Journal of Oilseed Brassica, 10 (1) : 51-55, January 2019

Influence of reduced tillage, mulching and INM practices on growth and yield of late sown *Toria* under *sali* rice fallow

Nitumoni Mahanta and K Kurmi

Department of Agronomy, Assam Agricultural University, Jorhat, Assam 785013, India
**Corresponding author email: nitumon154@gmail.com*
(Received: 26 November 2018; Revised: 15 December 2018; Accepted: 26 December 2018)

Abstract

A field experiment was conducted during the *rabi* season 2016-17 and 2017-18 to evaluate the response of newly developed *B. rapa* var. *Toria* var. JT-90-1 (*Jeuti*) to tillage, mulching and INM practices under late sown condition after harvest of *sali* rice at Instructional-cum-Research farm, Assam Agricultural University, Jorhat, India. The experiment was carried out in a split plot design with three replications, keeping tillage practices and mulching in the main plots and INM practices in the sub plots. The main plot treatments consisted of two tillage practices (P_1: Conventional tillage and P_2: Reduced tillage) and two mulching practices (M_1: No mulching and M_2: Mulching with paddy straw) and the sub plot treatments consisted of four nutrient management practices (N_1:100 % Recommended Dose of NPK *i.e.* RDF through chemical fertilizer, N_2: 50 % Recommended Dose of Nitrogen (RDN) through chemical fertilizer + 50% N through FYM, N_3: 50 % RDN through chemical fertilizer + 50% N through Vermicompost and N_4: 50 % RDN through chemical fertilizer + 50% N through Enriched Compost). Significantly higher seed yield of 740.45 and 632.12 kg ha^{-1} and stover yield of 2104.97 and 1866.94 kg ha^{-1} were recorded under the treatment reduced tillage during 2016-17 and 2017-18, respectively. Similarly, mulching with paddy straw also resulted significantly higher seed yield (750.69 and 639.41 kg ha^{-1}), stover yield (2133.04 and 1895.03 kg ha^{-1}) and seed oil content (34.22 and 33.99 %) during the years of experimentation, respectively. Among the nutrient management practices, integrated use of 50 per cent recommended dose of nitrogen through chemical fertilizer and rest 50 per cent through FYM recorded the highest seed yield (772.22 and 652.36 kg ha^{-1}), stover yield (2133.33 and 1904.17 kg ha^{-1}) and seed oil content (34.19 and 34.04 %) in the first and second year, respectively. Highest gross return (Rs.43,290), net return (Rs.25,282) and Benefit-cost ratio (2.40) were recorded when reduced tillage and mulching with paddy straw combined with 50 per cent recommended dose of nitrogen through chemical fertilizer and 50 per cent nitrogen through FYM.

Key words: *Enriched compost, late sown Toria, paddy straw mulching, reduced tillage, vermicompost*

Introduction

Rapeseed-mustard is the key edible oilseed crop of India and a major source of income especially to the marginal and small farmers in rainfed areas. It holds a great promise as an important oilseed crop because of its short duration and wide adaptability to diverse agro-climatic regions and soil type. India occupies first place in area of rapeseed-mustard with 6.32 mha, while it is next to China in production contributing 7.39 mt to the total global production (Anonymous, 2016a). In Assam, rapeseed-mustard occupies an area of only 2.86 lakh ha accounting 1.99 lakh tones of production and productivity being 698 kg/ha (Anonymous, 2016b). The poor performance of this crop in Assam is due to its dependence on the amount and distribution pattern of rainfall during the crop growing period as about 90% of the crop is grown under resource scarce rainfed condition where it suffers from moisture stress.

The main cause for less area under rapeseed-mustard in Assam is the difficulty in post *Kharif* rice tillage operations for timely sowing. The optimum sowing time of rapeseed-mustard in Assam is middle of October to middle of November. Even though the *Kharif* rice vacates the land in time, excess soil moisture at the time of rice harvesting does not permit proper field preparation and timely sowing of rapeseed-mustard. Furthermore, standing rice stubbles also obstruct normal tillage operation for the succeeding crop immediately after rice harvest resulting in delay in sowing of *toria* and by the time most of the residual soil moisture is exhausted during land preparation which results in uneven germination leading to poor yield. Under such circumstances, adoption of minimum tillage after cutting rice stubbles at the base and using it as mulch to conserve the residual soil moisture could be a good option (Chandrasekharan *et al.*, 1996). The need of the farmers to reduce the costs of

production and to reduce the turnaround period between harvest of rice and sowing of rapeseed have gained importance in recent years through reduced tillage practice. Integrated nutrient management has always been found to be better option in intensive cropping system compared to chemical based fertilizer management practices. Additionally, the organic component of INM also helps in soil moisture conservation by increasing water holding capacity of soil and moderating soil temperature. Keeping above facts in view, a field experiment was conducted to evaluate the response of late sown *Toria* to different tillage, mulching and nutrient management practices under *sali* rice fallow situation.

