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Effect of sowing dates and variety on growth, yield attributes and yield of rapeseed under organic farming practices in South Garo Hills, meghalaya

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ABSTRACT

A field experiment was conducted in Asugre Village, South Garo Hills, in 2022 and 2023 to assess the impact of sowing dates on the growth and yield of rapeseed (Brassica juncea L.) varieties TS38 and M27 using a Factorial Randomized Block Design. The study included four sowing dates (15th September, 30th September, 15th October, and 30th October) and two rapeseed varieties (M 27 and TS 38), replicated over two years. Results revealed that sowing dates significantly influenced yield traits. The 30th September sowing (S2) yielded the longest siliqua (4.77 cm in 2022 and 4.75 cm in 2023) and the highest number of siliqua per plant (131.04 in 2022 and 130.93 in 2023). This date also resulted in the highest seed yield (10.50 q/ha in 2022 and 10.20 q/ha in 2023), followed by the 15th October (S3) and 30th October (S4) sowing dates. Variety TS 38 outperformed M 27 in key yield characteristics such as plant height, primary branches, siliqua length, and number of siliqua per plant. TS 38 produced higher seed yields of 1.08 t/ha in 2022 and 1.04 t/ha in 2023, compared to M 27. The interaction between sowing date and variety showed the best performance when TS 38 was sown on 30th September (V2S2), with the highest siliqua length (5.65 cm in 2022 and 5.63 cm in 2023), number of siliqua per plant (135.66 in 2022 and 135.50 in 2023), and seed yield (1.17 t/ha in 2022 and 1.13 t/ha in 2023). The study faced challenges like unpredictable climatic conditions in South Garo Hills, which affected sowing dates and crop growth, and managing soil fertility under organic practices, which can be inconsistent. Additionally, variations in pest and disease pressure, along with genetic differences between rapeseed varieties, may have influenced the results, complicating the interpretation of the best sowing dates and variety for optimal yield.

Keywords: *Oilseed-rapeseed, Sowing dates, Varietal effect, NICRA, Growth Parameters, Yield Attributes, Yield, Economics of Rapeseed cultivation.*

Introduction

India ranks third in the world in terms of edible oil economy, following China and the United States. Among oilseeds, rapeseed mustard plays a significant role, contributing 79.77 lakh tons to India's total oilseed production, which is second only to soybeans (137.94 lakh tons). The crop's response to different sowing dates highlights its sensitivity to weather conditions [1]. Rapeseed mustard is widely used as a vegetable, oilseed, and condiment globally. It accounts 27% of India's edible oil consumption and 13% of global consumption [2]. This promising rabi crop is cultivated in several states including Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, Gujarat, West Bengal, Assam, Bihar, and Punjab. In India, rapeseed-mustard occupies around 75–80% of the total area planted with Brassica crops [3]. These crops are grown during the rabi season, which spans from September to October for sowing and February to March for harvesting. The timing of sowing is one of the most critical factors influencing mustard yield[4].In addition to primary nutrients, organic sources are rich in secondary nutrients that enhance soil fertility.

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Research by [5] indicates that the use of organic nutrients improves soil health, resulting in better performance of Indian mustard. According to [6], a two-year trial demonstrated that the combination of PSM + Azospirillum with 5.0 tonnes of FYM/ha and 80 kg of nitrogen per hectare significantly boosted mustard seed yield. The ideal sowing time is critical for achieving the crop's full genetic potential, as it provides optimal conditions such as temperature, light, humidity, and rainfall [7]. In *Brassica juncea* L., studies have shown that sowing on October 5th yields higher seed production compared to sowing a month later [8]. Additionally, both variety and climatic conditions play a significant role in determining the yield potential of Indian mustard. In view of the above factors, a field experiment titled "Effect of sowing dates and varietal performance on the growth and yield of Rapeseed (Brassica juncea L.)" was conducted during the rabi seasons of 2022 and 2023.

MATERIAL AND METHODS

The study was conducted over two consecutive seasons 2022 and 2023 in Asugre (NICRA village) located in the South Garo Hills of Meghalaya (25°35' N latitude, 90°32' E longitude, at an elevation of 169.11 meters above sea level). The soil in the experimental field was classified as sandy loam, with a pH of 6.5. The field also had low concentrations of organic carbon, available phosphorus, available potassium, and nitrogen. The experiment was designed using a Factorial Randomized Block Design (RBD) with two factors and three replications (2×3).

