Effect of Sowing Date and Nutrient Management Practices on Growth, Yield and Nutrient Uptake in Castor (Ricinus Communis L.)

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Abstract

Field experiment was carried out in Instructional farm, Krishi Vigyan Kendra, Angul of Odisha during rabi seasons of 2011-12 and 2012-13 to study effect of sowing date and nutrient management practices on growth, yield, nutrient uptake in castor . The experiment comprised of three main plot treatments viz. 15th November, 30th October, 15th October and four subplots viz RDF, 100 RDF+Sulphur, 50% RDF+FYM, 50% RDF+ FYM in split plot design with three replications. The results revealed sowing in 15th October recorded significantly higher plant height (153.49 cm), primary branches plant-1(8.3), dry matter accumulation plant-1 (179.46 g), no of capsules plant-1(104.67), grain yield (9.11 q ha-1), stover yield (27.72 q ha-1), harvest index (24.86 %) with maximum uptake of N, P, K and S by both seeds and stovers than delay sowing on 15th November. Among the nutrient management practices, application of 50% RDF+ vermicompost 2 t ha-1 recorded maximum dry matter accumulation plant-1 (194.72 g), grain yield(8.90 q ha-1) with harvest index(24.67%). Thus, sowing on 15th October and 50% RDF+ vermicompost 2 t ha-1 can be practiced for maximizing yield, improvement of growth, nutrient uptake in castor.

Key words: Castor, Nutrient management, Nutrient uptake, Sowing date, Yield.

1. Introduction

Castor (Ricinus communis L.) is an important non edible oil seed crop of India being cultivated in 6.15 lakh hectares with a production of 5.90 lakh tones (FAO, 2003). In Odisha state, it is grown in an area of 0.13 lakh hectares with a production of 0.08 lakh tonnes and a productivity of 6.36 q ha^{-1}. In Angul district of state castor is grown during both kharif and rabi in 140, 260 hactares respectively with a average productivity of 6.25 q ha^{-1} (Anonymous, 2012). Its productivity is much lower than the national average. Sowing time is one of the major non-monetary input affecting growth, yield and its contributing characters. Also sulphur free inorganic fertilisers have limited the crop yield. To build up soil fertility through INM was suggested as potential means to increase the soil fertility especially in dry lands (Subha Reddy, et al., 1991).The uptake of the nutrients by mustard increased due to gypsum application and deep ploughing. A profuse vegetative growth and higher yield due to deep tillage and S application through gypsum might have increased the uptake of these nutrients by the crop(Pal and Phogat,2005) Indian farmers are mostly marginal and small, do not apply the recommended doses of nutrients to these energy rich crops. Indigenously available organic sources of nutrients have been recorded to enhance the efficiency and reduce the requirements of chemical fertilisers. The functions of sulphur within the plant are closely related to those of nitrogen and the two nutrients are synergistic. Keeping in view the importance of sowing date and nutrient management in castor, an experiment was carried out to study the effect of sowing date and nutrient management practices on growth, yield and nutrient uptake in castor.

2. Materials and Methods

A field experiment was carried out in Instructional farm, Krishi Vigyan Kendra, Angul in Angul district in mid central table land zone of Odisha during rabi seasons of 2011-12 and 2012-13 to study effect of sowing date and nutrient management practices on growth, yield and nutrient uptake of castor. The geographical location of the area has 84^0 16´ to 85^0 23´ E longitudes and 20^0 31´ to 21^0 41´ N latitude and average elevation of 300 m above mean sea level. The average

rainfall in both the year during the study period from October to February was 130.52 mm. The mean maximum and mean minimum temperature registered in both the year was 32.8^0 C and 14.5^0 C respectively. The soil of the experimental site was slightly acidic in reaction (pH-5.52), sandy loam in texture with medium in organic carbon (0.48 %), available nitrogen 243.6 kg ha^{-1}), phosphorus13.35 kg ha^{-1}) and potash(265.4 kg ha^{-1}) contents (Jackson, 1973). The experiment involved three main plot treatments comprising different mulching viz.T_1- 15th October, T_2-30th October, T_3-15th November and four subplots viz N_1-RDF(60:40:40 kg NPK ha^{-1}), N_2-RDF+S(40kg ha^{-1}), N_3- 50% RDF+FYM 5 t ha^{-1}, N_4- 50% RDF+Vermicompost 2 t ha^{-1}. Experiment was conducted in split plot design with three replications in a fixed layout. Recommended package of practices were followed for growing castor cv.Aruna during both the year. The recommended fertilizer dose were N:P:K 60:40:40 kg ha^{-1} respectively. Full dose of P and K is as basal and N in 3 equal splits i.e, as basal, 35-40 DAS and 65-70 DAS. The FYM @5 t ha^{-1} and vermin compost @2 t ha^{-1} were applied. Sulphur @40 kg ha^{-1} through gypsum was drilled in rows of castor at time of sowing. Three numbers of irrigations were given during seeding, flower initiation and capsule development. Seed and stover samples taken after crop harvest were washed thoroughly, dried at 70^0C, pulverized and were digested in a diacid mixture of concentrated HNO_3 and $HCLO_4$ (9.1). The datas were statistically analyzed applying the techniques of analysis of variance and the significance of different sources of variations were tested by error mean square of Fisher Snedecor's 'F' test at probability level 0.05 (Cochran and Cox 1977).