Materials and Methods

A field experiment was conducted during the *rabi* season of the years 2016-17 and 2017-18 under rainfed condition at Instructional-cum-Research farm, Assam Agricultural University, Jorhat (26^0 47/ N latitude, 94^0 12/ E longitude and at an altitude of 86.6 m above mean sea level sea level), Assam, India. The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 5.5 and 5.4), medium in organic carbon (0.70% and 0.68%), medium in available N (301.06 kg/ha and 282.24 kg/ha), low in available P_2O_5 (21.03 kg/ha and 19.24 kg/ha) and medium in available K_2O (161.28 kg/ha and 154.56 kg/ha). The climate of the site of the study is sub-tropical humid with hot summer and cold dry winters. A range of mean minimum temperatures of 8-15^0C and 8.9-17.1^0C and mean maximum temperature of 24- 27.9^0C and 22.5^0C-28.7^0C were recorded during 2016-17 and 2017-18, respectively. The amount of rainfall received during the crop growing period were 102.2 mm and 79.6 mm during the corresponding years, respectively. The mean relative humidity in the morning and evening varied from 91-100 % and 44-66 %, respectively during the crop growing period of 2016-17. The corresponding values during the year 2017-18 were 94-100 % and 55-79 %, respectively. The treatments comprised of two tillage practices (P_1:Conventional tillage and P_2:Reduced tillage) and two mulching practices (M_1:No mulching and M_2: Mulching with paddy straw) in the main plot and four nutrient management practices *viz.*, N_1:100 % Recommended Dose of NPK *i.e.* RDF (40, 35 and 15 kg/ha N, P_2O_5 and K_2O) through chemical fertilizer, N_2: 50 % Recommended Dose of Nitrogen (RDN) through chemical fertilizer + 50% N through FYM, N_3: 50 % RDN through chemical fertilizer + 50% N through Vermicompost and N_4: 50 % RDN through chemical fertilizer + 50% N through Enriched Compost in sub plots were tested in a split plot design and each treatment was replicated thrice. The conventional tillage plots were first ploughed by tractor drawn disc plough after harvest of *Kharif* rice, subsequently cross harrowed by disc harrow. The stubbles and weeds were removed and the final land preparation was done by using rotovator. The reduced tillage plots were initially ploughed by tractor drawn disc plough and then cross ploughed by power tiller with stubble incorporation. In the nutrient management treatments, half of the nitrogen and full doses of phosphorus (P_2O_5), potassium (K_2O) and organic manures as per treatment were applied uniformly one day before sowing in the furrows opened for sowing of seeds and were incorporated into the soil uniformly by hoeing. The remaining half of the nitrogen was top dressed after weeding operation. The late sown *toria* var. 'JT-90-1' (*Jeuti*) was sown on 9th and 11th of December, respectively during 2016 and 2017 and 13 kg/ha (15.6 g/plot) seed rate was followed with a spacing of 25 cm row to row and 5-7 cm plant to plant by placing the seeds in the furrows of 4-5 cm depth. One weeding was done with garden hoe at 22 days after sowing and the mustard aphid infestation was controlled effectively by spraying Chlorpyriphos 20 EC at the rate of 2 ml/l twice at ten days interval.

Observations of growth and yield-attributing characters were recorded at 20, 40, 60 and 80 days after sowing of the crop. Plant height was measured by selecting ten representative plants at random from each of the plots. Leaf area was measured by leaf area meter and leaf area index was calculated by dividing the leaf area per plant by land area occupied by the plant. The numbers of primary branches and siliquae per plant were counted at the time of maturity from ten randomly selected plants in each plot. Subsequently, ten siliquae were selected at random from each plot to measure the length of siliqua and number of seeds per siliqua. For test weight, 1000 grains were randomly counted from each treatment, dried to 12% moisture and then their weight was recorded. The crop was harvested on 6th and 9th March, respectively during 2017 and 2018. The seed and stover yields per hectare were worked out on the basis of yield records in each plot. Seed oil content was determined with the help of "Soc-Plus" apparatus as per method described by AOAC (1960) by taking 5g seed samples from each plot. The analyses of the results were done using standard statistical procedure given by Panse and Sukhatme (1985). The critical differences (CD) at 5% probability level was calculated only when the F value had been found to be significant. By taking into account the prevailing cost of inputs and prices of output, the cost of cultivation, gross and net returns were calculated.