The first factor included four sowing dates: September 15, September 30, October 15, and October 30. The second factor consisted of two rapeseed varieties, M 27 and TS 38.

RESULTS AND DISCUSSION

The findings of the present study, titled "Effect of Sowing Dates and Varietal Selection on Growth, Yield Characteristics, and Rapeseed Yield in Organic Farming Systems of South Garo Hills, Meghalaya," are presented and analyzed in the following sections.

GROWTH PARAMETERS

The results presented in Table 1 and Table 2 clearly show that rapeseed variety has a significant effect on both plant height and the number of branches per plant at harvest. TS 38 outperformed the other varieties in plant height, measuring 127.77 cm and 4.99 branches per plant in 2022, and similarly in 2023 with a plant height of 127.59 cm and 4.94 branches per plant. These findings align with previous research, which highlighted the superior growth characteristics of this variety [9] [10][11]. In contrast, the date of sowing did not show any significant impact on either plant height or the number of branches per plant, suggesting that variations in sowing dates had little effect on these traits. Additionally, the interaction between sowing dates and varieties was not statistically significant, indicating no combined effect on these growth parameters. A trend observed was that later sowing resulted in shorter plants, possibly due to the colder temperatures typically experienced during the winter months, which could have hindered plant growth. However, this effect was not statistically significant. In summary, TS 38 proved to be the most robust variety in terms of growth, and while sowing dates did not have a significant impact on plant height or the number of branches, delayed sowing could reduce plant height due to cooler environmental conditions.

YIELD ATTRIBUTES

The data presented in Table 1 and Table 2 reveal that yield traits, including siliqua length and the number of siliqua per plant, were significantly affected by both the variety of rapeseed, sowing dates, and the interaction between these two factors. In variety Performance, the TS 38 variety consistently outperformed M 27 regarding siliqua length and the number of siliqua per plant in both years (2022 and 2023). Specifically, in 2022, TS 38 recorded a siliqua length of 4.45 cm and an average of 131.65 siliqua per plant, while in 2023, it measured 4.42 cm in siliqua length and 131.47 siliqua per plant. These findings suggest that TS 38 consistently produces longer siliqua and a higher number of siliqua per plant compared to M 27, likely due to its superior genetic traits.

Effect of Sowing Date: The timing of sowing also had a significant effect on these yield attributes. The best results for both siliqua length and the number of siliqua per plant were observed when sowing occurred on 30th September. In 2022, the siliqua length of TS 38 was 4.77 cm and the number of siliqua per plant was 131.04, while in 2023, sowing on the same date resulted in a siliqua length of 4.75 cm and 130.93 siliqua per plant. These findings indicate that sowing by the end of September promotes better yield attributes, likely due to more favorable environmental conditions during the plant's reproductive phase.

Interaction Between Variety and Sowing Date: A significant interaction was observed between the variety and sowing date. The combination of TS 38 and sowing on 30th September produced the highest values for both siliqua length and number of siliqua per plant across both years. In 2022, the siliqua length reached 5.65 cm with 135.66 siliqua per plant, while in 2023, it was 5.63 cm and 135.50 siliqua per plant, respectively. These results emphasize the importance of both variety selection and the timing of sowing in maximizing yield potential.

Impact of Temperature on Yield: The study also points out the potential negative impact of high temperatures on yield attributes. Increased temperatures during critical stages, such as flowering and siliqua formation, can result in floral sterility, causing flower and siliqua to drop, which ultimately reduces yield [12][13]. This suggests that while sowing time plays a crucial role in optimizing yield attributes, excessive heat during the reproductive phase can have a detrimental effect on these traits.

In conclusion, the TS 38 variety, when sown on 30th September, consistently yielded the best results for both siliqua length and the number of siliqua per plant in both 2022 and 2023. The interaction between sowing date and variety was significant, with the TS 38 × 30th September combination outperforming all other treatments. However, the study also suggests that elevated temperatures during key growth stages may negatively affect floral development and siliqua formation, reducing overall yield under certain conditions.

