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Effect of different dates of sowing along with various nitrogen levels and bio-inoculants on yield of fenugreek (*Trigonella foenum-greacum* L.)

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Abstract
Fenugreek is an important spice crop and widely in use all over the world but still neglected by the farmers due to its lower production rate as a result of improper sowing time and nutrient management. Hence, it is crucial to know the proper sowing time and nutrient management as per the varied agro-climatic conditions. A field experiment was conducted on fenugreek (cv. Rajendra Kanti) during the winter season of 2021-22, in order to evaluate the performance of different nitrogen levels with bio-inoculants (Azotobacter, Azospirillum, PSB and Rhizobium culture) @ 200 ml kg^{-1} of seeds, along with 0% Nitrogen + bio-inoculants with regards to yield and yield attributing characters. The dose of P and K remained constant in all the treatments suitably entangled with 2 dates of sowing (13th December and 28th December of 2021). The experiment was laid out in Factorial Randomized Block Design with 14 treatments and 3 replications. The results of the present investigation concluded that the significantly maximum pod length (11.05cm), maximum number of pods per plant (18.73), maximum number of seeds per pod (16.40), highest 1000 seed weight (13.12g), highest seed yield per hectare (438.56 kg) were recorded in the treatment T_5 receiving 60:25:40 NPK kg ha^{-1} (100% RDF) + seed treatment with bio-inoculants (200 ml kg^{-1} of seed) and sown earlier on 13th December 2021 is significantly higher than the other treatments.

Keywords: Fenugreek, Trigonella foenum-graecum L., bio-inoculants, Azotobacter, Azospirillum

Introduction
India is the land of spices and glory of Indian spices are known throughout the world. Indian spices are popularly known for their flavour and aroma in domestic as well as international markets. Among the seed spices, Fenugreek (*Trigonella foenum-graecum* L.) which belongs to the family Fabaceae is a substantially important. Its seeds are one of the staple spice used in Indian cuisine as flavouring agents with a sweet and nutty flavour reminiscent of maple syrup and burnt sugar, due to the presence of alkaloid Sotolon. The crop not only contributes to the cuisine effects but poses a great medicinal value and also used as domestic medicine in every household of India. The seeds contain diospenin, a drug used in synthesis of hormones. People have been using fenugreek in varying forms for hundres or potentially thousands of years to treat a very wide range of conditions such as digestive problems, gastritis, diabetes, menopause, arthritis, high blood pressure, ulcers, migraines, child birth pains etc. Earlier sowing dates had significantly higher influence on the yield of fenugreek (Bhutia, 2017) [3]. A remarkable response in case of yield of Fenugreek was also evidenced when a combined application of chemical fertilizers and bio-fertlizers was done. In Odisha, practically no research work has been conducted with reference to application of bio-inoculants, different dates of sowing and nitrogen levels in Fenugreek. Hence, this experiment was undertaken to observe the effects of different dates of sowing along with various nitrogen levels and bio-inoculants on yield of Fenugreek.

Materials and Methods
The present research entitled "Response of different dates of sowing along with various nitrogen levels and bio-inoculants on yield of fenugreek (*Trigonellafoenum-graecum* L.)" was carried out during rabi season, 2021-22 at the Research Farm, Binjhagiri, Chatabar of Institute of Agricultural Sciences, Bhubaneswar with the objective to study the effects of different levels of Nitrogen fertilizer application, effect of seed treatment with bio-inoculants and effect of different dates of sowing on yield of fenugreek Variety Rajendra Kanti was selected.

Fourteen treatments using different dates of sowing with different levels of nitrogen (dose of P and K remained constant in all the treatments) and bio-inoculants have been taken for this experiment include FYM @ 15 tonnes ha^{-1}.The sowing was done in Rabi season at different dates of sowing using FRBD. The dates for sowing were, 13th December (D1) and 28th December (D2) and the fertilizer treatments were T1(13th Dec. sowing, 60:25:40 kg NPK/ha), T2(13th Dec. sowing, 45:25:40 kg NPK/ha), T_3 (13th Dec sowing, 30:25:40 kg NPK/ha),T_4 (13th Dec. sowing, 0:25:40 kg NPK/ha + Bio-inoculants),T5 (13th Dec. sowing, 60:25:40 kg NPK/ha + Bio-inoculants),T6 (13th Dec. sowing, 45:25:40 kg NPK/ha + Bio-inoculants),T_7 (13th Dec. sowing, 30:25:40 kg NPK/ha + Bio-inoculants). The spacing of 30 cm x 10 cm was adopted in 2.0 m × 1.5 m sized plot. From each plot ten observation plants were selected to record the pod length, number of pods per plant, number of seeds per pod, 1000 seed weight and seed yield per plot. The details of the treatments applied in this experiment are given in Table 1.

