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Response of soybean [*Glycine max* (L.)] to different varieties and dates of sowing on growth, yield and economics under Satna conditions

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ABSTRACT

The field experiment titled "Response of soybean [Glycine max (L.)] to different varieties and dates of sowing on growth, yield and economics under Satna conditions" during Kharif 2024–25 at the Student Research Farm, Department of Agronomy, AKS University, Satna (M.P.). The objective was to assess the impact of different varieties and sowing dates on soybean growth, yield, and economics. The experiment was laid out in a factorial randomized block design with three replications, including four varieties (JS-20-116, JS-2034, JS-2172, and RVS-1110) and three sowing dates (10th July, 15th July, and 20th July). Results revealed that plant population was not significantly affected, although JS-2034 showed a slightly higher count. Variety 'JS-20-116' recorded significantly superior growth parameters including plant height (up to 51.42 cm), number of branches (7.27), leaves per plant (13.47), and nodules (22.67) at various growth stages. These parameters were maximized under the 10th July sowing date. 'JS-20-116' also exhibited delayed flowering (46.53 days), indicating a longer vegetative period beneficial for yield. Yield attributes such as number of pods per plant, seeds per pod, grain and stover yield were highest in JS-20-116, especially when sown on 10th July. The highest grain yield (2373 kg/ha), stover yield (33.87 q/ha), and test weight (175.20 g) were also recorded in this combination. Additionally, the maximum oil content (20.02%) was observed in JS-20-116. Economically, JS-20-116 sown on 10th July achieved the highest gross return (₹98,320q/ha), net return (₹78,550q/ha), and B-C ratio (3.97), followed by JS-2034 on the same date. The study concludes that JS-20-116 with a sowing date of 10th July is the most effective combination for maximizing soybean productivity and profitability under Satna's agro-climatic conditions.

Keywords: Date of Sowing, Economics, Soybean Yield.

INTRODUCTION

Soybean (*Glycine max* L.) is a type of legume that grows in temperate, tropical, and subtropical areas. Soybean is considered "Miracle Crop" or "Wonder Crop" owing to its good quality vegetable protein and edible oil. It's a great resource of digestible protein (40%) and edible oil (20%). So, it can help a lot with making up for the lack of protein in our Indian diet. The protein has a superior amino acid profile comparatively to other sources of plant protein (39% essential amino acids), the oil is highly digestible (good composition of fatty acids) and contains no cholesterol.

Varieties that produce more dry matter and send more of it to the parts of the plant that make seeds tend to give better yields. Newer soybean varieties are giving higher yields not just because of their genetic potential, but also because they mature earlier, don't drop their pods easily (no shattering), and are more resistant to diseases and insect pests. Choosing the right soybean variety is very important for getting the best yields because it helps make better use of water and fertilizer. A variety's genetic makeup affects how well it grows and produces under different weather and environmental conditions, so selecting the right one is crucial. To get the most from the available resources like water, nutrients, sunlight, and carbon dioxide, there needs to be the right number of plants in a given area. This plant density plays a big role in increasing crop productivity. Soybean genotypes differ in their response to photoperiod (Chavan *et al.* 2018). Therefore, more time for sowing would be possible if planting times were extended by genetic variations. Selection of suitable cultivar of soybean is of prime importance as the genetic potential of a variety limits the expression of its yield and affects plant growth in response of environmental condition. Poor seed viability and non-availability of early maturing, photo-insensitive, high yielding cultivars with resistance to biotic and abiotic stresses are the primary

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limitations limiting soybean productivity (Rajsekhar *et al.* 2021).

The Time of sowing is one of the most crucial yet least expensive production decisions influencing soybean (*Glycine max* L.) seed yield and quality (Patel *et al.,* 2022). As a thermo-sensitive and short-day crop, soybean growth and development are highly responsive to sowing time, which directly impacts its adaptation, phenological stages, and final productivity (Chaturvedi *et al.,* 2020). In Madhya Pradesh, the optimal sowing period varies with cropping systems; for multiple cropping under rainfed conditions, the ideal sowing window falls between meteorological weeks 25 and 27, while for rainfed mono-cropping systems, it ranges from weeks 28 to 29 (Basavaraj, 2020). Timely sowing is critical for establishing a uniform plant stand and achieving optimal growth, which collectively contribute to higher yields. Delayed sowing often leads to reduced vegetative growth, exposure to adverse climatic conditions, and increased susceptibility to pests and diseases. Conversely, sowing too early or too late can disrupt the crop's access to favourable temperature and rainfall, hindering pod development and seed filling. Studies have consistently shown that proper sowing time enhances growth parameters, improves pod filling, and ultimately results in higher yield and better crop performance (Deshmukh *et al.,* 2021).

