

Integrated nitrogen management options on growth and yield of *Rabi* castor, *Ricinus communis* L.

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ABSTRACT : A field experiment was conducted during 2011-12 on loamy sand soil at Sardarkrushinagar to evaluate the effect of integrated nitrogen management on growth and yield of *Rabi* castor. maximum growth in terms of plant height and number of branches per plant was observed with application of 75 per cent nitrogen through inorganic + 25% N through castor cake + *Azospirillum*. it also resulted in longer length of main spike, length of primary spike, more number of secondary and tertiary and total spikes per plant and more number of capsules on main spike. Integrated use of inorganic fertilizer with organic manure and seed treated with *Azospirillum* recorded highest seed yield. Oil content and oil yield was also higher with application of 75% N through inorganic + 25% N through castor cake + *Azospirillum*.

Key Words : Integrated nitrogen management, Growth, Yield

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India is the leader in the world castor seed and its oil production. It contributes about 55 per cent and 70 per cent of world area and production, respectively. Among the castor growing states, Gujarat holds first position with regards to area (52%), production (80%) and productivity (1833 kg/ha DOR, 2009-10) followed by Rajasthan and Andhra Pradesh. The productivity of Gujarat state compared to other states is the highest due to more than 90 per cent castor area covered by hybrids under irrigated conditions with special crop management practices. Castor oil is considered as versatile industrial raw material because it contains about 85-90 per cent of ricinoleic acid and hydroxy fatty acid. The castor oil is different from other vegetable oils in the sense that it does not freeze even under adverse temperatures of -12°C to -18°C. Therefore, considered as the best lubricating agent particularly for both high speed engines and aeroplanes. castor is generally grown in rainy season. There is also a greater scope of growing castor in *Rabi* season (Anonymous, 2003). The crop matures within 180-200 days in *Rabi* season as compared to 240-260 days in *Kharif* season. Nitrogen plays a vital role in nutrition of plants. Incidentally, these are the nutrients which are lacking mostly in the soil. The major attraction of using biofertilizers in integrated nutrient management (INM) system is to convert the unavailable nutrients to available form which is readily available and easily accessible by the plants.

RESEARCH PROCEDURE

A field experiment was conducted at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, during the *Rabi* season of 2011-12. The soil of experimental field was loamy sand in texture, slightly alkaline (pH 7.75) with low organic carbon (0.16%), low available nitrogen (153 kg/ha) and medium in phosphorus (39.7 kg/ha) and potash (kg/ha) contents. Treatments were laid out in randomised block design with four replications having plot size 6.0 x 4.5 m. The treatment consisted of eight nitrogen management practices viz., (T₁) RDN through inorganic (N-80 and P-25 kg/ha) (T₂) 50% N through inorganic +50% N through FYM + *Azospirillum*, (T₃) 50% N through inorganic + 50% N through vermicompost + *Azospirillum*, (T₄) 50% N through inorganic + 50% N through castor cake + *Azospirillum*, (T₅) 75% N through inorganic +25% N through FYM + *Azospirillum*, (T₆) 75% N through inorganic +25% N through vermicompost + *Azospirillum*, (T₇) 75% N through inorganic +25% N through castor cake + *Azospirillum*, (T₈) 50% N through inorganic + green manuring (sunn-hemp) + *Azospirillum*. Castor seed were dibbled at a depth of 4-5 cm by adopting a spacing of 90 cm X 60 cm., GCH 7 cultivar was used in the study. The recommended dose of fertilizer @ 80 N 25 P₂O₅ kg/ha was applied in 100 % RDN treatment.

Entire dose of P and 1/3 of N were applied in two equal split doses at primary and secondary spike initiation stages. In case of integrated nitrogen treatments, N content of organic manure were initially analysed and quantified to suit the scheduled quantity of N substitution as per the treatment and incorporated in the soil at the time of final ploughing. Nitrogen and phosphorus chemical fertilizer treatments were applied in the form of urea and DAP, respectively.

RESEARCH ANALYSIS AND REASONING

Growth characteristics *viz.*, plant height at 30, 60, 90, 120 DAS and at harvest (30.13, 97.69, 152.70, 173.34 and 196.76 cm, respectively), number of secondary and tertiary (18.86) and total branches (25.64) per plant recorded significantly higher with application of 75% N through inorganic + 25% N through castor cake + *Azospirillum* (T₇). While the lowest plant height

Table 1: Growth and yield attributes of *Rabi* castor as influenced by different INM treatments

