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Performance of Soybean Varieties in Relation to Different Sowing Dates in Kymore Plateau and Satpura Hills Zone of Madhya Pradesh

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ABSTRACT: The present investigation was carried at Research farm, Department of Physics and Agro-meteorology, College of Agricultural Engineering, JNKVV, Jabalpur (M.P.) during *kharif* season of 2022. Major objectives of the investigation were to find out the most suitable time for sowing of soybean, to assess the performance of soybean varieties under different dates of sowing and to work out economics of the treatments.

Non-availability of early maturing, photo-insensitive, high yielding cultivars with resistance to biotic and abiotic stresses are the major challenges limiting soybean productivity in present climate changing scenario. The experiment was laid out in split plot design taking three dates of sowing in different meteorological weeks *i.e.* 25th, 27th and 29th in main plots and three varieties (*viz.*, JS 20-98, JS 20-34 and JS 20-69) in sub-plots with three replications. The study revealed that sowing of soybean in 25th MW found most suitable. This sowing period can be extended up to 27th MW on basis of monsoon onset in the region without any substantial yield loss. Soybean sowing in 29th MW caused significant yield loss. Both varieties JS 20-98 and JS 20-69 were found to be superior over variety JS 20-34. Sowing of soybean varieties JS 20-98 and JS 20-69 during 25th meteorological week resulted more productive and remunerative.

Keywords: Soybean, Dates of sowing, Varieties, Meteorological week (MW), Photoperiod.

INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is a major oilseed crop in world and India. It is a leguminous crop which grows well in tropical and sub-tropical climate. It is originated from China and was introduced in India in 1968, from USA. Soybean contains about 40% protein well balanced in essential amino acids, 20% oil, 6-7% total mineral and 5-6% crude fibre (Chauhan *et al*., 1988).

Presently soybean is contributing 42% share of total oil seed production and 22 per cent to total oil production in India (IISR, 2022). Soybean tops both in oilseed and edible oil production worldwide. In India, soybean was grown in 11.4 million hectare area with 12.0 million tonnes of production and productivity of 1051 kg/ha in *kharif*-2022 (SOPA, 2022) and India ranks fifth position in world soybean production.

Soybean is one of the classical short day plants and faces thermo-sensitivity in nature (Karunakar *et al*., 2018). Impact of climatic adversities in recent past had a severe impact to harvest of soybean to its full potential. It is well reported that planting date influences soybean growth stages, due to variation in photoperiod, air temperature and rainfall distribution and amount during the crop cycle (Billore *et al.*, 2019). The late onset and early cessation of monsoon coupled with intermittent dry spells adversely affects the growing period and ultimately yield potential of soybean (Billore *et al.*, 2018). Planting of suitable genotype and shifting the sowing dates may address these challenges to a certain extent (Billore *et al.*, 2018).

Soybean genotypes differ in their response to photoperiod. Newly developed genotypes having good yield potential and disease and pest resistance are better suited under climate change scenario (Kathmale *et al.*, 2013). Therefore, expansion of sowing time by exploiting genetic variabilities would allow more time of sowing. Selection of suitable cultivar of soybean is of prime importance as the genetic potential of a variety limits the expression of its yield. The soybean yield is a complex quantitative trait that is significantly influenced by environmental factors. G × E interaction (GEI), which derives the performance of soybean genotypes differentially in various environmental conditions, is one of the main obstacles to increasing the net production (Rani *et al.*, 2023).

MATERIAL AND METHODS

The field experiment was carried out at Research farm, Department of Physics and Agro-meteorology, College of Agricultural Engineering, JNKVV, Jabalpur (M.P.) during *kharif* season of 2022. The regions soils are medium to deep in depth, black in colour with a neutral soil reaction. Soil of the experimental field was clay loam in texture. The soil was medium in organic carbon (0.65%), available nitrogen (290.54 kg/ha), available phosphorus (17.35 kg/ha) and available potassium (306.80 kg/ha). The pH of the soil is neutral (7.1) and the concentration of soluble salts was medium (0.25 dS/m). The experiment was laid out in split plot design taking three dates of sowing in different meteorological weeks *i.e.* 25th, 27th and 29th in main plots and three varieties (*viz.* JS 20-98, JS 20-34 and JS 20-69) in sub-plots with three replications. Best management practices were followed, as per recommendations of soybean crop in Madhya Pradesh. The data of the experiment were analyzed by using OPSTAT software (Sheoran *et al.,* 1998).