Table 1: The experiment comprised of the following treatments

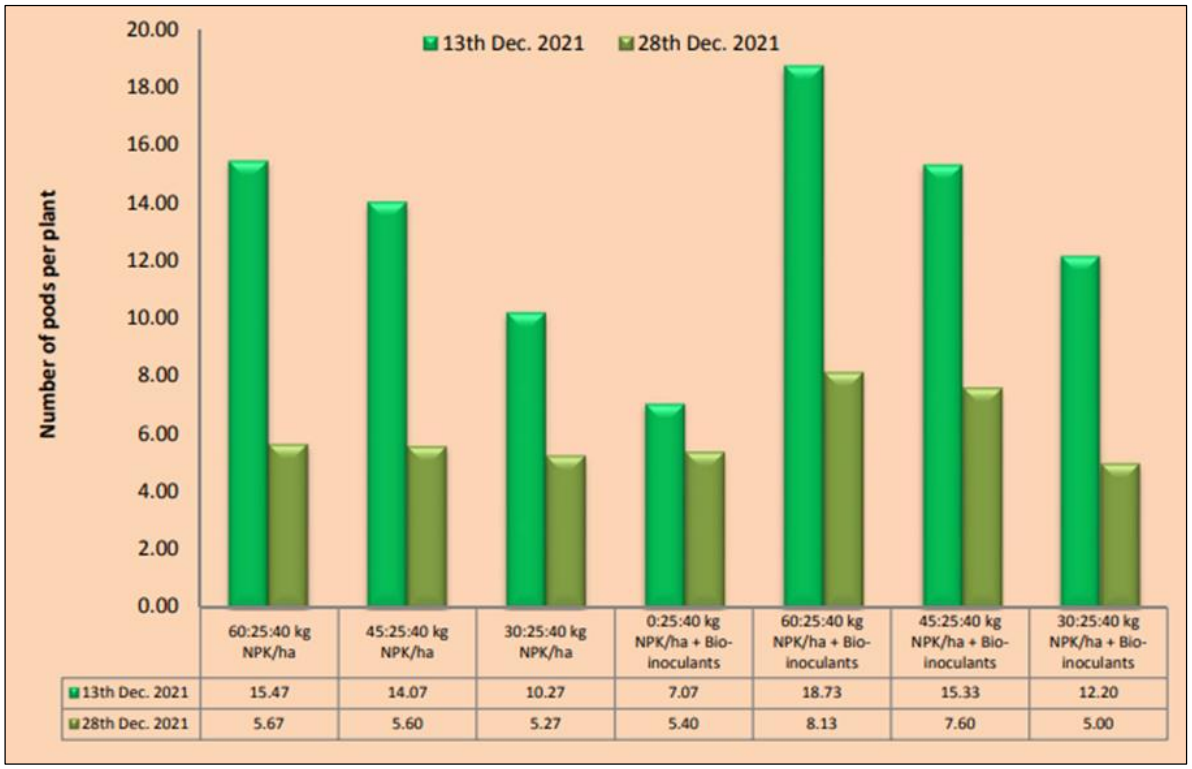
Treatments	Treatment Details
D1T1	(13th Dec. sowing, 60:25:40 kg NPK/ha)
D1T2	(13th Dec. sowing, 45:25:40 kg NPK/ha)
D1T3	(13th Dec. sowing, 30:25:40 kg NPK/ha)
D1T4	(13th Dec. sowing, 0:25:40 kg NPK/ha + Bio-inoculants)
D1T5	(13th Dec. sowing, 60:25:40 kg NPK/ha + Bio-inoculants)
D1T6	(13th Dec. sowing, 45:25:40 kg NPK/ha + Bio-inoculants)
D1T7	(13th Dec. sowing, 30:25:40 kg NPK/ha + Bio-inoculants)
D2T1	(28th Dec. sowing, 60:25:40 kg NPK/ha)
D2T2	(28th Dec. sowing, 45:25:40 kg NPK/ha)
D2T3	(28th Dec. sowing, 30:25:40 kg NPK/ha)
D2T4	(28th Dec. sowing, 0:25:40 kg NPK/ha + Bio-inoculants)
D2T5	(28th Dec. Sowing, 60:25:40 kg NPK/ha + Bio-inoculants)
D2T6	(28th Dec. sowing, 45:25:40 kg NPK/ha + Bio-inoculants)
D2T7	(28th Dec. sowing, 30:25:40 kg NPK/ha + Bio-inoculants)

