

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH AND DEVELOPMENT OF MUSTARD (*BRASSICA JUNCEA* L.) IN IRRIGATED CONDITION OF UPPER GANGETIC PLAINS

Sauhard Dubey^{1*}, M.Z. Siddiqui¹, Saurabh Rana¹, Gaurav Shukla², Dharmendra Singh² and Ashish Nath Pandey²

¹Department of Agronomy, CSAUA&T, Kanpur, Uttar Pradesh-208002, India

²Department of Agronomy, SVPUA&T, Meerut, Uttar Pradesh-250110, India

Email: Sauhardsd29@gmail.com

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Abstract: A field experiment was conducted to study the effect of integrated nutrient management on growth and development of mustard (*Brassica Juncea* L.) under timely sown irrigated conditions on sandy loam soil at Students' Instructional Farm (SIF) of C.S. Azad University of Agriculture and Technology, Kanpur. The experiment was laid out in Randomized Block Design replicated thrice. The treatments comprises of either 100% RDF (N:P:K:S) @ 120:60:40:40 kg ha⁻¹ or 75 % RDF @ 90:45:30:30 kg ha⁻¹ or 50 % RDF @ 60:30:20:20 kg ha⁻¹ along with combinations of vermicompost @ 1.25 t ha⁻¹ or 0.62 t ha⁻¹, FYM @ 5 t ha⁻¹ or 2.5 t ha⁻¹ with bio-fertilizers (azotobacter + PSB) @ 7.5 Kg ha⁻¹ + ZnSO₄ @ 10 Kg ha⁻¹. The results of the present investigation revealed that the growth and yield traits viz., plant height at maturity (201.41cm), number of branches at maturity (7.59 primary, 9.37 secondary and 3.97 tertiary branches), LAI at 90 DAS (4.46), dry matter accumulated at maturity (44.23 g/plant) and grains yield (23.25 q ha⁻¹) were recorded significantly highest with application of 50% RDF + FYM @ 2.5 t ha⁻¹ + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹. Hence, it may be recommended for farmers for higher yield in the area of Upper Gangetic Plains.

Keywords: Development, Fertilizers, FYM, Growth, Mustard, Vermicompost

INTRODUCTION

Oilseeds, the second largest agricultural commodity after cereals in India, play a significant role in India's agrarian economy, sharing 14% of the gross cropped area and accounting for nearly 1.5% of the gross national production and 8% of the value of all agricultural products. The gap in supply is being met through huge imports costing more than Rs. 26000 crores during 2009-10. Rapeseed and mustard are the major *Rabi* oilseed crops of India and stand next to groundnut in the oilseed economy. It is an important oilseed crops of the family cruciferae and occupy a prominent place among the leading oilseed crops being next to groundnut both in area and production, meeting the fat requirement of about 50 per cent population in the state of Uttar Pradesh, Punjab, Rajasthan and Assam. India is second in rapeseed and mustard production to China and first in area. A range of oilseed crops viz. groundnut, rapeseed and mustard, soybean, sesame, sunflower, safflower and niger (edible) and linseed and castor (non edible) are also cultivated in the country. In India, the overall area under rape mustard has increased to 6.64 million hectares in 2018-19, up from 6.39 million hectares a year ago while the production is jumped 19 per cent from a year earlier to a record 8.5 million tonnes. Vermicompost is a good organic source of plant nutrient supply. It is a rich source of nitrogen (3%), phosphorus (1%), potassium (1.50%), calcium (0.44%), magnesium (0.15%), sulphur (0.45%), zinc (24.43ppm), iron (175.2ppm), vitamins and growth

hormones which enhance plant height, dry matter per plant and seed yield. Rajiv (2019) stated that the organic amendments like FYM, vermicompost and bio-fertilizers might play a major role in supplementing the crop nutrients through their direct addition, improvement in soil condition, nitrogen fixation and solubilisation of fixed forms of phosphorus in soil. Rajiv (2014) reported that the application of vermicompost integration with inorganic fertilizers might have improved the availability of nutrients for crop use thus yielded higher to sole inorganic fertilizers. In contrary to synthetic fertilizers, vermicomposting reduce soil toxicity by buffering action, prevent soil degradation and enhance soil fertility status. Nitrogen is an important constituent of growth. Effect of N level on Indian mustard shows that all the growth characters except number of branches increases with the increasing nitrogen levels. Rajiv (2014a) reported good impact of dissemination and diffusion of conservation agronomical practices on area expansion (389.6 ha) as well as volume (623.36 t) and value of produce (199.47 lac) of mustard in Hamirpur district of Uttar Pradesh. Rajiv (2014b) also stated that the improved techniques increased in yield of vegetables by the margins of 44.35 to 58.23% over conventional system.

