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REVIEW ARTICLE

EFFECT OF MULCHING AND NUTRIENT MANAGEMENT PRACTICES ON GROWTH, YIELD, NUTRIENT UPTAKE OF INDIAN MUSTARD (*BRASSICA JUNCEA* L.) AND SOIL MOISTURE CONTENT

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ABSTRACT

Field experiment was carried out in Instructional farm, Krishi Vigyan Kendra, Angul of Odisha during *rabi* seasons of 2010-11 and 2011-12 to study effect of mulching and nutrient management practices on growth, yield, nutrient uptake of Indian mustard and soil moisture content. The experiment comprised of three main plot treatments *viz*. no mulching, soil mulching, straw mulching and four subplots *viz* RDF, RDF+Sulphur, 75% RDF+FYM, 75% RDF+vermicompost in split plot design with three replications. The results revealed that application of straw mulching@ 5t ha^{-1} recorded significantly higher dry matter accumulation $plant^{-1}$ (28.43 g) , no of siliquae $plant^{-1}$(171.58), grain yield(14.17 q ha^{-1}), stover yield (47.75 q ha^{-1}), harvest index (22.93 %), soil moisture content at harvest(14.8 %) with maximum uptake of N, P, K and S by both seeds and stovers than no mulching. Among the nutrient management practices, application of 75% RDF+ vermicompost 2 t ha^{-1} recorded maximum dry matter accumulation $plant^{-1}$ (30.85 g), grain yield(18.83 q ha^{-1}) with moisture content at harvest(13.67 %). Thus, application of straw mulching @ 5t ha^{-1} and 75% RDF+ vermicompost 2 t ha^{-1} can be practiced for maximizing yield, improvement of growth, nutrient uptake of Indian mustard and soil moisture content.

INTRODUCTION

Indian mustard *(Brassica juncea* L.) is the second important oilseed crop cultivating for its premier oil for manifold uses. India is the fourth largest oilseed economy in the world. Among the seven edible oilseeds cultivated in India, rapeseed-mustard contributes 28.6% in the total oilseeds production and ranks second after groundnut sharing 27.8% in the India's oilseed economy. The mustard growing areas in India are experiencing the vast diversity in the agro climatic conditions and different species of rapeseed-mustard are grown in some or other part of the country (Shekhawat *et al.*, 2012). In Odisha state, it is grown in an area of 0.24 lakh hectare with a production of 0.28 lakh tonnes and a productivity of 11.81 q ha^{-1} (Anonymous, 2012). Its productivity is much lower than the national average. One of the major problems in low productivity is due to moisture stress faced by the crop during latter part of the crop growth. So soil mousture conservation through mulching plays an important role for enhancing the productivity (Mandal and Ghosh, 1984). Because of deep tap root system and inherent tolerance to soil moisture stress, Indian mustard is generally grown under rainfed condition. Also sulphur free inorganic fertiliser 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 sulphur 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, donot 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 synergistics. There is a negative balance of sulphur in our soils as its addition through varios sources is much lower than the removal (Mohd *et al.*, 2007). Keeping in view the importances of mulching and nutrient management in Indian mustard , an experiment was carried out to study the effect of mulching and nutrient management practices on growth, yield, nutrient uptake of Indian mustard and soil moisture content.

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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 2010-11 and 2011-12 to study effect of mulching and nutrient management practices on

growth, yield, nutrient uptake of Indian mustard and soil moisture content. The geographical location of the area has 84^0 16′ to 85^0 23′ E longitude and 200 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 124.5 mm. The mean maximum and mean minimum temperature registered in both the year was 32.80 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 (0.45 %), available nitrogen (212.6 kg ha^{-1}), phosphorus (15.27 kg ha^{-1}) and potash (234.85 kg ha^{-1}) contents (Jackson, 1973). The experiment involved three main plot treatments comprising different mulching *viz.*T_1- No mulching, T_2-Soil mulching, T_3-Straw mulching @5t ha^{-1} and four subplots viz N_1-RDF(60:30:30 kg NPK ha^{-1}), N_2-RDF+S(40kg ha^{-1}), N_3- 75% RDF+FYM 5 t ha^{-1}, N_4- 75% 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 Indian mustard *cv.Pusa Bold* during both the year. The crop was sown during 2nd week of October with 30X10 cm spacing and harvested during 1st week of February. The recommended fertilizer dose were N:P:K 60:30:30 kg ha^{-1} respectively. Full dose of P and K as basal and N in 2 splits i.e 50% as basal and 50% at 30 DAS. All the moisture conservation practices were applied at 25 DAS. The straw mulch @5 t ha^{-1} was applied. Sulphur 40 kg ha^{-1} through gypsum was drilled in rows of mustard at time of sowing. Three numbers of irrigations were given during seeding, flower initiation and siliquae development. Soil samples were collected at 30 cm depth at 60 DAS and harvest to esimate soil moisture.

Seed and stover samples taken after crop harvest were washed throughly, 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). 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). 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).

