Journal of Oilseed Brassica, 9 (1) : 22-26, January 2018

Effect of sowing dates and nutrient management practices on important parameters in Toria (*Brassica rapa* L. var. Toria)

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(Received: 01 June 2017; Revised: 20 September 2017; Accepted: 30 October 2017)

Abstract

Effect of sowing date and nutrient management practices on growth, yield, nutrient uptake and economics of irrigated Toria were studied in an experiment comprised of three main plot treatments of different sowing dates *viz*., 15th October, 30th October, 14th November and four subplots *viz.*, RDF, RDF+Sulphur, 75% RDF+FYM, 75% RDF+FYM + Sulphur in split plot design replicated thrice. The results revealed that sowing of Toria on 15th October recorded significantly higher plant height (150.1 cm), no of primary branches plant^{-1} (5.2), dry matter accumulation plant^{-1} (28.6 g), no of siliquae plant^{-1} (185.1), grain yield (1524.7 kg ha^{-1}), harvest index (25.2 %) , B:C ratio (2.4), economic efficiency (Rs.376.8 ha^{-1} day^{-1}) with maximum uptake of N, P, K and S by seed. Among the nutrient management practices, application of 75% RDF+FYM + Sulphur (40kg ha^{-1}) recorded maximum plant height (157.2 cm), dry matter accumulation plant^{-1} (31.0g), no of siliquae plant^{-1} (201.2), no of seeds siliqua^{-1} (12.5), grain yield (1488.3 kg ha^{-1}) with harvest index (24.0 %). Maximum B:C ratio (2.5) and economic efficiency (Rs.358.7 ha^{-1} day^{-1}) was obtained in sole application of RDF and 75% RDF+FYM 5 t ha^{-1} respectively. Thus, sowing on 15th October and 75% RDF+FYM + Sulphur (40kg ha^{-1}) can be practiced for maximizing yield, income, improvement of growth, nutrient uptake of irrigated Toria.

Key words: *Economic efficiency, nutrient management practices, nutrient uptake, sowing date,* Toria

Introduction

Toria (*Brassica rapa* L. var. Toria) is an important oilseed crop of Odisha after harvest of *Kharif* paddy. In India, Toria is a short duration crop cultivated largely in Assam, Bihar, Orissa and West Bengal in the east mainly as winter crop. The rapeseed-mustard, which contributes nearly 80% of the total *Rabi* oilseed production, is a vital component in edible oil sector. The rapeseed-mustard crops are diverse in their agro-climatic requirements and crop management practices. In Odisha, rapeseed and mustard is grown in an area of about 0.116 million hectares. The total production comes to 0.049 million tonnes with a productivity of 422 kg ha^{-1} which is much below the national average of 1176 kg ha^{-1} (Pati and Mahapatra, 2015). Hence, the rapeseed-mustard productivity is much lower compared to national average. Also, the sulphur free inorganic fertilizers 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 (Subba Reddy *et al.*, 1991). The uptake of the nutrients by mustard increases 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 in these energy rich crops. An indigenously available organic source of nutrient has been recorded to enhance the efficiency and reduces the requirements of chemical fertilizers. The functions of sulphur within the plant are closely related to those of nitrogen and the two nutrients are synergistic. There is a negative balance of sulphur in our soils as its addition through various sources is much lower than the removal (Mohd *et al*., 2007). Keeping this in view, an experiment was carried out to study effect of sowing date and nutrient management practices on growth, yield, economics and nutrient uptake of irrigated Toria.

Materials and Methods

A field experiment was carried out in Instructional farm, Krishi Vigyan Kendra, Angul district in mid central table land zone of Odisha during *Rabi* seasons of 2013-14 and 2014-15 to study effect of sowing date and nutrient management practices on growth, yield, nutrient uptake and economics in irrigated Toria. The geographical location of the area has 85^0 04´ E longitude and 20^0 49´ 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 218.9 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-5.6), sandy loam in texture with medium in organic carbon (0.58 %), available nitrogen (236.4 kg ha^{-1}), phosphorus (15.2 kg ha^{-1}) and potash (252.8 kg ha^{-1}) contents (Jackson, 1973).

