per unit area at higher seed rate, which resulted in higher grain yield.

Table 2 revealed that soybean crop sown during the 2nd week of June recorded higher harvest index than crop sown at last week of May and 4th week of June. Maximum harvest index (0.38) was obtained in the 2nd week of June. The latter two dates of sowing also differed significantly. This might be attributed to the favorable growth conditions leading to higher vegetative growth contributing to grain and straw yield which resulted in higher harvest index. Similar results were obtained by Ozturk *et al*. (2016).

Harvest index was significantly influenced by different varieties. Significantly highest harvest index of (0.38) was obtained from Himso 1685 followed by Harit soya (0.36) and significantly lowest in Him soya (0.35). Similar findings were also reported by Mandloi *et al*. (2003).

The effect of seed rates on harvest index was also significant. 100 kg/ha seed rate recorded significantly higher harvest index than 75 kg/ha seed rate which amounts to 2.7 percent higher over 75 kg/ha seed rate. This could be ascribed to higher number of plants per unit area at higher seed rate, which resulted in higher harvest index.

Different dates of sowing had significantly influenced on protein content in grains. Soybean crop sown during the last week of May recorded significantly higher protein content over the crop sown during 4th week of June and 2nd week of June. The protein content in grains is partly a function of grain yield and uptake of nitrogen by grains. In earlier sowings, the higher yields were obtained; therefore, it is quite obvious that the protein content was lower on account of dilution effect. Similar results were obtained by Bender *et al*. (2015).

The result of the present studies concluded that soybean variety Himso 1685 sown during the second week of June with 100 kg seed per hecter produced significantly higher grain yield as well as comparable protein content.

Conflict of interest: The authors declare that there is no conflict of interest in this research paper.

Table 1. Yield attributes and grain yield as influenced by date of sowing, varieties and seed rates

Treatment	No. of pods/plant	Seed /pod (No.)	Test weight (g)
Date of sowing			
Last week of May	62.24	2.78	176.48
2nd week of June	63.89	3.10	170.40
4th week of June	62.01	2.31	168.94
SE m±	0.30	0.10	0.30
CD (P=0.05)	0.85	0.40	0.85
Variety			
Himso-1685	63.52	3.12	176.33
Harit soya	63.21	2.62	170.06
Himsoya	61.42	2.45	169.17
SE m±	0.30	0.10	0.30
CD (P=0.05)	0.85	0.40	0.85
Seed rate			
75 kg/ha	62.13	2.83	171.71
100 kg/ha	63.31	2.63	172.00
SE m±	0.24	0.10	0.24
CD (P=0.05)	0.69	NS	NS

Table 2. Grain yield, harvest invest and protein content as influenced by date of sowing, varieties and seed rates

Treatment	Grain yield(kg/ha)	Harvest index	Protein content (%)
Date of sowing			
Last week of May	1725.11	0.36	36.60
2nd week of June	1982.61	0.38	35.97
4th week of June	1542.17	0.34	35.34
SE m±	26.66	0.00	0.50
CD (P=0.05)	76.60	0.01	1.34
Variety			
Himso-1685	1955.56	0.38	36.26
Harit soya	1733.39	0.36	35.69
Himsoya	1560.94	0.35	35.97
SE m±	26.66	0.00	0.50
CD (P=0.05)	76.60	0.01	1.34
Seed rate			
75 kg/ha	1667.41	0.36	36.14
100 kg/ha	1832.52	0.37	35.80
SE m±	21.76	0.00	0.48
CD (P=0.05)	62.54	0.01	NS

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