RESULTS AND DISCUSSION

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, 7.16 and 13.5 % respectively with application of straw mulching@ 5t ha^{-1} as compared to no mulching (Table 1). Application of RDF+ Sulphur 40 kg ha^{-1} produced the tallest plant(157.2 cm), maximum number of primary branches $plant^{-1}$ (5.16) as compared to other nutrient management treatments attributed to increased cell division and cell elongation. These results are consistent with Rawat *et al.* (2000) and Sharma, (1994). Maximum dry matter accumulation $plant^{-1}$ (30.85 g) was recorded with application of 75% RDF+Vermicompost 2 t $ha^{-1.}$

Table 1. Effect of mulching and nutrient management practices on growth parameters of Indian mustard

Treatment	Plant height (cm)	No of primary branches $plant^{-1}$	Dry matter accumulation $plant^{-1}$ (g)
Mulching practices			
T_1- No mulching	146.03	4.61	25.05
T_2-Soil mulching	149.3	4.85	27.85
T_3-Straw mulching @5t ha^{-1}	150.1	4.94	28.43
SEm±	0.044	0.004	0.055
C.D at 5 %	0.173	0.017	0.217
Nutrient management practices			
N_1-RDF (60:30:30 kg NPK ha^{-1})	137.4	4.32	21.73
N_2-RDF+S (40kg ha^{-1})	157.2	5.16	29.52
N_3- 75% RDF+FYM 5 t ha^{-1}	145.7	4.67	26.34
N_4- 75% RDF+Vermicompost 2 t ha^{-1}	153.6	5.04	30.85
SEm±	0.092	0.005	0.063
C.D at 5 %	0.274	0.015	0.187

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

Table 2. Effect of mulching and nutrient management practices on yield attributing characters of Indian mustard

Treatment	No of siliquae $plant^{-1}$	No of seeds $siliqua^{-1}$	1000 grain weight (g)
Mulching practices			
T_1- No mulching	161.65	10.8	4.39
T_2-Soil mulching	168	11.56	4.49
T_3-Straw mulching @5t ha^{-1}	171.58	11.78	4.52
SEm±	0.105	0.016	0.002
C.D at 5 %	0.411	0.061	0.008
Nutrient management practices			
N_1-RDF (60:30:30 kg NPK ha^{-1})	145.3	10.3	4.02
N_2-RDF+S(40kg ha^{-1})	174.1	12.4	4.85
N_3- 75% RDF+FYM 5 t ha^{-1}	162.4	11.3	4.16
N_4- 75% RDF+Vermicompost 2 t ha^{-1}	186.5	11.5	4.83
SEm±	0.183	0.013	0.007
C.D at 5 %	0.543	0.04	0.02

Yield attributing characters

Application of straw mulching@ 5t ha^{-1} recorded (Table 2) the maximum yield attributing characters like no of siliqua plant^{-1}(171.58), no of seeds siliqua^{-1}(11.78), 1000 grain weight (4.52 g) which is 6.1, 9.1 and 3.0 %, respectively, higher than no mulching. Application of 75% RDF+Vermicompost 2 t ha^{-1} produced siliqua plant^{-1}(186.5) which is 28.4 % higher than sole 100% RDF. Maximum seeds siliqua^{-1}(12.4) was produced in RDF+ Sulphur 40 kg ha^{-1} followed by 75% RDF+Vermicompost 2 t ha^{-1}75% and 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 (20.6 %) as compared to sole 100% RDF and was at par with application of 75% RDF+Vermicompost 2 t ha^{-1} owing to better nitrogen and carbohydrate metabolism of plants that facilitates synthesis of nuclic acids and hormones which had encouraged the better filling of seeds (Yadav *et al*, 1999).

Yield

Application of mulching practices recorded significantly higher grain yield than no mulching treatment. (Table 3). Application of Straw mulching @ 5t ha^{-1} resulted maximum grain yield 14.17 q ha^{-1} followed by soil mulching (12.79 q ha-^{1}) which were 24.2 and 12.1% higher than no mulching respectively. Among the mulching practices, maximum stover yield (47.75 q ha^{-1}) and harvest index (22.93%) was observed in straw mulching @ 5t ha^{-1}. It may be due to sustained supply of nutrient and water to the crop. This is in line with the results reported by Dubey *et al*. (1993). 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 (18.83 q ha^{-1}) with harvest index (22.75 %).

Table 3. Effect of mulching and nutrient management practices on yield of Indian mustard

Treatment	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest index (%)
Mulching practices			
T_1- No mulching	11.41	45.13	20.22
T_2-Soil mulching	12.79	47.1	21.28
T_3-Straw mulching @5t ha^{-1}	14.17	47.75	22.93
SEm±	0.035	0.043	0.039
C.D at 5 %	0.136	0.171	0.152
Nutrientmanagement practices			
N_1-RDF (60:30:30 kg NPK ha^{-1})	11.53	41.90	21.56
N_2-RDF+S(40kg ha^{-1})	13.64	52.30	20.66
N_3- 75% RDF+FYM 5 t ha^{-1}	12.15	45.83	20.94
N_4- 75% RDF+Vermicompost 2 t ha^{-1}	18.83	47.0	22.75
SEm±	0.015	0.066	0.014
C.D at 5 %	0.043	0.196	0.04