The experiment involved three main plot treatments comprising different date of sowing *viz.* D_1- 15th October, D_2-30th October, D_3-14th November and four subplots viz N_1- RDF (60:30:30 kg NPK ha^{-1}), N_2- RDF + Sulphur (40kg ha^{-1}) , N_3- 75% RDF+FYM 5 t ha^{-1}, N_4- 75% RDF+ FYM 5 t ha^{-1} + Sulphur (40kg ha^{-1}). Experiment was conducted in split plot design with three replications in a fixed layout. Recommended package of practices were followed for growing Toria *cv*. *Sushree* during both the year. The crop was sown on different dates of sowing with 30 X 10 cm spacing. The recommended fertilizer dose were 60:30:30 N:P:K kg ha^{-1} respectively. Full dose of P and K as basal and N in two splits *i.e*. 50% as basal and 50% at 30 DAS. Sulphur 40 kg ha^{-1} through chemical fertilizer (Sulfex 80% WP) was applied at time of sowing. Three numbers of irrigations were supplied during seedling, flower initiation and siliquae 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) and sulphur in the extract was estimated by turbidimetric method (Chesnin and Yien, 1951). Economic efficiency (Rs ha^{-1} day^{-1}) was calculated by dividing net monetary returns ha^{-1} by total life period (day) of crop. The data 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).

Results and Discussion

Growth parameters

Significant differences were observed due to sowing date and nutrient management practices on crop growth parameters (Table 1). The plant height, no of primary branches $plant^{-1}$ and dry matter accumulation $plant^{-1}$ were significantly higher in 15th Oct sowing than 30th Oct and 14th Nov sowing may be due to favourable atmospheric conditions, especially temperature during growing period. These parameters increased by 2.8, 10.8 and 13.5% respectively on 15th October sowing as compared to 14th November. The reduction in plant height and dry matter accumulation during delay sowing was due to reduction in duration of vegetative growth stage, which slows the cell expansion and their growth (Meena *et al.*, 2015). Nutrient management practices showed significant difference in plant height, no of primary branches $plant^{-1}$ and dry matter accumulation $plant^{-1.}$ Application of 75% RDF+FYM + S (40kg ha^{-1}) recorded significantly higher plant height (157.2 cm), no of primary branches $plant^{-1}$ (5.2), dry matter accumulation $plant^{-1}$ (31.0g) might be due to increased cell division and cell elongation was matched with the results of Sharma *et al.* (1994).

Table 1: Effect of sowing date and nutrient management practices on growth parameters of irrigated Toria (Pooled of 2 years)

Treatment	Plant height (cm)	No of primary branches $plant^{-1}$	Dry matter accumulation $plant^{-1}$(g)
Sowing date			
D_1- 15th October	150.1	5.2	28.6
D_2- 30th October	149.1	4.9	28.0
D_3-14th November	146.0	4.7	25.2
SEm±	0.04	0.03	0.08
C.D at 5 %	0.15	0.11	0.26
Nutrient management practices			
N_1-RDF (60:30:30 kg NPK ha^{-1})	137.4	4.7	21.8
N_2-RDF+ S (40kg ha^{-1})	145.7	4.9	26.5
N_3- 75% RDF+FYM 5 t ha^{-1}	153.7	5.1	29.6
N_4- 75% RDF+ FYM 5 t ha^{-1}+ S (40kg ha^{-1})	157.2	5.2	31.0
SEm±	0.10	0.05	0.10
CD at 5 %	0.30	0.13	0.29

*RDF= Recommended Dose of Fertiliser; S=Sulphur; S.Em=Standard Error of Mean; CD= Critical Difference

