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Effect of farm yard manure and nitrogen on growth, yield and economics of castor (*Ricinus communis* L.)

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Abstract
An experiment was conducted during *kharif* season of the year 2017-18 at Agronomy Instructional Farm, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar to study the "Effect of farm yard manure and nitrogen on growth, yield and economics of castor (*Ricinus communis* L.)." Growth, yield attributing and yield of castor like plant height at 60, 120 DAS, at harvest, number of branches per plant, length of main spike, number of capsules/main spike, number of spikes/plant, seed yield/plant, seed yield and stalk yield were significantly increased with application of FYM prepared by pit method (M_2). Treatment M_2 (pit method) realized the highest net return with benefit: cost ratio. With regard to effect of different nitrogen management treatments on castor, all the growth and yield attributes such as plant height, number of branches per plant, length of main spike, number of capsules/main spike, number of spikes per plant, seed index, seed yield/plant, seed yield and stalk yield showed significant improvement due to application of 100% RDN + bio NPK consortium (N_3) which remained at par with treatment N_4 (75% RDN + bio NPK consortium) except plant height. The highest net realization and BCR were obtained under 100% RDN + bio NPK consortium (N_3) followed by treatment N_4 (75% RDN + bio NPK consortium).

Keywords: FYM, pit method, bio NPK consortium, castor, nitrogen

Introduction
Castor (*Ricinus communis* L.) is a non-edible oilseed crop having high industrial importance due to presence of unique fatty acid and ricinoleic acid. It belongs to family *Euphorbiaceae* and originated from Ethiopia. India is the world's largest producer of castor and its derivatives contributing to almost 65 percent share. Gujarat, Rajasthan and Andhra Pradesh are the major castor growing states in India. Castor seed contains 45 to 50 percent oil, which is considered as versatile industrial raw materials because of ricinoleic acid and hydroxyl fatty acid. The castor oil is differ from vegetable oil due to its non-freezing nature up to -18ºC temperature. It is therefore, considered as the best lubricating agent particularly for both high speed engines and aeroplanes. Castor oil has many medicinal uses, including constipation (when taken internally), relief from pain, inflammation and stomach problems. Castor has emerged as one of the most important agricultural commodities for earning much needed foreign exchange. After extraction of oil from the seeds remaining portion is known as castor cake which contains 4.5 percent nitrogen, 2.6 percent phosphorus and 1.0 percent potash. However, it is unfit as cattle feed due to presence of toxic substance *i.e*. ricin, but extensively used as organic manure.

FYM is the most common organic manure used for crop production by farmers in India, but they do not give adequate attention to the proper conservation and effective use of resource.. For preparing better quality FYM, the use of pit method for areas with less than 1000 mm precipitation is recommended (Prasad *et al.,* 2014) [11]. The existing practice of preparing farm yard manure by heap method in which heap of manure remains exposed to sun under open space/sky during the composting period. Losses of nutrients may occurred through volatilization and leaching when FYM is prepared by heap method as compared to pit method leads to poor in nutrient content and makes it less efficient and decreases its potentiality for increasing crop yield much more than that of FYM prepared by pit method. FYM produced by pit method with nutrient enrichment have good quality FYM with respect to major and micro nutrients content than indigenous heap method. FYM obtained by pit method contains 17.0, 9.0, 27.0, 7.0, 24.0, 7.0 and 10.0 percent higher nitrogen, phosphorus, potash, iron, zinc, manganese and copper than heap method, respectively (CIL, SDAU, S. K. Nagar). In present investigation, FYM contains 0.64% N, 0.22% P_2O_5 and 0.62% K_2O prepared by pit method

and 0.41% N, 0.17% P_2O_5 and 0.41% K_2O prepared by heap method.

Nitrogen is the most important determinant of plant growth and crop yield. Plants lacking in N show stunted growth and yellowish leaves. It is an essential component of the protein that builds cell material and plant tissue. The increasing cost of fertilizers play a significant role in increasing cost of agriculture produce and thereby reduction in net profit. Substitution of chemical fertilizers with biofertilizers found cost effective and eco-friendly. Micro-organisms play a vital role in fixing/solubilizing/mobilizing/recycling of macro and micro nutrients in agricultural eco-system. Although, they occur in soils naturally, their populations are often insufficient to bring about the desired level of nutrient mobilization (Welbaum *et al*., 2004) [18].