RESULTS AND DISCUSSION

A. Effect of sowing dates

Growth parameters were significantly affected by different sowing dates and varieties which is presented in Table 1. Significantly, higher plant height at harvest was recorded in crop sown during 25thMW (53.72 cm) as compared to crop sown in 29th MW (42.44 cm) but at par to crop sown in 27thMW (51.30 cm). Significantly, higher number of branches per plant at harvest were observed in crop sown during 25th MW (5.56) as compared to crop sown in 29th MW (4.16) but at par to crop sown in 27th MW (5.20). Significantly, higher dry weight per plant at harvest was recorded in crop sown during 25th MW (17.71 g) as compared to crop sown in 29th MW (12.35 g) but at par to crop sown in 27th MW (16.42 g).

These results might be due to congenial crop growth conditions which caused optimal utilization of the climatic resources such as temperature, humidity and day length (Hashemi, 2001) and had the impact on plant vegetative growth that in turn increased efficiency of photosynthesis and photo-assimilates transport. Thus, it is clear that timely sown crop had availed prolonged photoperiod for vegetative growth. As a result, plant attained maximum plant height as compared to late sown crop. Present study is corroborated by findings of Asewar *et al.* (2015); Raghuwanshi *et al.* (2017).

Seed yield and haulm yield of soybean were significantly influenced by sowing dates and varieties which is presented in Table 2 and Fig. 1. Significantly, higher seed yield was recorded when soybean was sown in 25th MW (1323 kg/ha) as compared to soybean sown in 29th MW (906 kg/ha) but statistically at par to soybean sown in 27th MW (1230 kg/ha). Significantly, higher haulm yield was recorded when soybean was sown in 25th MW (2532kg/ha) as compared to soybean sown in 29th MW (2271 kg/ha) but statistically at par to soybean sown in 27th MW (2475 kg/ha).Interactive effect of different sowing dates and varieties was found to be significant with respect to seed yield. Variety JS 20-98 when sown in 25th MW produced higher seed yield (1462 kg/ha) than other treatment combinations but statistically at par to variety JS 20-69 (1428 kg/ha) when sown in 25th MW. Minimum seed yield (834 kg/ha) was recorded when JS 20-34 was sown in 29th MW.

The highest seed and haulm yield in 25th MW sown crop is attributed to favourable photo-thermal effect, moisture,and temperature during vegetative and reproductive phases that resulted in higher biomass and photosynthates accumulation (Karunakar *et al*., 2018). Billore and Srivastava (2013) also reported that per day decrease in seed yield was (12.45 kg/ha/day) from normal dates in central India. These results are in confirmatory with the work done by Waghmare *et al.* (2019).

B. Effect of varieties

Growth parameters were significantly varied in different varieties. Among different soybean varieties growth parameters viz. plant height, number of branches per plant and dry weight per plant were recorded statistically at par in both JS 20-98 and JS 20-69 but both varieties were superior over variety JS 20-34.

Among the varieties, significantly higher seed yield (1238 kg/ha) was recorded with variety JS 20-98 as compared to variety JS 20-34 (1007kg/ha) but found to be statistically at par with the variety JS 20-69 (1214 kg/ha). Similar trend was observed for haulm yield.

The differences in growth parameters and yield of soybean varieties may be due to differences in their genetic makeup and inherent characteristics. Similar results were reported by Chaturvedi *et al.* (2020); Sharma *et al.* (2019).

C. Economics of treatments

Economic analysis was carried out by considering the cost prevailing for agronomic practices and inputs during the *kharif*- 2022. The cost incurred and profit derived are calculated and presented in Table 3, Fig. 2 and 3. Among different treatment combinations variety JS 20-98 sown in 25th MW fetched highest gross monetary returns, net monetary returns and benefit-cost ratio which was closely followed by variety JS 20-69 when sown in 25th MW.