Yield attributes

All yield attributes were significantly affected by sowing date and nutrient management practices (Table 2). The data reveals that 15th October sowing recorded the maximum yield attributing characters like no of siliquae plant^{-1} (185.1), no of seeds siliqua^{-1} (11.9), 1000 grain weight (4.5 g) which was significantly higher than 30th October and 14th November sowing. Application of 75% RDF+FYM + S (40kg ha^{-1}) produced maximum siliqua plant^{-1} (201.2), no of seeds siliqua^{-1} (12.5), 1000 grain weight (4.9 g) 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 and higher translocation of food material for formation of seed in advanced sowing. This was in agreement with Kumari *et al.* (2012) and Yadav (1999).

Table 2: Effect of sowing date and nutrient management practices on yield attributing characters and yield of irrigated Toria (Pooled of 2 years)

Treatment	No siliquae plant^{-1}	No seeds siliqua^{-1}	1000 grain weight (g)	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)
Sowing date						
D_1- 15th October	185.1	11.9	4.5	1524.7	4507.9	25.2
D_2- 30th October	181.2	11.6	4.5	1376.2	4734.9	22.5
D_3-14th November	174.4	10.9	4.4	1227.4	4769.9	20.4
SEm+	0.24	0.02	0.00	12.55	2.55	0.10
CD at 5 %	0.82	0.08	0.01	43.41	8.82	0.35
Nutrient management practices						
N_1-RDF (60:30:30 kg NPK ha^{-1})	156.7	10.4	4.0	1240.5	4185.9	22.8
N_2-RDF+S (40kg ha^{-1})	187.8	11.6	4.8	1307.5	4578.4	22.2
N_3- 75% RDF+FYM 5 t ha^{-1}	175.2	11.4	4.2	1467.9	5224.4	21.9
N_4- 75% RDF+ FYM 5 t ha^{-1}+ S (40kg ha^{-1})	201.2	12.5	4.9	1488.3	4695.0	24.0
S.Em+	0.48	0.02	0.01	6.04	4.47	0.03
CD (P=0.05 %)	1.39	0.07	0.016	17.64	13.05	0.08

Yield

Significant difference in seed yield, stover yield and harvest index were recorded with different sowing date and nutrient management practices (Table 2). Early sowing recorded significantly higher grain yield than delay sowing (Table 2). Sowing on 15th October resulted the maximum grain yield (1524.7 kg ha^{-1}) which was 10.8 and 24.3 % higher than 30th Oct and 14th Nov respectively due to higher yield attributing characters. Maximum stover yield (4769.9 kg ha^{-1}) was observed on 14th Nov sowing which was significantly higher that 15th and 30th October. The harvest index (25.2%) was significantly higher in 15th October sowing (Patel and Shelke, 1998). Among the nutrient management practices, application of 75% RDF+FYM + S (40kg ha^{-1}) was found to be superior over other nutrient management practices and recorded significantly higher grain yield (1488.3 kg ha^{-1}) with harvest index (24.0 %) than other treatments due to increased siliquae/plant, seeds/siliqua and better crop growth. Application of RDF+ Sulphur 40 kg ha^{-1} produced maximum stover yield (5224.4 kg ha^{-1}) may be due to better availability of nutrients and their translocation coupled with better physico-chemical and biological properties of soil (Jain and Sharma, 2000).

Nutrient uptake

Perusal of the results presented in (Table 3) clearly reveals that early sowing brought about significant differences in the uptake of nutrients by seeds over delay sowing. Maximum uptake of N, P, K and S by seed was obtained on 15th October sowing which were 50.7, 8.4, 12.1, 4.6 kg ha^{-1} respectively. The uptake of N, P, K and S by stover was maximum on 14th November sowing which were 27.8, 8.0, 65.3, 12.5 kg ha^{-1} respectively which was significantly higher than other sowing date. Application of 75% RDF+FYM + S (40kg ha^{-1}) recorded the maximum uptake of N, P, K and S by seed (51.9, 8.9, 12.7 and 5.3 kg ha^{-1}, respectively) which were significantly higher than other treatments. Significantly higher N (32.3 kg ha^{-1}) and K (78.1 kg ha^{-1}) uptake by stover was found in 75% RDF+FYM + S (40kg ha^{-1}). Similarly maximum P (9.6 kg ha^{-1}) and S (17.6 kg ha^{-1}) uptake by stover was found in RDF+ S (40kg ha^{-1}) which was significantly higher than other treatments. Higher accumulation and uptake of nutrients under these treatments could be ascribed to