Materials and Methods

The present experiment was conducted during *kharif* season of the year 2017-18 and laid out on Plot No. B-11 at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, North Gujarat on loamy sand soil to study the Effect of farm yard manure and nitrogen on growth, yield and economics of castor (*Ricinus communis* L.). The soil of the experimental field was loamy sand in texture, low in organic carbon (0.17%) and available nitrogen (155.7 kg/ha), medium in available phosphorus (33.9 kg/ha), available potash (189.0 kg/ha) with soil pH of 7.2. Castor variety GCH-7 was used as test crop. The data were statistically analyzed for various characters as described by Panse and Sukhatme (1985) [5].

Treatment details

The experiment evaluated in Randomized Block Design (Factorial concept) with two methods of FYM preparation M_1: Heap method and M_2: Pit method with four nitrogen management N_1: 100% RDN, N_2: 75% RDN, N_3: 100% RDN + bio NPK consortium and N_4: 75% RDN + bio NPK consortium in with specific criteria which were Recommended Dose of Nitrogen (RDN): 180 kg N/ha, FYM prepared by heap and pit methods was applied @ 10 t/ha as per treatment, NPK consortium was applied @ 5ml/kg seed as seed inoculation, Phosphorus was applied @ 37.5 kg P_2O_5/ha as common dose from SSP and FYM prepared by pit method contain 0.64% N, 0.22% P_2O_5 and 0.62% K_2O whereas, FYM prepared by heap method contain 0.41% N, 0.17% P_2O_5 and 0.41% K_2O.

Results and Discussion

Effect of methods of FYM preparation on growth parameters of castor

Various method of FYM preparation did not significantly influence on plant population at 30 DAS and at harvest. An application of FYM prepared by pit method (M_2) registered significantly the tallest plant at 60 DAS (38.7 cm), 120 DAS (69.0 cm) and at harvest (83.1 cm). FYM obtained from pit method (M_2) produced significantly higher number of branches per plant (23.4) and length of main spike (55.1 cm) at harvest than indigenous method of FYM preparation (M_1).

This might be due to use of FYM prepared by pit method is rich in nutrient content (0.64% N, 0.22% P_2O_5 and 0.62% K_2O) than heap method, which leads to increase nutrient availability in the soil reflected on growth of castor particularly taller plants. Significantly the higher number of branches per plant might be due to optimum supply of nutrients to the plant (as it contains higher N, P and K content) and nutrient translocation which ultimately linked with better plant growth and development. Significantly the highest length of main spike might probably due to higher nutrients content (N, P and K) in FYM prepared by pit method assured better availability of N and P in soil lead to increase in uptake of nutrients as compared to FYM prepared by heap method which improve vegetative growth of plant and consequently increase the length of spike.

Table 1: Plant height of castor at 60, 120 DAS and at harvest, Number of branches/plant, Length of main spike as influenced by different treatments

Treatments			Plant height (cm)			Number of Branches/plant	Length of main spike (cm)
			60 DAS	120 DAS	At harvest		
Methods of FYM preparation (M)							
M_1	:	Heap method	36.6	61.3	75.0	20.1	50.6
M_2	:	Pit method	38.7	69.0	82.1	23.4	55.1
S.Em.±			0.58	1.48	1.91	0.35	1.36
C.D. (P = 0.05)			1.71	4.34	5.61	0.85	3.99
Nitrogen management (N)							
N_1	:	100% RDN	37.1	63.4	75.8	20.2	51.8
N_2	:	75% RDN	35.3	62.4	73.9	19.3	48.6
N_3	:	100% RDN + Bio NPK consortium	40.8	70.5	85.8	23.7	57.8
N_4	:	75% RDN + Bio NPK consortium	37.4	64.2	77.7	22.3	53.3
S.Em.±			0.82	2.09	2.70	0.51	1.92
C.D. (P = 0.05)			2.42	6.14	6.80	1.05	5.65
Interaction (M × N)			NS	NS	NS	NS	NS
C.V.%			6.20	9.07	9.66	8.06	10.28

Effect of nitrogen management on growth parameters of castor

Plant population at 30 DAS and at harvest was not significantly affected due to nitrogen management treatments. An application of 100% RDN through inorganic fertilizer along with seed treatment of bio NPK consortium (N_3) recorded significantly the tallest plant at 60 DAS (40.8 cm), at 120 DAS (70.5 cm) and at harvest (85.8 cm), higher number of branches per plant (23.7) and length of main spike (57.8 cm).