YIELD

The analysis of seed yield in rapeseed revealed significant influences from both the variety, sowing dates, and their interaction, as summarized in Table 1 and Table 2.

Effect of Variety on Seed Yield: The TS 38 variety consistently outperformed M 27 in terms of seed yield over both years of the study. In 2022, TS 38 yielded 1.08 t/ha, while M 27 produced 0.90 t/ha. In 2023, TS 38 produced 1.04 t/ha, compared to M 27's 0.88 t/ha. These results suggest that TS 38 is a more productive variety for seed yield under the conditions of this study.

Effect of Sowing Date on Seed Yield: Sowing rapeseed on 30th September resulted in the highest seed yields in both years. In 2022, the seed yield was 1.05 t/ha, and in 2023, it was 1.04 t/ha. This indicates that sowing at the end of September is optimal for rapeseed production, likely due to more favorable environmental conditions during the reproductive growth phase, including better temperature, light, and moisture availability.

Interaction Between Variety and Sowing Date: The combination of TS 38 sown on 30th September produced the highest seed yields in both years. In 2022, this combination resulted in 1.17 t/ha, while in 2023, it yielded 1.13 t/ha. This was followed closely by TS 38 sown on 15th October, which resulted in 1.16 t/ha in 2022 and 1.13 t/ha in 2023, showing results statistically similar to the September 30th sowing. These findings underscore the importance of both variety choice and sowing timing, with TS 38 sown on 30th September proving to be the most productive combination in both years.

Impact of Sowing Date Timing: The study observed that both early and late sowing of rapeseed led to reduced seed yield. Early sowing was particularly beneficial, likely because it provided more favorable environmental conditions, allowing better uptake of light, water, and nutrients. This improved photosynthesis and plant growth [14]. These results are consistent with previous research [15] [16] [17]. which suggested that every crop variety has an optimal sowing window that maximizes its yield potential in a given region.

Rapeseed variety TS 38, when sown on 30th September, resulted in significantly higher yield attributes and seed yield in the South Garo Hills, Meghalaya. This variety showed excellent performance in terms of both growth and yield, with the highest seed yield recorded when sowing occurred at the end of September.
Key takeaways: TS 38 is the superior variety for yield. Sowing on 30th September yields the best results. Both too early and too late sowing can reduce seed yield, highlighting the importance of optimizing sowing time. Therefore, TS 38 sown at the end of September appears to be the best choice for growers in the South Garo Hills region.

Economics of Rapeseed Cultivation

1. Cost of Cultivation (Rs/ha)

The total cost of cultivation was estimated at Rs 31,000 per hectare, covering all expenses associated with the production process.

2. Gross Returns (Rs/ha)

The highest gross return of Rs 76,320 per hectare was achieved with the TS 38 × 30th September combination, while the lowest gross return, Rs 58,700 per hectare, was recorded for M 27 × 15th October.

3. Net Returns (Rs/ha)

For net returns, the TS 38 × 30th September combination yielded the highest at Rs 45,320 per hectare, while the lowest net return of Rs 27,700 per hectare was observed in M 27 × 15th October.

4. Benefit-Cost Ratio (BCR)

The TS 38 × 30th September combination also resulted in the highest Benefit-Cost Ratio (BCR) of 2.46, due to its higher net returns. In contrast, the M 27 × 15th October combination had the lowest BCR of 1.89.

Table-1: Growth parameters, yield attributes and yields of rapeseed as influenced by different date of sowing and varieties 2022