MATERIALS AND METHODS

The present experiment was conducted during the *Kharif* season of 2024-25 at the Research farm, Department of Agronomy, AKS University, Sherganj, Satna (M.P.). Geographically, Satna district lies in the Kymore Plateau and Satpura Hill Zone, MP-4 (Agro-climatic Zone-VIII). It is situated in the north-eastern part of Madhya Pradesh the latitude of $23^0$58' to $25^0$12' N and longitude of $80^0$21' to $81^0$23' east in Rewa division of M.P. State of India at an elevation of 315 m above mean sea level to find out the Growth, yield and quality response of Soybean [*Glycine max* (L.)] to manures and biofertilizers application.The total rainfall during the experimental period was 332.45 mm from 02 July to 07 Oct. The treatments were fitted in a Factorial Randomized Block design replicated three times thereby, making twelve treatment combinations as given V_1D_1:-(Soybean variety JS-2034 Sown on 10th July),V_2D_1:-(Soybean variety JS-20-116 Shown on 10th July), V_3D_1:-(Soybean variety JS-2172 Sown on 10th July), V_4D_1:- (Soybean variety RVS-1110 Sown on 10th July), V_1D_2:-(Soybean variety JS-2034 Sown on 15th July),V_2D_2:-(Soybean variety JS-20-116 Sown on 15th July), V_3D_2:- (Soybean variety JS-2172 Sown on 15th July), V_4D_2:-(Soybean variety RVS-1110 Sown on 15th July),V_1D_3:-(Soybean variety JS-2034 Sown on 20th July), V_2D_3:-(Soybean variety JS-20-116 Sown on 20th July), V_3D_3:-(Soybean variety JS-2172 Sown on 20th July), V_4D_3:-(Soybean variety RVS-1110 Sown on 20th July).

RESULTS AND DISCUSSION

The key findings of the present study, along with their corresponding discussions, are presented below. Appropriate tables are used to display the results, which are based on mean values.

Response of different varieties and date of sowing on growth characters of soybean

The experimental findings clearly shows that plant height, number of branches per plant, and number of leaves per plant were significantly influenced by the interaction of variety and sowing date across most stages of crop growth. The variety JS-20-116 recorded the highest plant height values of 23.03 cm, 41.25 cm, and 51.42 cm at 30, 60, and 90 days after sowing (DAS), respectively, particularly under the 10th July sowing date. This variety also showed superior performance in terms of number of branches and leaves per plant, followed closely by JS-2034. In contrast, JS-2172 recorded comparatively lower values for these growth parameters. Although plant population did not differ significantly among treatments, the enhanced plant vigor in JS-20-116 and JS-2034 indicated a greater response to favourable fertility and environmental conditions.
The early sowing date of 10th July was associated with improved vegetative growth, likely due to extended growth duration and optimal temperature and moisture availability during critical stages. This early sowing also led to increased leaf production and branching, contributing to improved canopy development. These observations are consistent with the

Table 1: Effect of different varieties and date of sowing on growth characters of soybean

Treatments	Plant height (cm) @ 90 DAS	Numberof leave/ plant at harvest	Number of branch /plant at 40 DAS	Number of Root nodules per plant before flowering
Variety				
JS-2034	47.13	10.64	5.02	18.31
JS-20116	48.65	12.09	5.73	19.80
JS-2172	45.93	9.27	6.20	15.89
RVS-1110	44.41	6.43	6.58	12.13
S.Em±	0.24	0.15	0.12	0.39
C.D. (*p*=0.05)	0.71	0.44	0.35	1.13
Date of sowing				
10th July	48.31	11.52	5.67	19.05
15thJuly	46.20	9.62	5.94	16.25
20thJuly	45.08	8.07	6.05	14.30
S.Em±	0.21	0.13	0.10	0.33
C.D. (*p*=0.05)	0.61	0.18	0.29	0.98

findings of Sharma *et al.* (2009), Pandey *et al.* (2005), Sarawagi *et al.* (2005), Batwal *et al.* (2007), and Thakur and Vyas (2005), who also reported enhanced vegetative growth with timely sowing. Overall, the results highlight that variety selection and timely sowing are critical factors in maximizing soybean growth performance under the given agro-climatic conditions.