This might be due to adequate supply of N through inorganic fertilizer which helped to rapid release and increase availability of nitrogen at early stage of crop growth and seed inoculation of biofertilizer bio NPK consortium which

enhanced cell division, cell enlargement and inter-nodal length by producing growth regulating hormones (auxin, gibberellins, vitamins *etc*.), increasing the biological nitrogen fixation and availability of phosphorus and potassium which in turn helped in better absorption and subsequent utilization of N for synthesis of chlorophyll molecules, as N is integral part of the chlorophyll molecules. These results in higher photosynthesis thereby producing more photosynthates and protein metabolism leading to more plant height. The results of present study on combined application of 75% or 100% RDF + *rhizobium* + PSB are well supported by Gudadhe *et al*. (2005) [5] and Saini *et al*. (2017) [15] in mustard, Bijarnia *et al*. (2014) [2] in *rabi* castor and Dhadge and Satpute (2014) [3] in groundnut. More number of branches per plant in these treatments is due to availability of major growth promoting nutrient N from inorganic fertilizers, fixation of atmospheric nitrogen, conversion of insoluble phosphorus into soluble form and better availability of K by seed inoculation with bio NPK consortium resulted in higher accumulation and translocation might have improved vegetative growth and ultimately increased number of branches per plant. These results are in conformity with those reported by Thadoda *et al*. (1996) [17], Rana *et al*. (2006) [13] and Dodiya *et al*. (2016) [4] reported that application of 100 or 120 kg N/ha produced significantly higher number of branches per plant in This might have accumulated more carbohydrates, resulting into increased length of spike, which is the storage organ. These findings are akin to the reports of Thadoda *et al*. (1996) [17], Patel (1997) [9] and Bijarnia *et al*. (2014) [2].

Effect of methods of FYM preparation on yield attributes and yield of castor

Remarkable improvement of yield attributes *viz*., number of capsules/main spike, number of spikes/plant and seed yield per plant (556.0 g) observed due to pit method of FYM preparation. An application of FYM prepared by pit method (M_2) gave significantly the highest seed (2861 kg/ha) and stalk yield (4768 kg/ha).

The increased number of capsules/main spike might be due to the increased supply of the major nutrients (NPK) to plant and better translocation of the photosynthates accumulated in the vegetative parts produce more number of capsules per plant. This increment in yield is ascribed to improvement in number of capsules per main spike and number of spikes per plant. Higher seed yield in this treatment might be because of increasing length of main spike, number of capsules per main spike, number of spikes per plant and seed yield per plant which resulted from use of FYM prepared by pit method having good quality well decomposed FYM and also higher N, P and K content as compared to heap method. The remarkable improvement of growth and yield parameters was observed in this treatment which ultimately reflected on stalk yield.

Table 2: Seed yield/plant, Seed yield, Stalk yield and economics as influenced by different treatments

Treatments			Number of capsules per main spike	Number of spikes per plant	Seed yield/plant (g)	Seed yield (kg/ha)	Stalk yield (kg/ha)
Methods of FYM preparation (M)							
M_1	:	Heap method	74.4	16.7	463.4	2454	4147
M_2	:	Pit method	80.8	19.1	556.0	2861	4768
S.Em.±			1.8	0.55	13.4	64.8	90.06
C.D. (P = 0.05)			5.3	1.60	39.4	190.5	264.8
Nitrogen management (N)							
N_1	:	100% RDN	74.3	16.6	486.2	2585	4318
N_2	:	75% RDN	73.7	15.6	446.7	2330	4157
N_3	:	100% RDN + Bio NPK consortium	84.5	20.7	559.7	2933	4953
N_4	:	75% RDN + Bio NPK consortium	77.9	18.8	546.3	2782	4392
S.Em.±			2.5	0.77	19.0	91.6	127.3
C.D. (P = 0.05)			7.4	2.27	55.7	269.4	374.5
Interaction (M × N)			NS	NS	NS	NS	NS
C.V.%			9.23	12.19	10.51	9.75	9.08