	Plant height (cm)	No.of primary branches	Length of siliqua (cm)	No. of siliqua per plant	Seed yield (t/ha)
M 27	84.03	3.77	3.91	123.37	0.90
TS 38	127.77	4.99	4.45	131.65	1.08
S.E(d) ±	1.72	0.07	0.06	0.42	0.03
C.D (p=0.05)	3.68	0.16	0.13	0.91	0.05
15th Sept	103.82	4.30	3.71	123.83	0.92
30th Sept	109.64	4.46	4.77	131.04	1.05
15th Oct	106.99	4.36	3.83	128.55	1.02
30th Oct	103.15	4.40	3.71	126.63	0.96
S.E(d) ±	2.43	0.11	0.09	0.60	0.04
C.D (p=0.05)	NS	NS	0.20	1.29	0.08
M 27 ×15th Sept	79.75	3.67	3.59	115.19	0.88
M 27 × 30th Sept	89.12	3.74	3.90	126.42	0.94
M 27 ×15th Oct	85.71	3.91	4.13	127.33	0.88
M 27 ×15th Oct	81.55	3.77	3.68	124.54	0.90
TS 38 × 15th Sept	127.89	4.94	3.84	132.47	0.96
TS 38 × 30th Sept	130.15	5.18	5.65	135.66	1.17
TS 38 × 15th Oct	128.27	4.82	4.33	129.77	1.16
TS 38 × 30th Oct	124.76	5.04	3.98	128.72	1.01
S.E(d) ±	3.43	0.15	0.13	0.85	0.05
C.D (p=0.05%)	NS	NS	0.29	1.82	0.11

Table-2: Growth parameters, yield attributes and yields of rapeseed as influenced by different date of sowing and varieties 2023

	Plant height (cm)	No. of primary branches	Length of siliqua (cm)	No. of siliqua per plant	Seed yield (t/ha)
M 27	84.00	3.74	3.79	123.31	0.88
TS 38	127.59	4.94	4.42	131.47	1.04
S.E(d) ±	1.68	0.06	0.06	0.43	0.02
C.D (p=0.05)	3.61	0.14	0.14	0.92	0.04
15th Sept	103.63	4.24	3.68	123.75	0.89
30th Sept	109.55	4.42	4.75	130.93	1.02
15th Oct	106.96	4.33	4.20	128.30	0.99
30th Oct	103.04	4.38	3.80	126.58	0.94
S.E(d) ±	2.38	0.09	0.09	0.61	0.03
C.D (p=0.05)	NS	NS	0.20	1.31	0.06
M 27 ×15th Sept	79.72	3.63	3.56	115.12	0.86
M 27 × 30th Sept	89.10	3.72	3.87	126.36	0.92
M 27 ×15th Oct	85.71	3.89	4.10	127.25	0.86
M 27 ×15th Oct	81.45	3.74	3.64	124.49	0.89
TS 38 × 15th Sept	127.54	4.85	3.80	132.37	0.92
TS 38 × 30th Sept	130.01	5.11	5.63	135.50	1.13
TS 38 × 15th Oct	128.20	4.78	4.30	129.34	1.12
TS 38 × 30th Oct	124.62	5.01	3.95	128.66	0.99
S.E(d) ±	3.37	0.13	0.13	0.86	0.05
C.D (p=0.05%)	NS	NS	0.28	1.85	0.11

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15^{th} Oct	106.99	4.36	3.83	128.55	1.02
30^{th} Oct	103.15	4.40	3.71	126.63	0.96
S.E(d) ±	2.43	0.11	0.09	0.60	0.04
C.D (p=0.05)	NS	NS	0.20	1.29	0.08
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M 27 ×15^{th} Oct	85.71	3.91	4.13	127.33	0.88
M 27 ×15^{th} Oct	81.55	3.77	3.68	124.54	0.90
TS 38 × 15^{th} Sept	127.89	4.94	3.84	132.47	0.96
TS 38 × 30^{th} Sept	130.15	5.18	5.65	135.66	1.17
TS 38 × 15^{th} Oct	128.27	4.82	4.33	129.77	1.16
TS 38 × 30^{th} Oct	124.76	5.04	3.98	128.72	1.01
S.E(d) ±	3.43	0.15	0.13	0.85	0.05
C.D (p=0.05%)	NS	NS	0.29	1.82	0.11

Table-2: Growth parameters, yield attributes and yields of rapeseed as influenced by different date of sowing and varieties 2023