Response of different varieties and dates of sowing on yield characters of soybean

The significant variation was observed among soybean varieties for yield and yield-attributing traits. JS-20-116 recorded the highest number of pods per plant, seeds per pod, grain yield per plant, and test weight, outperforming JS-2034 and RVS-1110, and remaining statistically at par with JS-2172. Its superior performance is attributed to enhanced root nodulation, better nutrient uptake, and genetic potential. JS-2034 ranked second, while RVS-1110 recorded the lowest yield. The increased number of effective pods, seeds per pod, and grain weight in JS-20-116 contributed to its higher yield. These results align with previous studies (Waghmare *et al.,* 2019; Basavaraj, 2020). Sowing on 10th July significantly improved yield components and protein content, likely due to favourable weather and a longer vegetative phase. Delayed sowing reduced yield, consistent with findings by Karunakar *et al.* (2018).

Response of different varieties and dates of sowing on quality character of soybean

The oil content in soybean seeds was significantly influenced by the variety used. Among the tested genotypes, variety JS-20-116 recorded the highest oil content (20.02%).

Table 2: Effect of different varieties and date of sowing on yield characters of soybean

Treatment	Number of pods / plant	Number of seeds/pod	Test weight	Grain yield	Stover yield	Oil content (%)	Net monetary returns	B: C ratio
Variety								
JS-2034	43.89	2.20	150.15	2267	31.67	17.49	74218	3.78
JS-20116	45.80	2.51	160.89	2312	31.97	17.99	75916	3.84
JS-2172	42.33	2.29	143.03	2201	30.50	16.41	71927	3.60
RVS-1110	39.64	1.96	130.66	1882	27.57	15.44	54041	2.72
S.Em±	0.37	0.10	1.44	27	0.48	0.21	1067	0.05
C.D. (*p*=0.05)	1.10	0.30	4.23	79	1.48	0.61	3131	0.15
Date of sowing								
10thJuly	44.95	2.53	157.12	2310	31.95	18.15	75824	3.84
15thJuly	42.93	2.20	147.18	2148	30.24	16.50	69183	3.50
20thJuly	40.87	1.98	134.27	2038	29.09	15.82	61582	3.12
S.Em±	0.32	0.09	1.25	23	0.41	0.18	924	0.04
C.D. (*p*=0.05)	0.95	0.26	3.66	69	1.21	0.53	2712	0.12

This increased oil accumulation is likely associated with the impact of timely sowing, which may have enhanced protein synthesis within the seeds. According to Waghmare *et al.* (2019), elevated protein levels may lead to a relative reduction in available carbohydrates that are essential precursors for fatty acid biosynthesis, particularly acetyl Co-A. The metabolic shift towards protein production, potentially triggered by higher nitrogen availability, might disrupt the balance between carbohydrate and lipid synthesis pathways. This imbalance could affect the overall fatty acid formation in the seeds, thereby influencing oil content. Despite this, JS-20-116 maintained superior oil levels, suggesting a favourable genotype-environment interaction under timely sowing conditions.

Economics

From farmer's point of view, the economic analysis of treatments has a great importance. The economic analysis of various treatments included cost of cultivation, gross monetary return, net monetary return and benefit cost ratio. The adoption of a uniform package of practices resulted in a common cost of cultivation for all treatment combinations.Among sowing dates highest GMR, NMR and B:C were recorded under 10th July sowing date followed respectively. The highest variety was JS-20-116 second highest variety JS-2034. Planting date is therefore one of the most crucial and least costly production choices influencing soybean seed yields and quality (Dubey *et al.* 2014**)**.

CONCLUSION

From the summarization of the above result, it can be concluded that variety JS-20-116, particularly when sown on 10th July, exhibited consistent superiority over other varieties and sowing dates across growth, yield, quality, and economic parameters. The variety JS-20-116 sown on 10th July resulted in enhanced growth characters as well as yield attributes and grain yield (2373 kg/ha). Furthermore, oil content, gross return (₹98,320q/ha), net return (₹78,550q/ha), and benefit-cost ratio (3.97) were also recorded under the same treatment combination, confirming its economic viability.

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