Therefore, in view of above facts, the field experiment was conducted to study the effect of integrated nutrient management on growth and development parameters (plant height, No. of branches, LAI and dry matter accumulation) of

*Corresponding Author

mustard (*Brassica Juncea* L.) in irrigated condition of Upper Gangetic Plains.

MATERIALS AND METHODS

The experiment was conducted at Students' Instruction Farm (SIF) of Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (U.P) during *Rabi* season 2017-18. The field was well levelled and irrigated by tube well. Soil of the experimental field was sandy loam in texture with 7.9 pH and electrical conductivity was 0.33 dSm⁻¹. Nine different treatments *viz.*, 100% RDF (N:P:K:S @ 120:60:40:40 kg ha⁻¹), 100% RDF + bio-fertilizers (azotobacter + PSB) @ 7.5 kg ha⁻¹, 75% RDF + FYM @ 2.5 t ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹, 75% RDF + vermicompost @ 0.62 t ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹, 75% RDF + FYM @ 2.5 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹, 75% RDF + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹, 50% RDF + vermicompost @ 1.25 t ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹, 50% RDF + FYM @ 5 t ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ and 50% RDF + FYM @ 2.5 t ha⁻¹ + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ were tested against control in randomized block design (RBD). The treatments were replicated thrice to avoid any effect of heterogeneity as per standard procedure. Land preparation was started after harvesting of *kharif* crop, for proper germination of seeds. Seeds were sown in rows at a distance of 45 cm by using seeds rate of 5 kg ha⁻¹. The recommended dose of fertilizers were applied at the rate of 120 kg N, 60 kg P₂O₅, 40 kg K₂O and 40 kg S (elemental sulphur) per hectare. Full amount of phosphorus, potash, sulphur and 75% nitrogen was applied as basal dose while the remaining amount of nitrogen was applied after first irrigation as top dressing. The crop was further fertilized with FYM, vermicompost, bio-fertilizer, sulphur and zinc according to treatments. Three phases thinning was done during the crop period in which first thinning was done at seedling stage

at 10 days after sowing to maintain optimum plant to plant distance by 15 cm followed by 15-20 DAS and 40 DAS. Crop variety Pusa Mustard-30 was used under study, which is a low erucic acid variety of Indian mustard [*Brassica Juncea* (L.) Czern & Coss] developed by Division of Genetics, Indian Agricultural Research Institute, New Delhi. The new released variety along with integrated nutrient management increased significantly number of leaves per plant and dry matter accumulation and number of branches per plant leading to better plant floral growth thus leads to increase in yield. The crop was harvested at physiological maturity on 18th March, 2018. The data regarding growth characters and yield were analysed with statistical analysis and significance of treatments were tested with the help of 'F' test.

RESULT AND DISCUSSION

Growth parameters

The data regarding growth characters *viz.*, plant height, number of branches, LAI (leaf area index) and dry matter accumulation are depicted in Table 1, Table 2, Table 3 and Table 4, respectively.

Plant height

The maximum plant height of 12.77, 121.13, 193.46 and 201.41 cm were obtained at 30 DAS, 60 DAS, 90 DAS and at maturity respectively, with the application of 50% RDF + FYM @ 2.5 t ha⁻¹ + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₁₀) followed by 75% RDF + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ (T₇) and 50% RDF + vermicompost @ 1.25 t ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₈) (Table 1). However, these three treatments were statistically at par with each other. Treatment T₁₀ (50% RDF + FYM @ 2.5 t ha⁻¹ + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹) significantly superior over 100% RDF (N:P:K:S @ 120:60:40:40 kg ha⁻¹) (T₂) as well as control (T₁). Jaiswal *et al.* (2017) also reported similar results.