Effect of nitrogen management on yield attributes and yield of castor

Treatment N_3 (100% RDN + bio NPK consortium) produced significantly higher number of capsules per main spike (84.5), number of spikes per plant (20.7), seed index (31.7 g) and seed yield/plant (559.7 g), however it was at par with treatment N4 (75% RDN + bio NPK consortium). Significant enhancement in seed (2933 kg/ha) and stalk yield (4953 kg/ha) recorded under treatment N_3 (100% RDN + bio NPK consortium). However, it was statistically at par with treatment N_4 (75% RDN + bio NPK consortium) in case of seed yield.

Number of capsules per spike might also be due to higher dry matter accumulation and effective partitioning of the assimilates to the sink, as a results of better availability of nitrogen coinciding with physiological needs of the crop. Several researchers observed that number of capsules per plant increased significantly up to 90 kg N/ha (Paida and Parmar, 1980 and Bhosekar, 1992) [7, 1] and with application of 100 kg N/ha through inorganic fertilizer (Reddy *et al*., 1993) [14]. It encourages better photosynthesis and preparation of more photosynthates which contributes towards the formation of spikes per plant in good number. The results are supported by Gudadhe *et al*. (2005) [5] reported that application of 100% RDF + seed inoculation with *Azotobacter* registered more number of siliquae per plant in mustard. Subbiah and Asija (1996) [16] found that number of spikes per plant of castor were increased with increase in levels of N up to 120 kg/ha and Raghavaiah and Sudhakara (2000) [12] revealed that maximum number of primary spike, secondary spike and total were found with application of 100 kg N/ha in castor. Higher seed yield was mainly because of increase in yield attributing parameters like number of capsules per main spike, number of spikes per plant, seed yield per plant and seed index. The higher seed yield was also due to cumulative effect of elevated growth stature as well as yield structure.

Moreover, inorganic fertilizer might have helped in increasing uptake of nutrients. This may be due to better synthesis of chlorophyll in leaves since fertilizers contain appreciable quantity of nutrients, which might have help in chlorophyll synthesis. This finding indicated that combine application of chemical fertilizer and biofertilizers is superior to sole inorganic fertilizer application. The results are supported by the findings of Gudadhe *et al*. (2005) [5] and Nagdive *et al*. (2007) [6] in mustard; Dhadge and Satpute (2014) [3] in summer groundnut and Saini *et al*. (2017) [15] in rapeseed. Application of higher level of nitrogen also significantly increased seed yield was reported by Rana *et al*. (2006) [13], Patil *et al*. (2009) [10] and Dodiya *et al*. (2016) [4]. Moreover, an application of chemical fertilizers along with biofertilizers such as bio NPK consortium had pronounced effect on vegetative growth due to higher photosynthetic rate and chlorophyll content of the plant. The results are supported by the findings of Gudadhe *et al*. (2005) [5], Dhadge and Satpute (2014) [3] and Saini *et al*. (2017) [15].

Interaction effect

The interaction effect of method of FYM preparation and different nitrogen management were found non-significant with respect to all growth, yield attributes and yield of castor.

Effect on economics

Maximum net realization (Rs.58336/ha) and BCR (1.99) were noted under treatment M_2 (Pit method) and lowest net realization (Rs.45246/ha) and BCR (1.82) with treatment M_1 (Heap method). On the basis of economics, treatment N_3 (100% RDN + bio NPK consortium) realized the highest net realization (Rs. 62652/ha) and BCR (2.09) followed by treatment N_4 (75% RDN + bio NPK consortium).