Table 4. Effect of mulching and nutrient management practices on soil moisture content

Treatment	Moisture content (%) at 60 DAS	Moisture content (%) at harvest
Mulching practices		
T_1- No mulching	18.7	11.5
T_2-Soil mulching	20.5	13.6
T_3-Straw mulching @5t ha^{-1}	21.3	14.8
SEm±	0.028	0.042
C.D at 5 %	0.109	0.165
Nutrientmanagement practices		
N_1-RDF (60:30:30 kg NPK ha^{-1})	19.57	12.83
N_2-RDF+S(40kg ha^{-1})	20.17	13.3
N_3- 75% RDF+FYM 5 t ha^{-1}	20.37	13.4
N_4- 75% RDF+Vermicompost 2 t ha^{-1}	20.57	13.67
SEm±	0.004	0.042
C.D at 5 %	0.013	0.013

Table 5. Effect of mulching and nutrient management practices on nutrients uptake

Treatment	Uptake by seed (kg ha^{-1}) of				Uptake by stover (kg ha^{-1}) of			
	N	P	K	S	N	P	K	S
Mulching practices								
T_1- No mulching	38.7	6.44	9.26	3.47	24.67	7.13	57.72	11.02
T_2-Soil mulching	45.25	7.53	10.82	4.07	27	7.81	63.2	12.09
T_3-Straw mulching @5t ha^{-1}	50.66	8.43	12.12	4.57	27.48	7.95	64.3	12.3
SEm±	0.183	0.025	0.036	0.014	0.053	0.015	0.124	0.024
C.D at 5 %	0.718	0.1	0.142	0.054	0.207	0.06	0.186	0.067
Nutrient management practices								
N_1-RD (60:30:30 kg NPK ha^{-1})	40.65	6.7	9.7	3.58	23.49	6.71	54.94	10.48
N_2-RDF+S(40kg ha^{-1})	51.81	8.89	12.71	5.33	31.92	9.42	76.93	17.27
N_3- 75% RDF+FYM 5 t ha^{-1}	41.87	6.94	9.98	3.77	25.68	7.34	59.16	11
N_4- 75% RDF+Vermicompost 2 t ha^{-1}	45.14	7.34	10.52	3.46	24.44	7.05	55.94	8.46
SEm±	0.078	0.013	0.018	0.011	0.067	0.022	0.181	0.095
C.D at 5 %	0.233	0.038	0.052	0.033	0.199	0.064	0.539	0.199

This may be due to its high nutritinal composition. Application of RDF+ Sulphur 40 kg ha^{-1} produced 18.3% higher grain yield as compared to sole 100% RDF alone may be due to better availability of nutrients and their translocation. Simillarly application of 75% RDF+FYM 5 t ha^{-1} recorded 5.4 % higher grain yield than sole 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 Patel and Shelke (1998) and Jain and Sharma (2000).

Soil moisture content

Mulching treatments recorded higher soil moisture content than no mulch treatment both at 60 DAS and harvest. Straw mulching @5t ha^{-1} conserved more moisture (21.3% at 60 DAS and 14.8 % harvest) as compared to other mulching treatments (Table 4) owing to reduced crop weed competition for moisture and reduced evaration loss resulting more moisture conservation. These results are also in agrrement with results of Nikam *et al.* (2009). Soil mulching resulted moisture content (20.5 and 13.6 % at 60 DAS and harvest respectively). No mulching resulted minimum moisture content 18.7 and 11.5 % at 60 DAS and harvest respectively. The higher soil moisture content below the mulches might be due to reduction in soil surface evaporation and weed intensity (Shiurgure *et al.*, 2003). These results are in agrrement with Kumar *et al*., (2001). Among the nutrient management practices, application of 75% RDF+Vermicompost 2 t ha^{-1} recorded maximum moisture content 20.57 and 13.67 % at 60 DAS and harvest respectively. Similar results were obtained by Banik *et al.* (2008).

Nutrient uptake

Perusal of the results presented in (Table 5) clearly reveals that all the mulching practices brought about significant differences in the uptake of nutrients over no mulching. Maximum uptake of N, P, K and S was obtained in straw mulching @5t ha^{-1} which were (11.96, 1.99, 2.86 and 1.1 kg ha^{-1} respectively) higher by seed and (2.81, 0.82, 6.58 and 1.28 kg ha^{-1} respectively) higher by stover than no mulching. Application of RDF+ Sulphur 40 kg ha^{-1} recorded the maximum uptake of N, P, K and S by seed (51.81, 8.89, 12.71 and 5.33 kg ha^{-1}, respectively) and by stover (31.92, 9.42, 76.93 and 17.27 kg ha^{-1}, respectively) followed by 75% RDF+Vermicompost 2 t ha^{-1}; 75% 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 Kumaran and Solaimalai (2000).

Conclusion

Thus, application of Straw mulching @ 5t ha^{-1} and 75% RDF+Vermicompost 2 t ha^{-1} was found to be beneficial and can be practiced for maximizing the yield of Indian mustard, improvement of quality, conserving soil moisture.

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