Common cost of cultivation (Rs 35,620/ha) for all treatment combinations was due to adoption of uniform package of practices. Hence it is clear that, sowing date is one of the most important and least expensive production decisions affecting soybean seed yields. Results of present studies with respect to economic viability of sowing dates and varieties are in agreement with findings of Dubey *et al.* (2014); Vyas and Khandwe (2014).

Table 1: Growth parameters of soybean as influenced by sowing dates and varieties.

Treatments	Plant height at harvest (cm)	Branches/plant at harvest	Dry matter/ plant (g)at harvest
Main Plots: Sowing Dates			
25th MW (D_1)	53.72	5.56	17.71
27th MW (D_2)	51.30	5.20	16.42
29th MW (D_3)	42.44	4.16	12.35
SEm ±	**0.79**	**0.13**	**0.43**
CD (P= 0.05)	**3.20**	**0.53**	**1.75**
Sub Plots: Varieties			
JS 20-98 (V_1)	56.80	5.68	16.53
JS 20-34 (V_2)	36.25	3.28	13.76
JS 20-69 (V_3)	54.41	5.96	16.18
SEm ±	**0.85**	**0.09**	**0.24**
CD (P= 0.05)	**2.66**	**0.29**	**0.73**

Table 2: Seed and haulm yield of soybean as influenced by sowing dates and varieties.

Varieties **Sowing Dates**	**Seed yield (kg/ha)**				**Haulm yield (kg/ha)**			
	JS 20-98 (V_1)	**JS 20-34 (V_2)**	**JS 20-69 (V_3)**	**Mean**	**JS 20-98 (V_1)**	**JS 20-34 (V_2)**	**JS 20-34 (V_3)**	**Mean**
25th MW (D_1)	1462	1079	1428	**1323**	2685	2313	2597	**2532**
27th MW (D_2)	1297	1108	1284	**1230**	2588	2267	2570	**2475**
29th MW (D_3)	956	834	930	**906**	2335	2196	2283	**2271**
Mean	**1238**	**1007**	**1214**		**2536**	**2259**	**2483**	
	SEm ±		CD (P= 0.05)		SEm ±		CD (P= 0.05)	
Sowing Dates	24.51		98.83		29.71		119.80	
Varieties	15.64		48.73		21.47		66.91	
Interaction (V×D)	33.02		119.54		42.49		151.42	

(V×D): For comparing performance of varieties in different sowing dates

Table 3: Economic analysis of soybean varieties under different dates of sowing.

Sowing Dates	Varieties	Cost of cultivation (Rs/ha)	Gross monetary returns (Rs/ha)	Net monetary returns (Rs/ha)	Benefit- cost ratio
25th MW (D_1)	JS 20-98 (V_1)	35620	73620	38000	2.07
	JS 20-34 (V_2)	35620	55665	20045	1.56
	JS 20-69 (V_3)	35620	71805	36185	2.02
27th MW (D_2)	JS 20-98 (V_1)	35620	66136	30516	1.86
	JS 20-34 (V_2)	35620	56725	21105	1.59
	JS 20-69 (V_3)	35620	65492	29872	1.84
29th MW (D_3)	JS 20-98 (V_1)	35620	50434	14814	1.42
	JS 20-34 (V_2)	35620	44645	9025	1.25
	JS 20-69 (V_3)	35620	49123	13503	1.38