Table 3: Economics as influenced by different treatments

Treatments			Net realization (Rs./ha)	BCR
Methods of FYM preparation (M)				
M_1	:	Heap method	45246	1.82
M_2	:	Pit method	58336	1.99
Nitrogen management (N)				
N_1	:	100% RDN	48551	1.85
N_2	:	75% RDN	38948	1.69
N_3	:	100% RDN + Bio NPK consortium	62652	2.09
N_4	:	75% RDN + Bio NPK consortium	57008	2.00

Conclusion

In light of results obtained from present investigation, it is concluded that apply 10 t FYM/ha prepared by pit method along with 75% RDN (135 kg/ha) through fertilizer + seed inoculation with bio NPK consortium for securing higher seed yield. However, to realize higher net return, apply 100% RDN along with 10 t FYM/ha prepared by pit method along with bio NPK consortium.

References

1. Bhosekar VK. Effect of irrigation, nitrogen and plant density on yield attributes and yield of castor. Indian Journal of Agronomy. 1992;37(1):203-205.
2. Bijarnia AL, Patel NM, Shivran A, Jat RK. Integrated nitrogen management options on growth and yield of *Rabi* castor. Advance Research Journal of Crop Improvement. 2014;4(1):38-40.
3. Dhadge SM, Satpute NR. Effect of integrated nutrient management on growth, yield and quality of summer groundnut. International Journal of Agricultural Sciences. 2014;10(1):314-316.
4. Dodiya CJ, Solanki RM, Modhvadia JM, Chatrabhuji BJ, Barad BB. Influence of plant geometry and fertility levels on growth and yield of *rabi* castor. The Bioscan. 2016;11(1):445-448.
5. Gudadhe NN, Mankar PS, Khawale VS, Dongarkar KP. Effect of biofertilizers on growth and yield of mustard. Journal of Soils and Crops. 2005;15(1):160-162.
6. Nagdive SJ, Bhalerao PD, Dongarwar UR, Goud VV. Effect of irrigation and nutrient management on yield, quality and uptake of nutrients by mustard (*Brassica juncea* L.). Journal of Soils and Crops. 2007;17(1):128-132.
7. Paida VJ, Parmar MT. A note on effect of different levels of nitrogen and phosphorus on yield and yield attributes of castor GAUCH-1. Gujarat Agricultural University Research Journal. 1980;5(2):48-51.
8. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers, ICAR, New Delhi; c1985.
9. Patel SM. Response of castor (*Ricinus communis* L.) to various levels of spacing, nitrogen and phosphorus under North Gujarat Agro-climatic condition. M.Sc. (Agri.) Thesis (Unpublished) Gujarat Agricultural University, Sardarkrushinagar; c1997.
10. Patil HB, Abhram T, Zade KK. Productivity of American hybrid cotton on entisols of eastern U.P. under integrated nutrient management. Journal of Maharashtra Agricultural University. 2009;34(1):78-79.
11. Prasad R, Kumar D, Rana DS, Shivay YS, Tewatia RK. Text book of Plant Nutrient Management. Published by Indian Society of Agronomy, New Delhi, 2014, 273.
12. Raghavaiah CV, Sudhakara Babu SN. Effect of seedling date, female: Male proportion and nitrogen on certified seed production of GCH-4 castor hybrid. Journal of Oilseeds Research. 2000;13(3):1016-1022.
13. Rana DS, Giri G, Pachauri DK. Evaluation of castor genotype for productivity, economics, litter fall and changes in soil property under different levels of inter-row spacing and nitrogen. Indian Journal of Agronomy. 2006;51(4):318-322.
14. Reddy GS, Venkateswarulu B, Maruthisanker GR. Effect of different organic materials as source of nitrogen on growth and yield of castor. Journal of Oilseeds Research. 1993;10(1):151-152.
15. Saini LB, George PJ, Singh SB. To study the effect of biofertilizers and nitrogen management on growth and yield of rapeseed. International Journal of Current Microbiology and Applied Sciences. 2017;6(8):2652-

2658.
16. Subbiah BV, Asija GL. A rapid procedure for the estimation of available nitrogen in soils. Current Science. 1996;25(8):259.
17. Thadoda NK, Sukhadia NM, Malavia DD, Moradia AM. Response of castor (GCH 4) to planting geometry and N fertilization under rainfed condition. Gujarat Agricultural University Research Journal. 1996;21(2):85-87.
18. Welbaum GE, Sturz AV, Dong ZM, Nowak J. Managing soil microorganisms to improve productivity of eco-system. Critical Reviews in Plant Sciences. 2004;23(2):175-193.