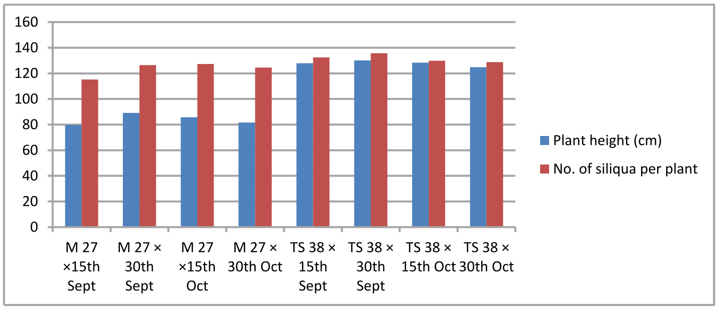

Fig-1: Growth parameters, yield attributes and yields of rapeseed as influenced by different date of sowing and varieties 2022 (Graphical Representation)

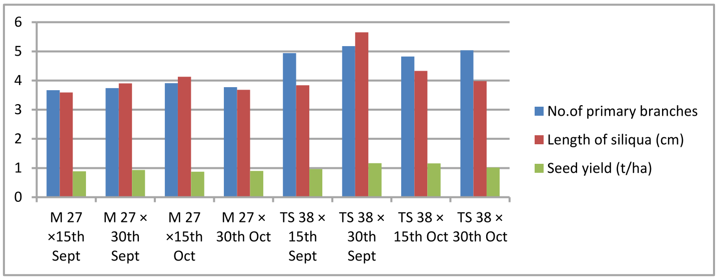

Fig-2: Growth parameters, yield attributes and yields of rapeseed as influenced by different date of sowing and varieties 2022 (Graphical Representation)

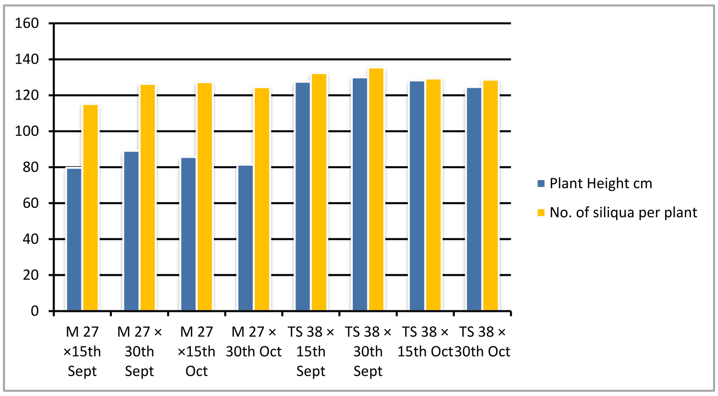

Fig-3: Growth parameters, yield attributes and yields of rapeseed as influenced by different date of sowing and varieties 2023 (Graphical Representation)

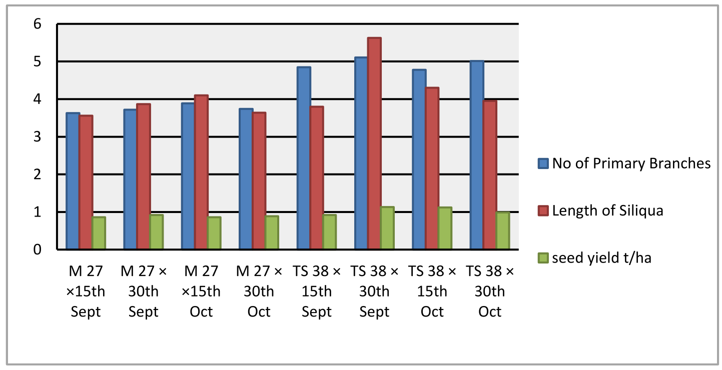

Fig-4: Growth parameters, yield attributes and yields of rapeseed as influenced by different date of sowing and varieties 2023 (Graphical Representation)

Table- 3: Economics of Rapeseed (2022 & 2023)

Performance of Rapeseed on Economics	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio
M 27 ×15th Sept	31,000	58,700	27,700	1.89
M 27 × 30th Sept	31,000	60,200	29,200	1.94
M 27 ×15th Oct	31,000	59,300	28,300	1.91
M 27 ×15th Oct	31,000	60,150	29,150	1.94
TS 38 × 15th Sept	31,000	62,350	31,350	2.01
TS 38 × 30th Sept	31,000	76,320	45,320	2.46
TS 38 × 15th Oct	31,000	74,320	43,320	2.40
TS 38 × 30th Oct	31,000	61,850	30,850	2.00