Table 1. Plant height of mustard as influenced by different treatments

Treatments		Plant height (cm)			
		30 DAS	60 DAS	90 DAS	At maturity
T ₁	Control	11.28	78.93	125.83	128.65
T ₂	100% RDF (N:P:K:S @ 120:60:40:40 kg ha ⁻¹)	11.46	103.03	164.25	168.55
T ₃	100% RDF + bio-fertilizers (azotobacter + PSB) @ 7.5 kg ha ⁻¹	11.49	106.03	169.10	176.18
T ₄	75% RDF + FYM @ 2.5 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	11.68	107.83	171.93	175.74
T ₅	75% RDF + vermicompost @ 0.62 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	12.14	112.13	178.75	182.71
T ₆	75% RDF + FYM @ 2.5 t ha ⁻¹ + bio-fertilizers @ 7.5 kg ha ⁻¹	12.55	115.83	184.72	189.15
T ₇	75% RDF + vermicompost @ 0.62 t ha ⁻¹ + bio-fertilizers @ 7.5 kg ha ⁻¹	12.57	119.23	190.07	194.28

T ₈	50% RDF + vermicompost @ 1.25 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	12.45	118.23	188.56	192.74
T ₉	50% RDF + FYM @ 5 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	12.07	117.53	187.45	191.60
T ₁₀	50% RDF + FYM @ 2.5 t ha ⁻¹ + vermicompost @ 0.62 t ha ⁻¹ + bio-fertilizers @ 7.5 kg ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	12.77	121.13	193.46	201.41
S.E. (d) ±		1.079	4.605	10.095	13.487
C.D. at 5%		N. S	9.670	21.216	28.346

Number of branches/plant

In case of number of branches/plant, application of 50% RDF + FYM @ 2.5 t ha⁻¹ + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₁₀) recorded highest number of primary branches of 6.64, 7.35 and 7.59 at 60 DAS, 90 DAS and at maturity respectively (Table 2). It was followed by 75% RDF + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ (T₇) and 50% RDF + vermicompost @ 1.25 t ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₈). However, excluding the treatment of control (T₁) and 100% RDF (T₂), all the treatments from T₃ to T₁₀ were statistically at par with each other in terms of number of primary branches. The minimum values of number of primary branches of 4.33, 4.79 and 4.95 at 60 DAS, 90 DAS and at maturity respectively, were found in control.

Similar trend was also observed in case of number of secondary branches/plant and application of 50% RDF + FYM @ 2.5 t ha⁻¹ + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₁₀) recorded highest number of secondary branches of 9.17, 9.31 and 9.37 at 60 DAS, 90 DAS and at maturity respectively, followed by 75% RDF

+ vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ (T₇) and 50% RDF + vermicompost @ 1.25 t ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₈) at maturity stage whereas, at the stage of 60 DAS and 90 DAS, the trend is different and treatment T₇ was followed by 50% RDF + FYM @ 5 t ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₉) in terms of secondary branches.

Similarly to number of primary and secondary branches/plant, the significant role of different sources of nutrient was observed and application of 50% RDF + FYM @ 2.5 t ha⁻¹ + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₁₀) recorded significantly highest number of tertiary branches of 3.14, 3.73 and 3.97 followed by 75% RDF + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ (T₇) and 50% RDF + vermicompost @ 1.25 t ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₈) which were significantly superior over other treatments. This may be due to the better establishment of plants under these treatments compared to other remaining treatments and it might be also due to improvement in nutrient availability for crop use. Mukherjee (2016) and Yadav *et al.* (2018) also reported similar results.

Table 2. Effect of different treatments on number of branches of mustard crop

Treatments	Primary branches			Secondary branches			Tertiary branches			
	60 DAS	90 DAS	At maturity	60 DAS	90 DAS	at maturity	60 DAS	90 DAS	At maturity	
T ₁	Control	4.33	4.79	4.95	5.98	6.01	6.10	2.05	2.43	2.59
T ₂	100% RDF (N:P:K:S @ 120:60:40:40 kg ha ⁻¹)	5.65	6.25	6.46	7.81	7.91	7.97	2.68	3.17	3.38
T ₃	100% RDF + bio-fertilizers (azotobacter + PSB) @ 7.5 kg ha ⁻¹	5.91	6.53	6.75	8.16	8.08	8.34	2.80	3.31	3.53
T ₄	75% RDF + FYM @ 2.5 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	5.92	6.55	6.77	8.18	8.22	8.35	2.81	3.32	3.54
T ₅	75% RDF + vermicompost @ 0.62 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	6.15	6.80	7.03	8.49	8.59	8.68	2.91	3.45	3.68
T ₆	75% RDF + FYM @ 2.5 t ha ⁻¹ + bio-fertilizers @ 7.5 kg ha ⁻¹	6.36	7.03	7.26	8.77	8.86	8.97	3.01	3.56	3.79