Results and Discussion

Growth characters

The growth attributing characters, *viz.* plant height at maturity, number of leaves per plant and leaf area index at 60 DAS were found to be higher in the plots prepared with reduced tillage as compared to those with conventional tillage (Table-1). However, there was no statistical difference in plant height during 2016-17 and number of leaves and LAI at 60 DAS during 2017-18. These results might be due to higher soil moisture content, better utilization of residual soil moisture and accumulation of comparatively higher organic matter in soil under reduced tillage system. Similar results were also reported by Christian and Bacon (1990).

Significantly higher plant height, numbers of leaves per plant and leaf area index at 60 DAS were recorded when the crop was mulched with paddy straw (M_2) as compared to un-mulched plots during both the years of experimentation. This might be due to better conservation of soil moisture by reducing evaporation losses, optimization of soil temperature, reduced weed population and gradual increase in soil organic matter through decomposition of mulch material under mulching treatment. Singh and Rana (2006) also reported higher plant growth under mulching.

All the integrated nutrient management practices remained at par with each other and showed their superiority over the chemical fertilization in all the three growth parameters. However, the variations were significant only in case of LAI at 60 DAS and INM with 50 per cent of recommended N through chemical fertilizer and 50 per cent N through FYM (N_2) was found to be best. These results were in agreement with the findings of Saikia (2011).

Table 1. Growth parameters of late sown *Toria* as influenced by tillage, mulching and integrated nutrient management practices

Treatment	Plant height (cm) at maturity		No. of leaves/plant at 60 DAS		LAI at 60 DAS	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
Tillage Practices (P)						
P_1: Conventional tillage	90.11	79.68	7.11	4.60	1.15	1.07
P_2: Reduced Tillage	92.11	82.89	8.03	5.08	1.36	1.15
S.Em (±)	0.678	0.535	0.256	0.263	0.0014	0.061
CD (P=0.05)	NS	1.85	0.89	NS	0.05	NS
Mulching (M)						
M_1: No Mulching	89.81	79.01	6.96	4.14	1.16	1.00
M_2: Mulching with PS	92.42	83.56	8.18	5.54	1.35	1.22
S.Em (±)	0.67	0.535	0.256	0.263	0.0014	0.061
CD (P=0.05)	2.35	1.85	0.89	0.91	0.05	0.21
Nutrient Management (N)						
N_1: 100 % RDF	89.38	80.05	7.24	4.23	1.16	1.03
N_2: 50% RDN +FYM	92.24	82.66	8.27	5.20	1.35	1.19
N_3: 50% RDN +VC	91.75	81.52	7.45	4.99	1.27	1.12
N_4: 50% RDN +EC	91.08	80.92	7.32	4.93	1.25	1.10
S.Em (±)	1.293	0.683	0.55	0.38	0.040	0.032
CD (P=0.05)	NS	NS	NS	NS	0.12	0.09

PS= Paddy Straw; RDF: Recommended Dose of Fertilizer; RDN: Recommended Dose of Nitrogen; VC: Vermicompost; EC: Enriched Compost

Yield attributes

Yield attributing characters *viz.*, number of primary branches and siliquae per plant, length of siliqua and number of seeds per siliqua were found to be higher under reduced tillage system during both the years of investigation (Table-2). However, significant differences were observed number of primary branches per plant during 2016-17 and number of siliquae per plant during 2017-18 only. Shekhawat *et al.* (2016) also found higher yield attributing characters in Indian mustard under reduced tillage as compared to the conventional tillage system. Mulching with paddy straw brought significantly higher values for yield attributing characters during both the years and these results were in conformity of Awasthi *et al.* (2007) in Indian mustard.