Results and Discussions

A careful observation of data relating to yield and yield components of fenugreek (number of pods per plant, number of seed per pod, length of pod, weight of 1000 seeds, yield per plot and yield per hectare) as influenced by different level of nitrogen (100% RDF, 75% RDF, 50% RDF) in combination with bio-inoculation and date of sowing. Recommended dose of fertilizer along with bio inoculants and date of sowing were able to influence the yield and its components (number of pods per plant, number of seed per pod, length of pod, weight of 1000 seeds, yield per plot and yield per hectare) may be to a reasonable extend 90 DAS.

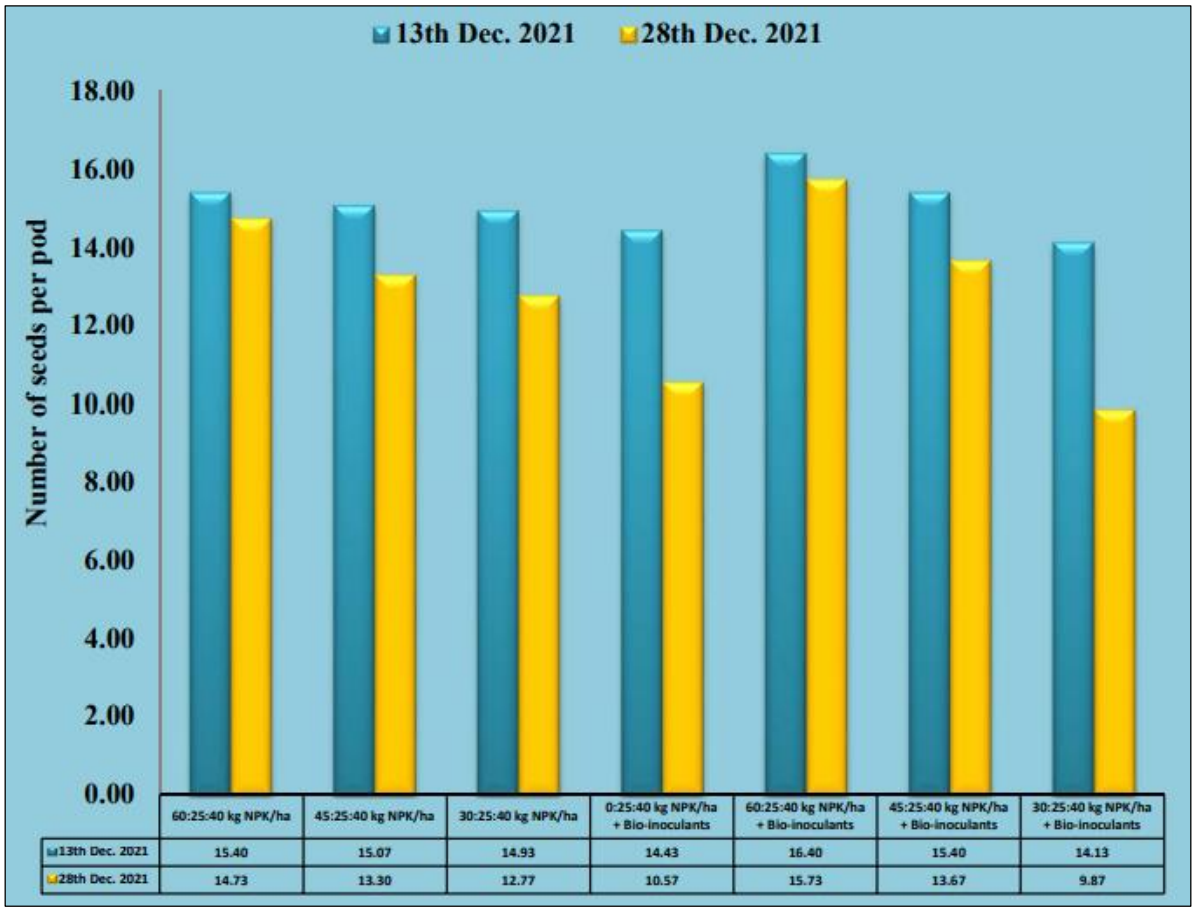
A significant variation in number of pods $plant^{-1}$ was recorded in the different dates of sowing of fenugreek in the experiment. Significantly maximum number of pods $plant^{-1}$ was recorded in 13th December sowing (13.30) and minimum number of pods $plant^{-1}$ was recorded in 28th December sowing (6.10). Among different levels of nitrogen with bio-inoculation no significant variation was observed within the treatments. However maximum number of pods $plant^{-1}$ (13.43) was found in the treatment of 100% RDF with bio-inoculation, followed by 75% RDF with bio-inoculation (11.47). The minimum number of pods $plant^{-1}$ (6.23) was recorded in the treatment of 0% nitrogen with bio-inoculation. Combined effect of different dates of sowing and different level of nitrogen with bio-inoculation, did not show significant variation among the treatments. However, the maximum number of pods $plant^{-1}$ (18.73) was recorded in the treatment of 100% RDF with bio-inoculation and minimum number of pods $plant^{-1}$ (5.00) was observed in the treatment of 50% RDF with bio-inoculation. The 13th December sowing with 100% RDF and bio-inoculation produced the highest number of number of pods per plant due to earlier sowing as compared to late sowing on 28th December. This might be due to better vegetative growth in early sown crop and the crop getting sufficient time for its growth under favourable condition which would have resulted the maximum pods per plant. The results obtained in this investigation are in close agreement with the findings of Sultana *et al.* (2016) [5] and Abdou *et al.* (2021) [2] in fenugreek.