Table 3: Effect of sowing date and nutrient management practices on nutrients uptake by seed and stover of irrigated Toria (Pooled of 2 years)

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								
D_1- 15th October	50.7	8.4	12.1	4.6	25.0	7.4	58.6	11.2
D_2- 30th October	45.3	7.5	10.8	4.1	27.3	8.0	64.1	12.3
D_3-14th November	38.8	6.4	9.2	3.5	27.8	8.0	65.3	12.5
SEm±	0.29	0.05	0.08	0.03	0.09	0.04	0.20	0.03
C.D (P=0.05 %)	1.02	0.17	0.26	0.09	0.31	0.05	0.70	0.09
Nutrient management practices								
N_1-RDF (60:30:30 kg NPK ha^{-1})	40.7	6.7	9.7	3.5	23.8	6.9	55.8	8.6
N_2-RDF+S (40kg ha^{-1})	41.9	6.9	10.0	3.6	26.0	9.6	60.0	17.6
N_3- 75% RDF+FYM 5 t ha^{-1}	45.2	7.3	10.5	3.8	24.7	7.2	56.8	10.7
N_4- 75% RDF+ FYM 5 t ha^{-1}+ S (40kg ha^{-1})	51.9	8.9	12.7	5.3	32.3	7.5	78.1	11.2
SEm±	0.15	0.03	0.04	0.02	0.13	0.07	0.34	0.08
CD (P=0.05%)	0.43	0.08	0.12	0.07	0.39	0.11	1.00	0.23

Table 4: Effect of sowing date and nutrient management practices on economics of irrigated Toria (Pooled of 2 years)

Treatment	Cost of cultivation (Rs ha^{-1})	Net return (Rs ha^{-1})	B : C ratio	Economic efficiency (Rs ha^{-1} day^{-1})
Sowing date				
D_1- 15th October	20035.4	28263.3	2.4	376.8
D_2- 30th October	19885.5	24041.7	2.2	320.6
D_3-14th November	19835.5	19615.9	2.0	261.6
SEm±	1.80	376.51	0.02	5.0
C.D at 5 %	6.23	1302.74	0.05	17.4
Nutrient management practices				
N_1-RDF (60:30:30 kg NPK ha^{-1})	15793.7	23761.2	2.5	316.8
N_2-RDF+S (40kg ha^{-1})	19793.7	21983.3	2.1	293.1
N_3- 75% RDF+FYM 5 t ha^{-1}	20043.9	26898.6	2.3	358.7
N_4- 75% RDF+ FYM 5 t ha^{-1}+ S (40kg ha^{-1})	24043.9	23251.4	2.0	310.0
S.Em±	33.7	156.63	0.01	2.09
C.D (P=0.05 %)	98.3	457.1	0.03	6.1

** Sale price of Toria seed Rs30.20/kg and straw Rs.0.50/kg for the year 2013-14 and 2014-15*

better availability and synergistic effect of applied nutrients (Kumaran and Solaimalai, 2000).

Economics

Data pertaining to economics of two year study (Table 4) revealed that the cost of cultivation, net return, benefit: cost ratio and economic efficiency was significantly influenced by sowing date and nutrient management practices. However, maximum cost of cultivation, net return, benefit:cost ratio and economic efficiency was obtained on 15th October sowing followed by 30th October sowing (Dutta and Enghipi,2016).