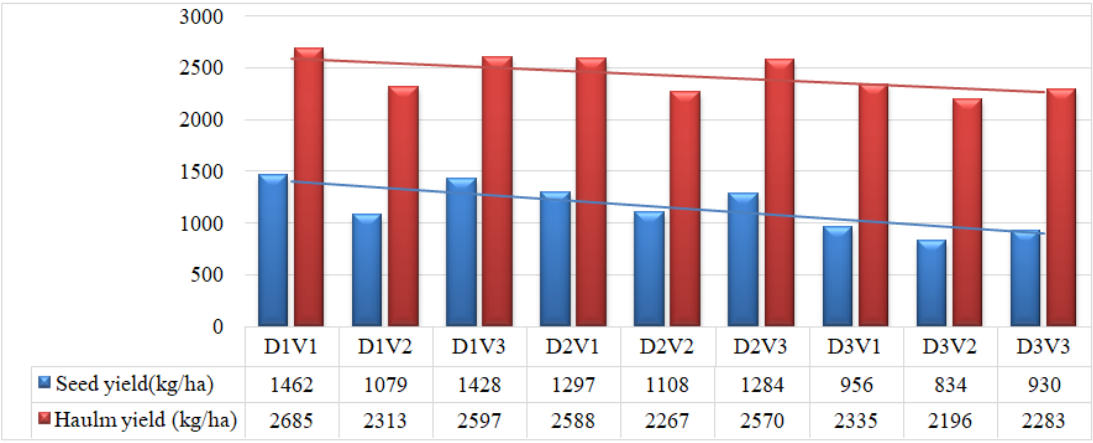

Fig. 1. Effect of sowing dates and varieties on seed and haulm yield of soybean of soybean.

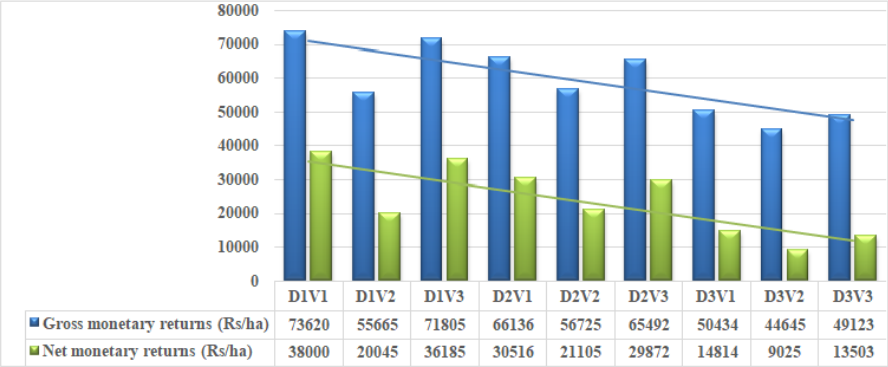

Fig. 2. Effect of sowing dates and varieties on gross and net monetary returns of soybean.

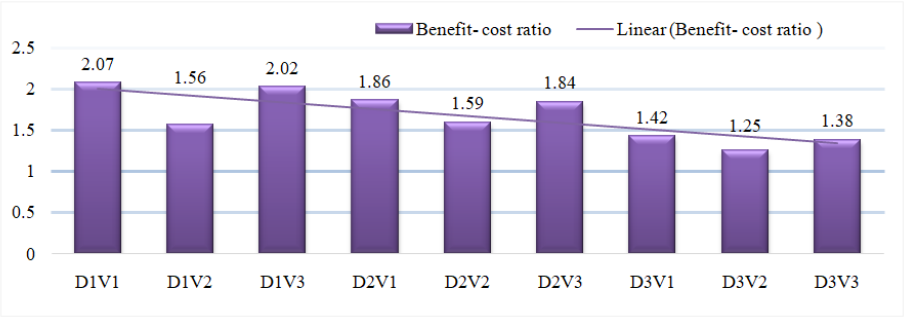

Fig. 3. Effect of sowing dates and varieties on benefit-cost ratio of soybean.

CONCLUSIONS

Based on the foregoing discussion, it can be concluded that 25th meteorological week is best period for sowing of soybean in Kymore Plateau and Satpura Hills Zone of Madhya Pradesh but it can extended upto 27thmeteorological week based on monsoon onset. Both varieties JS 20-98 and JS 20-69 are suitable for getting higher yield. Sowing of soybean varieties JS 20-98 and JS 20-69 during 25th meteorological week will be more productive and remunerative.

FUTURE SCOPE

The experiment should be carried out by adding more newly notified varieties to find photo-thermo insensitive variety suited for wider range of sowing dates for combating climate changing scenario.

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Conflict of Interest. None.

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