Significant variation in number of seeds pod^{-1} was recorded on different date of sowing. Significantly maximum number of seeds pod^{-1} (15.01) was observed in 13th December sowing. Minimum number of seeds pod^{-1} (13.04) was recorded in 28th December sowing.From among different nitrogen levels with bio-inoculation, significantly maximum number of seeds pod^{-1} (16.07) was recorded in the 100% RDF with bio inoculation which was at par with 100% RDF (15.07) only. Minimum number of seeds pod^{-1} (12.00) was recorded in the treatment of 50% RDF with bio-inoculation. The combined effect of different dates of sowing and nitrogen levels with bio-inoculation showed no significant variation among the treatments. However, maximum number of seeds pod^{-1} (16.40) was recorded in the treatment of 100% RDF with bio-inoculation in 13th December sowing, whereas minimum number of seeds pod^{-1} (9.87) was recorded in 50% RDF with bio-inoculation sown on 28th December. The 13th December sowing in 100% RDF with bio-inoculation indicating the highest number of seeds per pod due to earlier sowing as compared to late sowing on 28th December. This might be due to the fact that the nutrient supplied through inorganic and organic sources mostly nitrogen increases the concentration of carbohydrate and as the seeds served as a reservoir of the carbohydrates, the number might have been increased. The results obtained in this investigation are in close agreement with the findings of Sultana *et al.* (2016) [5] and Bhutia *et al.* (2017) [3] in fenugreek.



	60:25:40 kg NPK/ha	45:25:40 kg NPK/ha	30:25:40 kg NPK/ha	0:25:40 kg NPK/ha + Bio-inoculants	60:25:40 kg NPK/ha + Bio-inoculants	45:25:40 kg NPK/ha + Bio-inoculants	30:25:40 kg NPK/ha + Bio-inoculants
13th Dec. 2021	15.47	14.07	10.27	7.07	18.73	15.33	12.20
28th Dec. 2021	5.67	5.60	5.27	5.40	8.13	7.60	5.00

Fig 1: Effect of dates of sowing with different levels of nitrogen and bio-inoculants on number of pods of fenugreek (*Trigonella foenum-graecum* L.)



	60:25:40 kg NPK/ha	45:25:40 kg NPK/ha	30:25:40 kg NPK/ha	0:25:40 kg NPK/ha + Bio-inoculants	60:25:40 kg NPK/ha + Bio-inoculants	45:25:40 kg NPK/ha + Bio-inoculants	30:25:40 kg NPK/ha + Bio-inoculants
13th Dec. 2021	15.40	15.07	14.93	14.43	16.40	15.40	14.13
28th Dec. 2021	14.73	13.30	12.77	10.57	15.73	13.67	9.87

Fig 2: Effect of date of sowing with different levels of nitrogen and bio-inoculants on number of seeds per pod of fenugreek (*Trigonella foenu-graecum* L.).