Treatments	Plant height (cm)					Number of branches /plant		Length of spikes (cm)	
	30 DAS	60 DAS	90 DAS	120 DAS	At harvest	Secondary and tertiary	Total	Main spike	Primary spike
T ₁ -RDN through inorganic fertilizer.	23.7	73.5	116.0	128.1	136.95	14.0	18.1	51.8	27.2
T ₂ -50% N through inorganic + 50% N through FYM + <i>Azospirillum</i> .	25.0	75.3	116.9	133.4	146.0	14.9	20.5	57.1	28.7
T ₃ -50 %N through inorganic+50% N through vermicompost + <i>Azospirillum</i> .	24.0	76.3	117.3	136.1	146.2	15.0	21.8	57.8	30.8
T ₄ -50 % N through inorganic + 50% N through castor cake + <i>Azospirillum</i> .	24.1	78.1	122.0	139.3	151.0	15.3	21.4	60.0	31.6
T ₅ -75 % N through inorganic + 25% N through FYM + <i>Azospirillum</i> .	25.6	85.3	134.0	163.9	171.5	16.3	24.8	68.7	35.5
T ₆ -75 % N through inorganic+25% N through vermicompost + <i>Azospirillum</i> .	29.2	91.9	149.7	170.7	187.0	17.9	25.1	71.2	36.8
T ₇ -75 % N through inorganic + 25% N through castor cake + <i>Azospirillum</i> .	30.1	97.7	152.7	173.3	196.7	18.9	25.6	72.5	37.6
T ₈ -50 % N through inorganic + Green manuring + <i>Azospirillum</i> .	24.9	77.5	124.1	141.7	153.3	15.7	22.3	60.8	32.6
S.E.±	1.0	3.8	5.2	6.2	6.7	0.7	1.0	2.2	1.5
C.D. (P=0.05)	3.0	11.2	15.2	18.2	19.7	2.0	3.0	6.6	4.4

Table 2 : Yield attributes, seed yield, oil content and oil yield of *Rabi* castor as influenced by different INM treatments

Treatments	Number of spikes /plant		Number of capsules on main spike	100-seed weight	Seed yield		Oil content (%)	Oil yield (kg/ha.)
	Secondary and tertiary	Total			Per plant (g)	kg/ha.		
T ₁ -RDN through inorganic fertilizer.	9.0	11.1	55.3	26.3	131.1	2296.9	46.3	1066.2
T ₂ -50% N through inorganic + 50% N through FYM + <i>Azospirillum</i> .	9.7	12.6	56.7	27.7	138.4	2415.6	46.6	1123.6
T ₃ -50 %N through inorganic + 50% N through vermicompost + <i>Azospirillum</i> .	9.9	12.7	57.2	27.9	140.9	2508.0	47.0	1178.0
T ₄ -50 % N through inorganic + 50% N through castor cake + <i>Azospirillum</i> .	10.1	13.1	59.7	28.4	145.5	2588.3	47.5	1227.8
T ₅ -75 % N through inorganic + 25% N through FYM + <i>Azospirillum</i> .	11.9	14.2	63.6	29.0	160.2	2817.7	49.5	1398.6
T ₆ -75 % N through inorganic + 25% N through vermicompost + <i>Azospirillum</i> .	12.2	15.6	66.5	29.7	166.3	2943.4	50.3	1483.0
T ₇ -75 % N through inorganic + 25% N through castor cake + <i>Azospirillum</i> .	13.0	16.5	68.7	32.3	171.6	3048.9	52.1	1582.6
T ₈ -50 % N through inorganic + Green manuring + <i>Azospirillum</i> .	10.2	13.2	62.0	28.0	147.1	2598.4	48.0	1244.2
S.E.±	0.6	0.6	2.1	1.1	6.9	152.3	1.3	80.5
C.D. (P=0.05)	1.6	1.8	6.0	3.1	20.3	446.7	3.8	236.0

at 30, 60, 90, 120 and at harvest, number of secondary and tertiary and total branches per plant were recorded under 100% RDN through inorganic fertilizer (T_1) (Table 1).

Better performance of this treatment with respect to plant height and number of branches might be due to lesser C:N ratio of castor cake which resulted in mineralisation and increased availability of nitrogen to the plant throughout the crop growth period. These result are in conformity with the findings of Patel and Pathak (2002).

Observation on length of main and primary spikes (cm) (Table 1) revealed that significantly longer spikes were obtained with 75% N through inorganic + 25% N through castor cake + *Azospirillum* (T_7) compared to other treatments (Table 1). Better growth of the plant coupled with adequate availability of nutrients from castor cake might have resulted in the production of lengthy spike as compared to other sources of nutrients. Similar results were observed with the application of castor cake in sunflower crop (Bodake and Rana, 2009).

The number of spikes per plant, no. of capsules on main spike and 100 seed weight is an index of final yield as they are the significant contributory factors for seed yield in castor (Ramji Bind and Patil, 1997). In this study, the total number of spikes /plant, number of capsules on main spikes and 100 seed weight recorded by with 75% N through inorganic + 25% N through castor cake + *Azospirillum* (T_7) were significantly

higher compared to other treatments (Table 2). Integration of inorganic nitrogen fertilizer with organic nitrogen source (castor cake) and *Azospirillum* has resulted in more number of spikes/plant and more number of capsules on main spike compared to other treatments.

More number of spikes per plant, capsules on main spike and 100 seed weight contributed more to final seed yield. The significant increase in seed yield under integrated nitrogen management treatments was due to beneficial effect of organic manures on growth and yield parameters through increased supply of nutrients with increased mineralisation and improvement of physico-chemical properties of the soil. These results are in accordance with the findings of Bapy Akula and Bapy Reddy (1998). On other hand, integrated nitrogen management also effect the oil content and oil yield. Oil content and oil yield obtained with 75% N through inorganic + 25% N through castor cake + *Azospirillum* (T_7) was significantly higher compared to rest of treatments which in agreement with the findings of Shirisha *et al.* (2010).

Thus, integrated nitrogen management practices were found as efficient as that of application of 100% RDN through inorganic fertilizer with improved growth and yield attributes. Among different organic sources, substitution of 25% RDN with castor cake was found best with higher seed and oil productivity.

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