3. Results and Discussion

3.1 Growth Parameters

Growth parameters like plant height, no of primary branches $plant^{-1}$ and dry matter accumulation $plant^{-1}$ were significantly increased by 2.79, 7.1 and 13.52 % respectively with sowing in 15th October as compared to delay sowing 15th November(Table 1). Application of RDF+ Sulphur 40 kg ha^{-1} produced the tallest plant (160.75 cm), maximum number of primary branches $plant^{-1}$ (8.69) as compared to other treatments attributed to increased cell division and cell elongation. These results are consistent with Agrawal and Porwal (2006). Maximum dry matter accumulation $plant^{-1}$ (194.72 g) was recorded with application of 50% RDF+Vermicompost 2 t ha^{-1}.

3.2 Yield Attributing Characters

Sowing in 15th October recorded (Table 2) the maximum yield attributing characters like no of capsules $plant^{-1}$(104.67), no of seeds $capsule^{-1}$(3.82), 1000 grain weight (105.37 g) which is 6.15, 9.14 and 3.21 %, respectively, higher than 15th November. Application of 50% RDF+Vermicompost 2 t ha^{-1} produced capsules $plant^{-1}$(113.77) which is 28.4 % higher than 100% RDF. Maximum seeds $capsule^{-1}$(4.02) was produced in RDF+ Sulphur 40 kg ha^{-1} followed by 50% RDF+Vermicompost 2 t ha^{-1} and 50% RDF+FYM 5 t ha^{-1} which were at par. Application of RDF+ Sulphur 40 kg ha^{-1} showed a significant increase in 1000 grain weight (113 g) as compared to 100% RDF and was at par with application of 50% RDF+Vermicompost 2 t ha^{-1} owing to better nitrogen and carbohydrate metabolism of plants that facilitates synthesis of nucleic acids and hormones which had encouraged the better filling of seeds (Kumar and Santh, 2008).

3.3 Yield

Early sowing recorded significantly higher seed yield than delay sowing.(Table 3) . 15th October sowing, resulted maximum seed yield 9.11 q ha^{-1} followed by 30th October (8.22 q ha^{-1}) which was 24.1 and 12.0% higher than 15th November respectively. Similarly, maximum stover yield(27.72 q ha^{-1}) and harvest index (24.86 %) was observed in 15th October sowing .Among the nutrient management practices, application of 75% RDF+vermicompost 2 t ha^{-1} was found to be superior over other nutrient management practices and recorded the maximum grain yield(8.90 q ha^{-1}) with harvest index(24.67 %). This may be due to its high nutritional composition. Application of RDF+ Sulphur 40 kg ha^{-1} produced 18.4% higher grain yield as compared to 100% RDF alone may be due to better availability of nutrients and their translocation. Similarly application of 50% RDF+FYM 5 t ha^{-1} recorded 5.4 % higher seed yield than 100% RDF attributed to increase in soil organic carbon, secondary and micro-nutrient availability coupled with better physico-chemical and biological properties of soil. These results are in conformity with findings of Rana et al. (2005).

3.4 Nutrient Uptake

Perusal of the results presented in (Table 4) clearly reveals that early sowing brought about significant differences in the uptake of nutrients over delay sowing. Maximum uptake of N, P, K and S was obtained in 15th October sowing which were (12.12, 1.1, 1.0and 0.59 kg ha^{-1} respectively) higher by seed and (1.51, 0.42, 3.31 and 0.63 kg ha^{-1} respectively) higher by stover than delay sowing on 15th November. Application of RDF+ Sulphur 40 kg ha^{-1} recorded the maximum uptake of N, P, K and S by seed (33.70,4.94,2.78 and 2.93 kg ha^{-1}, respectively and by stover (17.23,4.92,38.72 and8.49 kg ha^{-1}, respectively) followed by 50 % RDF+Vermicompost 2 t ha^{-1}; 50% RDF+FYM 5 t ha^{-1} and RDF(60:30:30 kg NPK ha^{-1}) which were statistically significant in case of both seed and stover. Higher accumulation and uptake of nutrients under these treatments could be ascribed to better availability and synergistic effect of applied nutrients. These results are in agreement with Patel et al. (2009) and Parmar et al. (2009).