The length of pod in effect of different dates of sowing as influenced by different nitrogen levels and bio-inoculation in the experiment are presented in Figure 3. Different dates of sowing recorded significant variations in lengths of pod of fenugreek. Significantly maximum length of the pod (10.43 cm) was observed in 13th December sowing, whereas a

minimum pod length (9.66 cm) was recorded in 28th December sowing. The data recorded in different nitrogen levels with bio-inoculation also showed significant variations among the treatments. Significantly maximum length of pod was recorded in the treatment of 100% RDF with bio-inoculation (10.60 cm) which was at par with other nitrogen levels, except the treatment of 0% nitrogen with bio-inoculation (8.82 cm) which was minimum. The combined treatment effect of different dates of sowing and nitrogen level with bio-inoculation didn't show any significant variation among treatments. However, maximum length of pod (11.05 cm) was recorded both in the treatments of 100% RDF with bio-inoculation and 75% RDF with bio-inoculation sown on 13th December. The minimum length of pod (8.81 cm) was observed in 0% nitrogen with bio-inoculation sown on the same date. The 13th December sowing in 100% RDF with bio-inoculation indicated the maximum length of pod (cm) due to earlier sowing as compared to late sowing on 28th December. This might be due to the more number of seeds present in the pod which resulted in increased length of pod. This has already been reported and confirmed with the findings of Kauser *et al*. (2015) [4] and Bhutia *et al*. (2017) [3] in fenugreek.

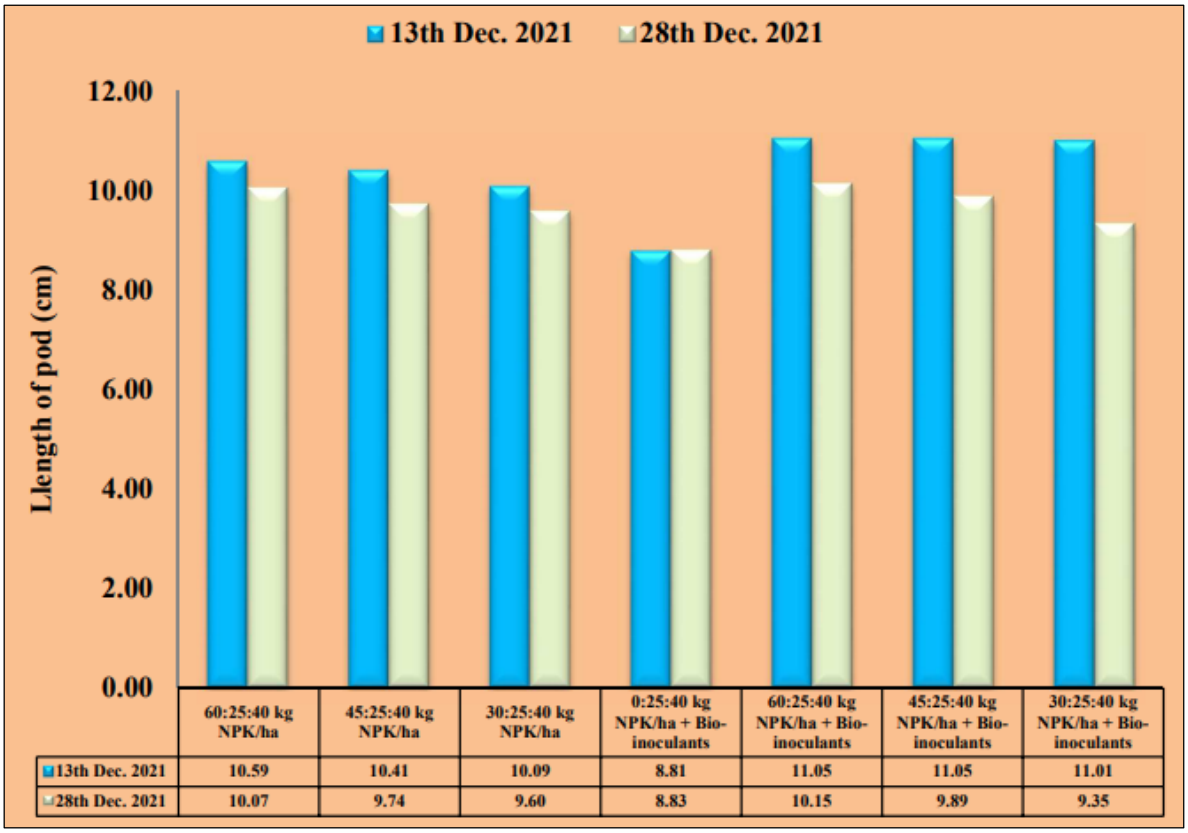


Fig 3: Effect of date of sowing with different levels of nitrogen and bio-inoculants on length of pod (cm) of fenugreek (*Trigonella foenum-graecum* L.).