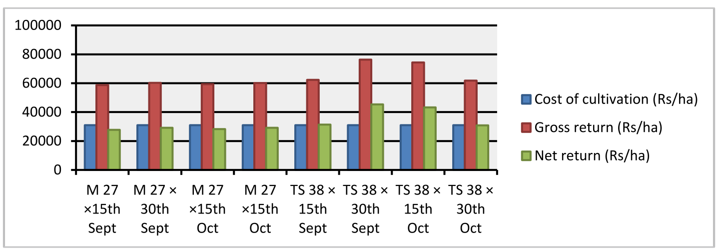

Fig-5: Economics of Rapeseed 2022 & 2023 (Graphical Representation)

Future scope of study

Future studies could expand by testing additional rapeseed varieties to identify those best suited for organic farming in varying climatic conditions. Investigating long-term effects of organic fertilizers and soil management practices on yield and sustainability could enhance farming methods. Climate change impact studies would be crucial to understand how shifting weather patterns affect sowing dates and crop performance. Incorporating precision agriculture techniques could help optimize sowing times and resource use. Finally, exploring the socio-economic feasibility and farmer adoption of these practices would help inform policies for sustainable rapeseed cultivation.

CONFLICT INTERESTS

The authors have stated that there are no conflict interests to disclose.

Acknowledgements

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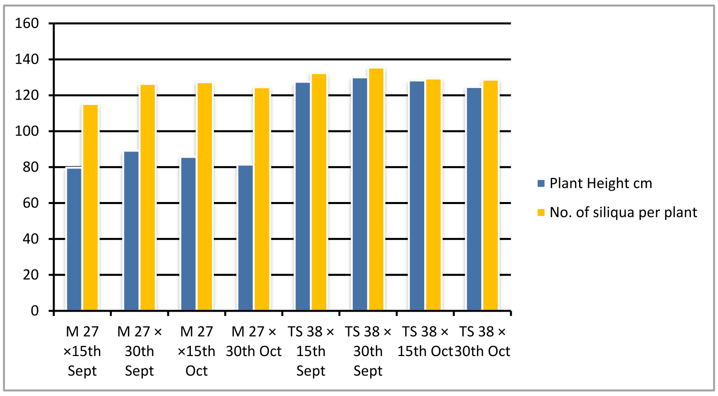

Fig-3: Growth parameters, yield attributes and yields of rapeseed as influenced by different date of sowing and varieties 2023 (Graphical Representation)

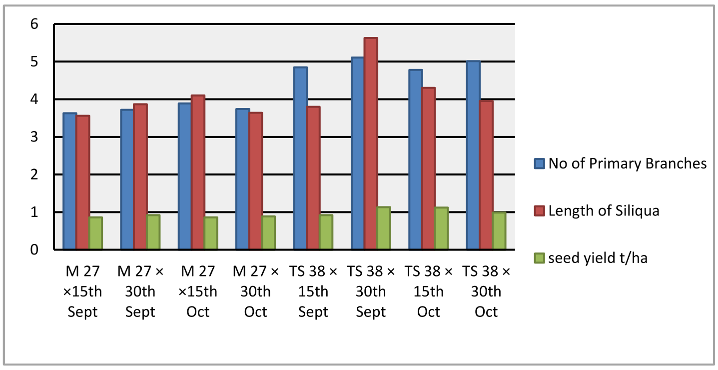

Fig-4: Growth parameters, yield attributes and yields of rapeseed as influenced by different date of sowing and varieties 2023 (Graphical Representation)

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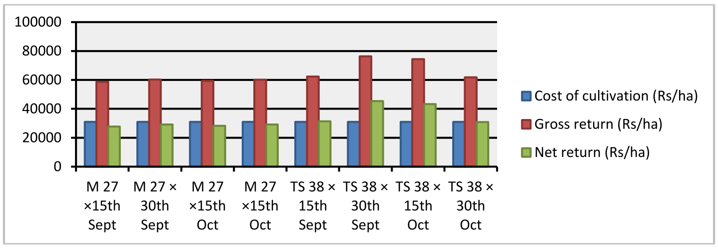

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The authors have stated that there are no conflict interests to disclose.

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