Table 1. Effect of sowing date and nutrient management practices on growth parameters of Castor

Treatment	Plant height (cm)	No of primary branches $plant^{-1}$	Dry matter accumulation $plant^{-1}$(g)
Sowing date			
T_1- 15th November	149.33	7.75	158.09
T_2-30th October	152.68	8.17	175.78
T_3-15th October	153.49	8.3	179.46
SEm+	0.030	0.008	0.398
C.D at 5 %	0.116	0.032	1.561
Nutrient management practices			
N_1-RDF (60:40:40 kg NPK ha^{-1})	140.51	7.27	137.15
N_2-RDF+S (40kg ha^{-1})	160.75	8.69	186.32
N_3- 50% RDF+FYM 5 t ha^{-1}	148.99	7.86	166.25
N_4- 50% RDF+Vermicompost 2 t ha^{-1}	157.99	8.48	194.72
SEm+	0.061	0.009	0.453
C.D at 5 %	0.182	0.027	1.345

**RDF: Recommended Dose of Fertiliser; S: Sulphur; SEM: Standard Error of Mean; CD: Critical Difference*

Table 2. Effect of sowing date and nutrient management practices on yield attributing characters of castor

Treatment	No capsules plant^{-1}	No seeds capsule^{-1}	1000 grain weight (g)
Sowing date			
T_1- 15th November	98.61	3.50	102.22
T_2-30th October	102.49	3.75	104.50
T_3-15th October	104.67	3.82	105.37
SEm±	0.127	0.016	0.049
C.D at 5 %	0.498	0.061	0.194
Nutrient management practices			
N_1-RDF (60:40:40 kg NPK ha^{-1})	88.64	3.34	93.66
N_2-RDF+S (40kg ha^{-1})	106.21	4.02	113.0
N_3- 50% RDF+FYM 5 t ha^{-1}	99.21	3.67	96.92
N_4- 50% RDF+Vermicompost 2 t ha^{-1}	113.77	3.73	112.53
SEm±	0.222	0.013	0.155
C.D at 5 %	0.658	0.040	0.461

Table 3. Effect of sowing date and nutrient management practices on yield of castor

Treatment	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest index (%)
Mulching practices			
Sowing date			
T_1- 15th November	7.34	26.20	21.99
T_2-30th October	8.22	27.52	23.12
T_3-15th October	9.11	27.72	24.86
SEm±	0.028	0.050	0.059
C.D at 5 %	0.111	0.198	0.230
Nutrient management practices			

N_1-RDF (60:40:40 kg NPK ha^{-1})	7.41	24.33	23.41
N_2-RDF+S (40kg ha^{-1})	8.77	30.37	22.46
N_3- 50% RDF+FYM 5 t ha^{-1}	7.81	26.61	22.76
N_4- 50% RDF+Vermicompost 2 t ha^{-1}	8.90	27.29	24.67
SEm±	0.012	0.077	0.02
C.D at 5 %	0.035	0.228	0.061

Table 4. Effect of sowing date and nutrient management practices on nutrients uptake of castor

Treatment	Uptake by seed (kg ha^{-1}) of				Uptake by Stover (kg ha^{-1}) of			
	N	P	K	S	N	P	K	S
Sowing date								
T_1- 15th November	23.24	3.58	1.99	1.91	13.32	3.73	29.05	5.42
T_2-30th October	27.17	4.18	2.33	2.23	14.58	4.08	31.81	5.95
T_3-15th October	35.36	4.68	2.99	2.50	14.83	4.15	32.36	6.05
SEm±	0.186	0.013	0.033	0.004	0.039	0.012	0.096	0.009
C.D at 5 %	0.729	0.05	0.13	0.015	0.154	0.048	0.375	0.034
Nutrient management practices								
N_1-RDF (60:40:40 kg NPK ha^{-1})	24.41	3.72	2.08	1.96	12.68	3.51	27.65	5.15
N_2-RDF+S (40kg ha^{-1})	32.11	4.94	2.75	2.93	17.23	4.92	38.72	8.49
N_3- 50% RDF+FYM 5 t ha^{-1}	25.15	3.86	2.15	2.07	13.86	3.83	29.78	5.41
N_4- 50% RDF+Vermicompost 2 t ha^{-1}	33.70	4.08	2.78	1.90	13.20	3.68	28.16	4.16
SEm±	0.093	0.006	0.025	0.003	0.050	0.017	0.140	0.024
C.D at 5 %	0.276	0.019	0.073	0.009	0.148	0.051	0.416	0.072

4. Conclusion

Thus, sowing on 15th October and 50% RDF+ vermicompost 2 t ha^{-1} can be practiced for maximizing yield, improvement of growth, nutrient uptake in castor.

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