The weight of 1000 seeds (g) in effect of different dates of sowing as influenced by different nitrogen levels and bio-inoculation in the experiment are presented in Figure 4. The different dates of sowing showed significant effect on the weight of 1000 seeds. Significantly maximum weight of 1000 seeds (12.66 g) was recorded in 13th December sowing, with a minimum weight of 1000 seeds (11.82) on 28th December sowing. Among different levels of nitrogen with bio-inoculation no such significant variation was observed. However, maximum weight of 1000 seeds (12.70 g) was recorded in 100% RDF with bio-inoculation and minimum weight of 1000 seeds (11.58 g) was observed in 28th December sowing. The combined effects of dates of sowing and different nitrogen levels also exhibited no significant variations on 1000 seed weight. However, maximum weight of 1000 seeds (13.12 g) was recorded in 100% RDF with bio-inoculation sown on 13th December and minimum weight of 1000 seeds (11.20 g) was recorded in 0% nitrogen level with bio-inoculation in 28th December sowing.

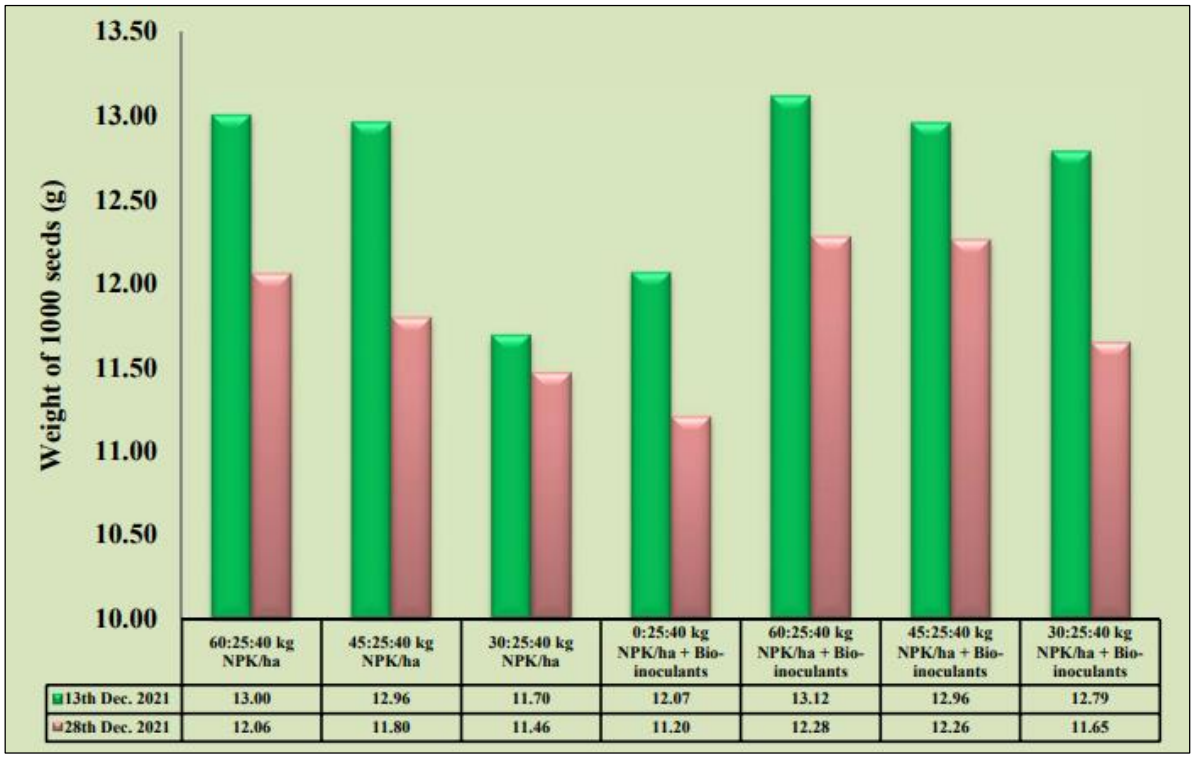


Fig 4: Effect of date of sowing with different levels of nitrogen and bio-inoculants on weight of 1000 seeds (g) of fenugreek (*Trigonellafoenum-graecum* L.).