Table 2. Yield attributing parameters of late sown *Toria* as influenced by tillage, mulching and integrated nutrient management practices

Treatment	No. of primary branches/plant		No. of siliquae /plant		Length of siliqua (cm)		No. of seeds /siliqua	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
Tillage Practices (P)								
P_1: Conventional tillage	5.37	4.29	51.99	44.65	4.95	4.86	21.42	19.78
P_2: Reduced Tillage	5.96	4.88	54.56	47.66	4.98	4.91	21.71	19.97
S.Em (±)	0.056	0.192	0.846	0.597	0.02	0.02	0.33	0.31
CD (P=0.05)	0.19	NS	NS	2.07	NS	NS	NS	NS
Mulching (M)								
M_1: No Mulching	5.16	4.18	50.70	43.75	4.86	4.82	20.83	19.22
M_2: Mulching with PS	6.16	4.99	55.85	48.57	5.07	4.95	22.30	20.54
S.Em (±)	0.056	0.192	0.846	0.597	0.02	0.02	0.33	0.31
CD (P=0.05)	0.19	0.66	2.93	2.07	0.09	0.08	1.15	1.06
Nutrient Management (N)								
N_1: 100 % RDF	5.29	4.33	50.32	42.81	4.91	4.79	20.92	19.25
N_2: 50% RDN +FYM	5.93	4.96	57.90	48.76	5.03	4.97	22.70	21.12
N_3: 50% RDN +VC	5.76	4.63	52.88	46.68	4.97	4.90	21.29	19.70
N_4: 50% RDN +EC	5.67	4.42	52.00	46.38	4.95	4.87	21.36	19.45
S.Em (±)	0.154	0.157	0.718	0.675	0.03	0.04	0.43	0.46
CD (P=0.05)	0.45	0.46	2.09	1.97	0.08	0.11	NS	1.34

Table 3. Yield performance of late sown *Toria* as influenced by tillage, mulching and integrated nutrient management practices

Treatment	Seed yield (kg/ha)			Stover yield (kg/ha)			Harvest index (%)		Seed oil content (%)	
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	2016-17	2017-18
Tillage Practices (P)										
P_1: Conventional tillage	679.17	587.19	633.44	1967.95	1754.06	1861.01	25.68	25.01	34.03	33.87
P_2: Reduced Tillage	740.45	632.12	686.53	2104.97	1866.94	1985.97	26.37	25.29	34.11	33.97
S.Em (±)	9.783	5.43	6.70	11.365	12.53	11.48	0.267	0.092	0.03	0.03
CD (P=0.05)	33.85	18.79	23.20	39.33	43.36	39.74	NS	NS	NS	NS
Mulching (M)										
M_1: No Mulching	668.92	579.90	624.69	1939.86	1725.97	1832.92	25.49	25.09	33.92	33.84
M_2: Mulching with PS	750.69	639.41	695.28	2133.04	1895.03	2014.06	26.56	25.21	34.22	33.99
S.Em (±)	9.783	5.43	6.70	11.365	12.53	11.48	0.267	0.092	0.03	0.03
CD (P=0.05)	33.85	18.79	23.20	39.33	43.36	39.74	0.93	NS	0.11	0.11
Nutrient Management (N)										
N_1: 100 % RDF	646.53	561.04	604.03	1892.01	1675.33	1783.68	25.14	25.05	33.89	33.74
N_2: 50% RDN +FYM	772.22	652.36	712.57	2133.33	1904.17	2018.75	26.78	25.49	34.19	34.04
N_3: 50% RDN +VC	726.04	623.19	674.86	2084.65	1855.83	1970.28	26.20	25.11	34.12	33.97
N_4: 50% RDN +EC	694.44	602.01	648.47	2035.83	1806.67	1921.25	25.98	24.96	34.07	33.92
S.Em (±)	25.94	22.13	22.81	27.58	20.85	23.54	0.454	0.611	0.04	0.04
CD (P=0.05)	75.71	64.60	66.57	80.50	60.85	68.70	NS	NS	0.11	0.11

PS= Paddy Straw; RDF: Recommended Dose of Fertilizer; RDN: Recommended Dose of Nitrogen; VC: Vermicompost; EC: Enriched Compost

Among the nutrient management treatments, integrated nutrient management, comprising of 50 per cent of recommended N through chemical fertilizer and 50 per cent N through FYM recorded significantly highest values of number of primary branches per plant, number of siliquae per plant, siliqua length and number of seeds per siliqua during both the years except number of seeds per siliqua during 2016-17. However, it remained at par with INM comprising of 50 per cent of recommended N through chemical fertilizer and 50 per cent N through vermin-compost with respect to number of primary branches per plant. These results are attributable to the findings of Singh and Singh (2015) in late sown Indian mustard (*B. juncea*).