T ₇	75% RDF + vermicompost @ 0.62 t ha ⁻¹ + bio-fertilizers @ 7.5 kg ha ⁻¹	6.54	7.24	7.48	9.04	9.15	9.23	3.10	3.67	3.92
T ₈	50% RDF + vermicompost @ 1.25 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	6.49	7.18	7.41	8.76	8.89	9.15	3.07	3.64	3.87
T ₉	50% RDF + FYM @ 5 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	6.45	7.14	7.38	8.91	8.98	9.10	3.05	3.62	3.86
T ₁₀	50% RDF + FYM @ 2.5 t ha ⁻¹ + vermicompost @ 0.62 t ha ⁻¹ + bio-fertilizers @ 7.5 kg ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	6.64	7.35	7.59	9.17	9.31	9.37	3.14	3.73	3.97
S.E. (d) ±		0.464	0.417	0.478	0.818	0.477	0.505	0.286	0.322	0.326
C.D. at 5%		0.974	0.879	0.991	1.719	1.003	1.061	0.601	0.678	0.686

LAI (leaf area index)

At 30 DAS, there was no significant difference in LAI between different treatments. The values of LAI reveals that the different or high doses of nutrient has no significant effect till 30 DAS in mustard crop as the plant in its initial vegetative stage does not show any effect of nutrients. Whereas, the LAI of 2.66 and 4.46 were recorded highest at 60 and 90 DAS respectively, with the application of 50% RDF +

FYM @ 2.5 t ha⁻¹ + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₁₀) (Table 3). It was followed by 75% RDF + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ and 50% RDF + vermicompost @ 1.25 t ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₈). The minimum values of leaf area index were found in control. Bhati and Sharma (2006) also reported similar results.

Table 3. Effect of different treatments on LAI of mustard crop

Treatments		LAI		
		30 DAS	60 DAS	90 DAS
T ₁	Control	0.34	1.97	3.29
T ₂	100% RDF (N:P:K:S @ 120:60:40:40 kg ha ⁻¹)	0.39	2.26	3.79
T ₃	100% RDF + bio-fertilizers (azotobacter + PSB) @ 7.5 kg ha ⁻¹	0.40	2.32	3.88
T ₄	75% RDF + FYM @ 2.5 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	0.41	2.37	3.97
T ₅	75% RDF + vermicompost @ 0.62 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	0.41	2.37	3.95
T ₆	75% RDF + FYM @ 2.5 t ha ⁻¹ + bio-fertilizers @ 7.5 kg ha ⁻¹	0.41	2.37	3.95
T ₇	75% RDF + vermicompost @ 0.62 t ha ⁻¹ + bio-fertilizers @ 7.5 kg ha ⁻¹	0.43	2.49	4.16
T ₈	50% RDF + vermicompost @ 1.25 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	0.42	2.43	4.07
T ₉	50% RDF + FYM @ 5 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	0.41	2.37	3.97
T ₁₀	50% RDF + FYM @ 2.5 t ha ⁻¹ + vermicompost @ 0.62 t ha ⁻¹ + bio-fertilizers @ 7.5 kg ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	0.46	2.66	4.46
S.E. (d) ±		0.026	0.148	0.25
C.D. at 5%		N.S	0.312	0.43

Dry matter accumulation

The highest dry matter accumulation of 2.66, 18.37, 42.96 and 44.23 at 30 DAS, 60 DAS, 90 DAS and at maturity were recorded in treatment of application of 50% RDF + FYM @ 2.5 t ha⁻¹ + vermicompost @

0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₁₀) followed by 75% RDF + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ (T₇) and 50% RDF + vermicompost @ 1.25 t ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₈). The difference

between treatments was significant at the stages of 60 DAS, 90 DAS and at maturity but at 30 DAS, there is no significant difference between treatments. The reason behind more dry matter in integrated nutrient supply may be the proper establishment of crop plants, increased height and larger vegetative growth. These results are in close conformity of Jakhar and Singh (2004), Mandal and Sinha (2004),

Singh *et al.* (2015) and Tomar *et al.* (2017). Rajiv *et al.* (2012) also reported that the sulphur application increased plant height, branches/plant and dry matter/plant significantly over no sulphur application in sesame and it might be because sulphur is involved in photosynthetic process of plant, which has a direct bearing on development and plant growth.