The yield hectare^{-1} (kg) as affected by different dates of sowing and nitrogen levels with bio-inoculation of the experiment are presented in Figure 5. Seed yield ha^{-1} of fenugreek sown on different dates, resulted in significant variations. Significantly maximum yield ha^{-1} (351.10 kg) was recorded in 13th December sown crops while minimum yield ha^{-1} (272.87 kg) was recorded in 28th December sown crops. Significant variation was also obtained from among different levels of nitrogen. Significantly maximum yield ha^{-1} (387.17 kg) was recorded in the treatment with 100% RDF with bio-inoculation, which was at par with the treatment of 75% RDF with bio-inoculation (352.00 kg). The minimum yield ha^{-1} (277.61 kg) was obtained in the treatment with 0% nitrogen with bio-inoculation. No significant variations were observed among the treatments due to the combined effects of different dates of sowing, nitrogen levels and bio-inoculation. However, the maximum yield ha^{-1} (438.56 kg) was obtained in 100% RDF with bio-inoculation in 13th December sowing and a minimum yield ha^{-1} (212.78 kg) was recorded in the treatment of 75% RDF without bio-inoculation, sown on 28th December. The 13th December sowing in 100% RDF with bio-inoculation produced the maximum yield per hectare (kg) due to earlier sowing as compared to late sowing on 28th December. This might be due to the fact that an application of required nutrient through different sources might have produced more number of branches, more pods per plant and weight of seeds, which would have resulted in maximum yield per plot and per hectare seed yield. The results obtained in this investigation are in close agreement with the findings of Sultana *et al.* (2016) [5] and Abdou *et al.* (2021) [2] in fenugreek.

Economics

The table 2 shows that the treatment D1T5 was the best in respect to gross income Rs.65784, net income Rs.36450.25 with highest total cost of cultivation of Rs.29333.75 followed by treatment D1T6; gross income Rs. 58000.5, net income Rs. 29546.75 with a cost of cultivation of Rs. 28453.75. The lowest gross income Rs. 31917, net income Rs. 4663.25 with a cost of cultivation of Rs. 27253.75 was recorded in the treatment D2T2. The highest BC ratio was observed in treatment D1T5; 2.2 while the lowest BC ratio was observed in treatment D2T2; 1.1. The results obtained from the present investigation was confirmed and agreed with the findings of Yamuna *et al.* (2022) [7].

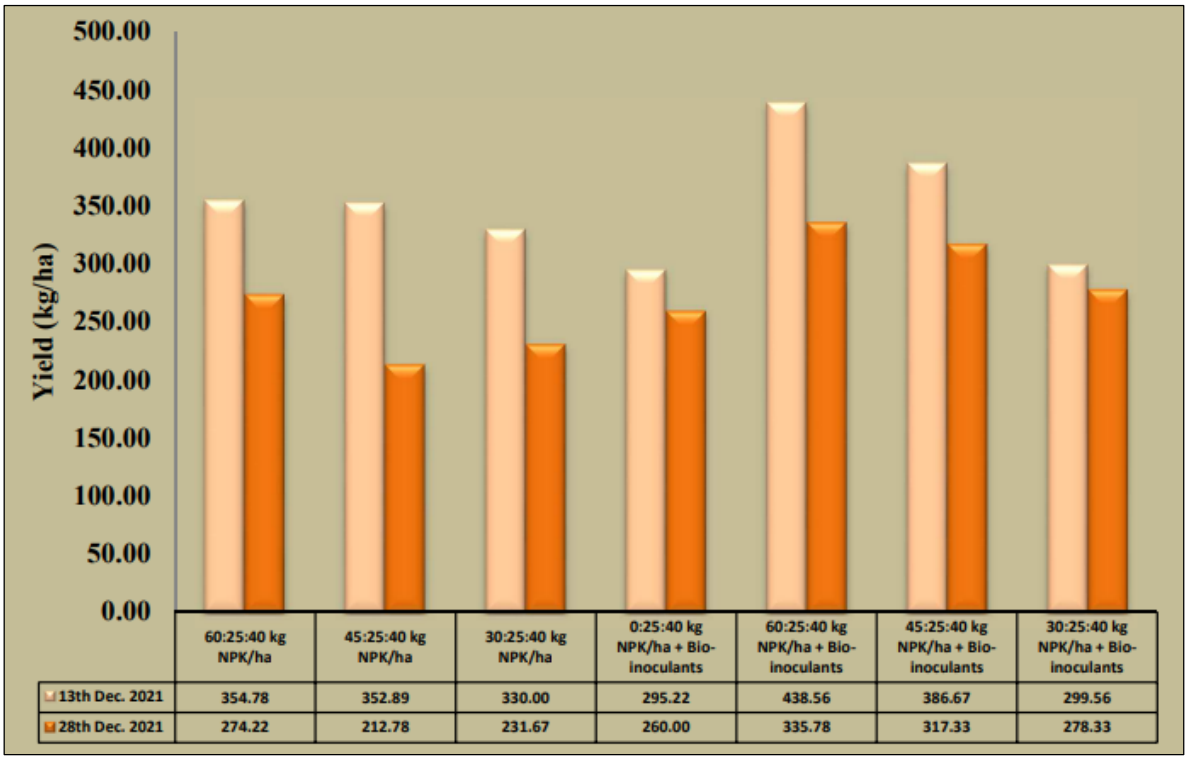


Fig 5: Effect of date of sowing with different levels of nitrogen and bio-inoculants on yield ha^{-1} (kg) of fenugreek (*Trigonella foenum-graecum* L.)