Among different nutrient management practices, cost of cultivation varied from Rs. 15793.7 to Rs. 24043.9 ha^{-1} with maximum in 75% RDF+ FYM 5 t ha^{-1}+ Sulphur (40kg ha^{-1}) due to higher input cost towards fertilizer application. Net return ranged from Rs. 21983.3 to Rs. 26898.6 ha^{-1}. Maximum B: C ratio (2.5) was obtained with sole application of RDF due to lower cost of cultivation. Similarly, economic efficiency (Rs.358.7 ha^{-1} day^{-1}) was found to be highest in 75% RDF+FYM 5 t ha^{-1} which was superior other nutrient management practices due its higher yield and lower cost of cultivation. These results are also similar with the findings of Sharma *et al*. (2017).

Conclusion

Thus, the study revealed that shifting of sowing from 14th Nov to 15th Oct and application of 75% RDF+FYM + Sulphur (40kg ha^{-1}) can be practiced for maximizing yield, income, improvement of growth, nutrient uptake of irrigated Toria.

References

Chesnin L and Yien CH. 1951. Turbidimetric determination of sulphur. *Soil Sci Soc America Proc* **15**: 149-150.

Cochran WG and Cox GM. 1977. Experimental Designs. Asia Publishing House. Kolkata, pp. 95-132 & 142-181.

Dutta R and Enghipi J. 2016. Effect of dates of sowing and nitrogen levels on nutrient uptake (kg/ha), nutrient use efficiency and quality of yellow sarson. *J Oilseed Brassica* **7**: 174-179.

Jackson ML. 1973. Soil Chemical Analysis, Prentice Hall of India Private Limited, New Delhi.

Jain NK and Sharma PP. 2000. Integrated nutrient management in mustard. *J Oilseeds Res* **17**: 127-129.

Kumaran S and Solaimalai A. 2000. Effect of organic manure and inorganic fertilisers on yield and nutrient uptake of irrigated groundnut. *Crop Res* **20**: 35-38.

Kumari A, Singh RP and Yeshpal. 2012. Productivity, nutrient uptake and economics of mustard hybrid (*B. juncea*) under different planting time and row spacing. *Indian J Agron* **57**: 61-67.

Meena RK, Parihar SS, Singh M and Khanna M. 2015. Influence of date of sowing and irrigation regimes on crop growth and yield of wheat (*Triticum aestivum*) band its relationship with temperature in semi arid region. *Indian J Agron* **60**: 92-98.

Mohd AB, Singh R and Kohli A. 2007. Effect of Integrated use of farm yard manure and fertilizer nitrogen with and without sulphur on yield and quality of Indian mustard. *J Indian Soc Soil Sci* **55**: 224-226.

Pal D and Phogat VK. 2005. Effect of deep tillage and gypsum on yield and N, P, K and S uptake by Mustard. *J Indian Soc Soil Sci* **53**: 134-136.

Patel JR and Shelke VB. 1998. Effect of FYM, phosphorus and sulphur on growth, yield and quality of Indian mustard (*B. juncea*). *Indian J Agron* **43**: 713-717.

Pati P and Mahapatra PK. 2015. Yield performance and nutrient uptake of Indian mustard (*B. juncea* L.) as influenced by integrated nutrient management. *J Crop Weed* **11**: 58-61.

Sharma JP. 1994. Response of Indian mustard (*B. juncea)* to different irrigation schedules and nitrogen and sulphur levels. *Indian J Agron* **39**: 421-425.

Sharma RK, Sharma SK and Balyan JK. 2017. Productivity and profitability of Indian mustard under different organic nutrient management practices in semi-arid region. *J Oilseed Brassica* **8**: 89-94.

Subba Reddy G, Venkataswaralu and Shankara GRM. 1991. Green leaf mannuring as an alternative nitrogen source for castor bean on marginal soils of India. *American J Alt Agri* **6**: 132-138.

Yadav MS, Singh RN and Meheta D.1999. Boron requirement of crops. *Indian Farming* **48**: 4-5.