Table 4. Effect of different treatments on dry matter accumulation of mustard

Treatments		Dry matter accumulation			
		30 DAS	60 DAS	90 DAS	At maturity
T ₁	Control	2.35	12.19	27.95	31.58
T ₂	100% RDF (N:P:K:S @ 120:60:40:40 kg ha ⁻¹)	2.39	15.91	36.47	37.01
T ₃	100% RDF + bio-fertilizers (azotobacter + PSB) @ 7.5 kg ha ⁻¹	2.39	16.38	37.55	37.95
T ₄	75% RDF + FYM @ 2.5 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	2.43	16.65	38.18	38.59
T ₅	75% RDF + vermicompost @ 0.62 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	2.53	17.31	39.69	40.12
T ₆	75% RDF + FYM @ 2.5 t ha ⁻¹ + bio-fertilizers @ 7.5 kg ha ⁻¹	2.61	17.89	41.02	41.53
T ₇	75% RDF + vermicompost @ 0.62 t ha ⁻¹ + bio-fertilizers @ 7.5 kg ha ⁻¹	2.62	18.47	42.21	42.66
T ₈	50% RDF + vermicompost @ 1.25 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	2.59	18.26	41.87	42.32
T ₉	50% RDF + FYM @ 5 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	2.51	18.16	41.62	42.07
T ₁₀	50% RDF + FYM @ 2.5 t ha ⁻¹ + vermicompost @ 0.62 t ha ⁻¹ + bio-fertilizers @ 7.5 kg ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	2.66	18.37	42.96	44.23
S.E. (d) ±		0.37	1.050	2.093	2.506
C.D. at 5%		N.S	2.207	4.399	5.266

Grains yield

The grains yield of mustard influenced significantly by different treatment (Table 5). The significantly highest grains yield of 23.25 q ha⁻¹ was produced with the application of 50% RDF + FYM @ 2.5 t ha⁻¹ + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₁₀). It was followed by 75% RDF + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ (T₇) and 50% RDF + vermicompost @ 1.25 t ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₈). The most probable reason for this phenomenon may be taller plant and higher dry matter, more vegetative growth under proper organic and

inorganic nutrient supply (INM). This might had resulted to increase grains yield. These findings are in accordance with the findings of Giri *et al.* (2005), Tripathi *et al.* (2011), Baranwal *et al.* (2017), Singh *et al.* (2018) and Yadav *et al.* (2018). Rajiv (2014) also reported that the application of vermicompost integration with inorganic fertilizers might have improved the availability of nutrients for crop use thus yielded higher to NPK fertilizers treatment. A poor grains yield was produced as a result of reflection of poor fertility as reported by Tomar *et al.* (2016) and Tomar *et al.* (2019) in different crops.

Table 5. Effect of treatments on grains yield of mustard

Treatments		Grains yield (q ha ⁻¹)
T ₁	Control	14.75
T ₂	100% RDF (N:P:K:S @ 120:60:40:40 kg ha ⁻¹)	19.23

T ₃	100% RDF + bio-fertilizers (azotobacter + PSB) @ 7.5 kg ha ⁻¹	19.82
T ₄	75% RDF + FYM @ 2.5 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	20.15
T ₅	75% RDF + vermicompost @ 0.62 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	20.95
T ₆	75% RDF + FYM @ 2.5 t ha ⁻¹ + bio-fertilizers @ 7.5 kg ha ⁻¹	21.65
T ₇	75% RDF + vermicompost @ 0.62 t ha ⁻¹ + bio-fertilizers @ 7.5 kg ha ⁻¹	22.90
T ₈	50% RDF + vermicompost @ 1.25 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	22.10
T ₉	50% RDF + FYM @ 5 t ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	21.97
T ₁₀	50% RDF + FYM @ 2.5 t ha ⁻¹ + vermicompost @ 0.62 t ha ⁻¹ + bio-fertilizers @ 7.5 kg ha ⁻¹ + ZnSO ₄ @ 10 kg ha ⁻¹	23.25
S.E. (d) ±		1.400
C.D. at 5%		2.942

CONCLUSION

On the basis of above findings, it can be concluded that the application of 50% RDF + FYM @ 2.5 t ha⁻¹ + vermicompost @ 0.62 t ha⁻¹ + bio-fertilizers @ 7.5 kg ha⁻¹ + ZnSO₄ @ 10 kg ha⁻¹ (T₁₀) shows the outstanding results in terms of significant growth and development parameters (plant height, number of branches, leaf area index and dry matter accumulation) and grains yield. Therefore, it may be recommended for cultivation of mustard under Upper Gangetic Plains.

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