Seed yield

Both the main-plot treatment factors *viz.*, reduced tillage and mulching with paddy straw recorded higher magnitude of seed oil content, harvest index, seed and stover yield over conventional tillage and no-mulching, respectively (Table 3). On an average, there was an increase of 8.38 and 6.71 per cent of seed and stover yield, respectively in reduced tillage over conventional method of tillage. The corresponding increase due to mulching over non-mulching were 11.30 and 9.88 per cent, respectively. However, the effects due to tillage practices were not significant in case of harvest index and seed oil content. These results might be attributable to the better availability of soil moisture throughout the crop growing period in reduced tillage and mulching plots. Abdullah (2014) and Shekhawat *et al.* (2016) also reported similar findings of mustard seed oil content under minimum tillage and seed and biological yield under reduced tillage as compared to conventional tillage, respectively.

Integrated nutrient management, comprising of 50 per cent of recommended N through chemical fertilizer and 50 per cent N through FYM recorded significantly highest seed and stover yield and seed oil content. However, the seed yield registered under INM comprising with 50 per cent of recommended N through chemical fertilizer and 50 per cent N through vermi-compost also remained at par with the highest value. Singh and Singh (2015) reported similar results in Indian mustard. Higher seed oil content under integrated nutrient management was found by Singh and Sinsinwar (2006). From the present investigation, it was found that in Assam the seed yield, stover yield and seed oil content of late sown *Toria* variety JT-90-1 (*Jeuti*) grown after harvest of *kharif* rice could be increased by combined approach of reduced tillage associated with paddy straw mulching and integrated nutrient management comprising of 50 per cent recommended dose of nitrogen through chemical fertilizer and 50 per cent nitrogen either through FYM or vermi-compost.

References

Abdullah AS. 2014. Minimum tillage and residue management increase soil water content, soil organic matter and canola seed yield and seed oil content in the semiarid areas of Northern Iraq. *Soil Tillage Res* **144**: 150-155.

Anonymous. 2016a. Agricultural Statistics at a glance. Directorate of Economics and Statistics, Department of Agriculture, Cooperation and Farmers Welfare, Government of India.

Anonymous. 2016b. Statistical Hand Book, Assam. Directorate of Economics and Statistics, Government of Assam, p. 28.

AOAC. 1960. Official Methods of Analysis, *(*ed 9), Association of Official Agricultural Chemists, Washington DC, pp. 119.

Awasthi UD, Singh RB and Dubey SD. 2007. Effect of sowing date and moisture-conservation practice on growth and yield of Indian mustard (*B. juncea*) varieties. *Indian J Agron* **52**: 151-153.

Chandrasekharan B, Bhattacharyya HC and Gogoi JK. 1996. Problems and prospects of soil management for lowland rice pulse rotation. *ACIAR Proc* **70**: 162-186.

Christian DG and Bacon ETG. 1990. A long-term comparison of ploughing, tine cultivation and direct drilling on the growth and yield of winter cereals and oilseed rape on clayey and silty soils. *Soil Tillage Res* **18**: 311-331.

Panse VG and Sukhatme PV. 1985. *Statistical Methods for Agricultural Workers*. Indian Council of Agricultural Research, New Delhi.

Saikia R. 2011. Effect of Integrated Nutrient Management (INM) and seed rate on Rapeseed (*B. campestris* var. *Toria*). M Sc (Ag) Thesis, Assam Agricultural University, Jorhat.

Shekhawat K, Rathore SS, Kandpal BK, Premi OP, Singh D and Chauhan JS. 2016. Crop establishment techniques affect productivity, sustainability and soil health under mustard-based cropping systems of Indian semi-arid regions. *Soil Tillage Res* **158**: 137-146.

Singh H and Singh RP. 2015. Effect of nutrient management practices on yield and quality of Indian mustard (*B. juncea*) under late sown condition. *Ann Agric Res New Series* **36**: 65-71.

Singh R and Sinsinwar BS. 2006. Effect of integrated nutrient management on growth, yield, oil content and nutrient uptake of Indian mustard (*B. juncea*) in eastern part of Rajasthan. *Indian J Agril Sci* **76**: 322-324.

Singh T and Rana KS. 2006. Effect of moisture conservation and fertility on Indian mustard (*B. juncea*) and lentil (*Lens culinaris*) intercropping system under rainfed conditions. *Indian J Agron* **51:** 267-270.