Table 2: Table of Economics

Treatments	Yield (Kg / ha)	Gross Income (Rs.) (Yield kg/ha × sale price)	Total Cost of cultivation (Rs.)	Net Income / Profit (Rs.)	B:C Ratio
D1T1	354.78	53217	28133.75	25083.25	1.9
D1T2	352.89	52933.5	27253.75	25679.75	1.9
D1T3	330.00	49500	26833.75	22666.25	1.8
D1T4	295.22	44283	26733.75	17549.25	1.7
D1T5	438.56	65784	29333.75	36450.25	2.2
D1T6	386.67	58000.5	28453.75	29546.75	2.0
D1T7	299.56	44934	28033.75	16900.25	1.6
D2T1	274.22	41133	28133.75	12999.25	1.4
D2T2	212.78	31917	27253.75	4663.25	1.1
D2T3	231.67	34750.5	26833.75	7916.75	1.2
D2T4	260.00	39000	26733.75	12266.25	1.4
D2T5	335.78	50367	29333.75	21033.25	1.7
D2T6	317.33	47599.5	28453.75	19145.75	1.7
D2T7	278.33	41749.5	28033.75	13715.75	1.5

Conclusion

The present experiment infers clearly that fenugreek crop with 100% RDF (60:25:40 kg NPK ha^{-1}) with bio-inoculation (Azotobacter, Azospirillum, PSB and Rhizobium culture @ 200 ml kg^{-1} of seeds) sown on 13th December exhibited almost the highest number of pods plant^{-1} (18.73), number of seeds pod^{-1} (16.40), length of pod (11.05 cm), weight of 1000 seeds (13.12 g), and seed yield ha^{-1} (438.56 kg) as compared to other treatments. So earlier sowing along with recommended dose of fertilizer (60:25:40 kg NPK ha^{-1}) with bio-inoculation (Azotobacter, Azospirillum, PSB and Rhizobium culture @ 200 ml kg^{-1} of seeds) may be recommended to the farmers for cultivation of fenugreek in Bhubaneswar agro-climatic condition. For the betterment of farming community, farmers must adopt the fenugreek crop cultivation in coastal region also but the most important point to be considered is the suitable sowing time. Early exposure of the crop to the lower temperature will give a satisfactory yield with immense profit both by producing leaf and seed yield. As the spices always play an important role in our Indian cuisine so fenugreek cultivation is a crowning crop as compared to other crops and the medicinal properties are like cherry on the cake.

References

1. Mawer R. Fenugreek: An Herb with Impressive Health Benefits. Healthline; c2019.
2. Abdou, Fatah MAH - A, AA. Effect of planting date and compost fertilization on Fenugreek plant, MiniaJ.of Agric. Res. & Develop. 2021;41(2):15-22.
3. Bhutia KC, Bhutia SO, Chatterjee R, Chattopadhyay N. Growth, Phenology and Yield of Fenugreek (*Trigonella foenum-graecum* L.) as Influenced by Date of Sowing. Int. J Curr. Microbiol. App. Sci. 2017;6(10):1810-1817.
4. Kauser H, Bhoomika HR, Ibaad MH. Interaction effects of different sowing dates and stage of pinching on

growth, yield and economics of Fenugreek (*Trigonella foenum – graecum* L.), Int. J Pure App. Biosci. 2018;6(2):167-171.
5. Sultana S, Das G, Das B, Sarkar S. Influence of dates of sowing on growth and yield dynamics of fenugreek (*Trigonella foenum-graecum* L.) International Journal of Green Pharmacy. 2016;10(4):S233.
6. Sahu PK, Naruka IS, Haldar A, Chundawat RS, Kumar L. Studies on the effects of integrated nutrient management on fenugreek (*Trigonella foenum-graecum*) L., International Journal of Chemical Studies. 2020;8(2):1082-1089.
7. Yamuna P, Solanki RM, Malam KV. Response of fenugreek (*Trigonella foenum-graecum* L.) to varying fertilizer levels and bio-fertilizer inoculations under South Saurashtra conditions, The Pharma Innovation Journal. 2022;11(5):2401-2407.