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Varietal and Fertilization Effects on Growth and Yield of Mustard under Coastal Agroecosystem

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The present experiment was carried out during the winter season of 2018-19 and 2019-20 at Regional Research Station (Coastal Saline Zone) under BCKV, Kakdwip, South 24-Parganas. The objective of the study was to find out the ideal combination of mustard genotype and fertilizer (NPK) levels for the coastal region of West Bengal. The field trial was set up in a split-plot design with four mustard genotypes (TBM 143, TBM 204, Kranti and Pusa Bold) in main plots and four fertilizer levels (Control, 100% RDF, 125% RDF and 150% RDF) in the sub-plots, each replicated thrice. Among the tested genotypes,Kranti and TBM 143 were found to be superior in terms of their growth attributes, yield components, seed yield (1.28 and 1.29 t ha^{-1}, respectively), leaf chlorophyll content and nutrient content. Application of 150% RDF (120 kg of N, 60 kg of P_2O_5, and 60 kg of K_2O ha^{-1}) proved to be effective in producing the highest growth attributes, yield components, seed yield, leaf chlorophyll content and nutrient content, in all the tested genotypes. Nutrient-omission treatment (control plots) caused a serious reduction in growth attributes, yield components and seed yields (83% reduction as compared to 100% RDF) in all the mustard genotypes. In the coastal belt of West Bengal cultivation of both genotypes, Kranti and TBM 143 with 150% RDF are recommended for achieving higher yields.

(***Key words:*** *Leaf chlorophyll content, Phenophases, Productivity, Soil nutrient status, Yield components*)

In West Bengal, mustard is commonly grown under irrigated conditions (Ray *et al.*, 2015) and has gained popularity among the farmers of coastal Bengal in the last two decades. But most of the farmers still grow mustard as a *paira* crop with residual soil moisture in the rice field. As a result, the growth and yield performance of this crop always remains low as compared to the sole crop (Banerjee *et al.*, 2018). In South 24 Parganas district, 6.01 thousand tonnes of mustard seed was produced from 4.38 thousand hectares area during 2020-21, contributing only 0.81% of the state's production (GoWB, 2021). Moreover, the crop grown in this district occupies only 0.74% of the total mustard growing area of West Bengal, and hence, there is huge scope to grow mustard as a sole crop under the rice-fallow system. Out of the 22 mustard growing districts in the state, South 24 Parganas is ranked fourth in terms of crop productivity (1.37 t ha^{-1}) during 2020-21; however, it was a little higher than the state average productivity (1.25 t ha^{-1}) (GoWB, 2021). Despite sustained efforts given by the farmers, the crop productivity in this region remains much lower than the expected level. This could be mainly attributed to the use of age-old genotypes having poor yielding ability and sub-optimal doses of fertilizers without considering the soil fertility.

Genotype and fertilizer level are the key factors that can determine the growth and yield of mustard, across different growing environments (Ray *et al.*, 2016). But the challenge lies with the availability of improved cultivars at the onset of the growing season and the lack of soil-test reports for fixing site-specific optimal fertilizer recommendations. Hence, farmers have no other options but to use locally available poor-yielding cultivars and blanket fertilizer recommendations. Although few studies have already indicated that both factors (variety and fertilizer) are critically required

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for achieving a higher yield of mustard, there is hardly any work done so far in the coastal region. Hence, the present study hypothesized that yield augmentation of the sole mustard crop could be possible under a rice-fallow system with the use of new improved cultivars and customized fertilizer levels in the coastal saline zone of West Bengal.

MATERIALS AND METHODS

Field experiments were conducted during the winter seasons of 2018-19 and 2019-20 at the Regional Research Station (Coastal Saline Zone) under Bidhan Chandra Krishi Viswavidyalaya, Akshaynagar, Kakdwip, South 24-Parganas, West Bengal (situated at 22° 40´ N latitude, 88° 18´ E longitude and 7 m above mean sea level). The objective of the present study was to understand the variation in growth and yield-determining traits of some promising mustard cultivars under varied NPK fertilization practices in coastal Bengal. The experimental soil (0-30 cm layer) was clay in texture with $pH_{1:2.5}$ of 5.95, organic carbon of 0.61%, EC of 1.63 dS m^{-1} (Measured in soil water suspension of 1:10 ratio), available N of 160 kg ha^{-1}, available P_2O_5 of 96.5 kg ha^{-1} and available K_2O of 327.5 kg ha^{-1}. The field trial was arranged in a split-plot design with four mustard genotypes in the main plots and four fertilizer (NPK) levels assigned to the sub-plots, each replicated thrice. The area of each plot was 20 m^2 (5 m × 4 m). In this study, we evaluated 2 BARC-released gamma-mutant genotypes of rapeseed mustard (TBM143 and TBM 204) along with the national (Kranti) and zonal checks (Pusa Bold), while the four levels of NPK-fertilizer were $N_0P_0K_0$ (Control), $N_{80}P_{40}K_{40}$ (Recommended dose of fertilizer/RDF), $N_{100}P_{50}K_{50}$ (125% RDF) and $N_{120}P_{60}K_{60}$ (150% RDF). The salient characteristics of the tested genotypes are presented in Table 1.

Under moist conditions, seeds of all four genotypes were dibbled @ 5 kg ha^{-1} under line sowing at 30 cm × 10 cm spacing. Excess plants in each line were thinned out at 20 days after sowing (DAS) to maintain the optimum plant population. Fertilizer NPK was provided to each cultivar with four pre-determined rates. At each fertilizer level, the half dose of nitrogen along with a full dose of phosphorus and potassium were supplied as basal during final land preparation (just before seed sowing). The remaining half dose of nitrogen was top-dressed at 25 DAS (just after the first weeding). Three irrigations were given at the critical growth stages *i.e.*, at active growth stage (20 DAS), siliqua development stage (40 DAS) and grain filling stage (60 DAS). To protect the crop against the attack of sucking pests (aphids, jassids, thrips, etc.), Confidor (Imidacloprid) 17.8% SL was applied @ 4 mL 10 L^{-1} of water at 45 DAS. Actara (Thiamethoxam) 25 % WG @ 5 g 15 L^{-1} of water was sprayed at 55 DAS to combat the incidence of other sucking pests. Whitefly and leaf miner attack were hindered by two foliar sprays (50 and 70 DAS) of Tarzan (Triazophos) 40% EC @1.5 mL L^{-1} of water.

In each plot, 5 randomly selected plants from destructive sampling (1 m long row) were used to record plant height and number of branches $plant^{-1}$ at harvest.

Table 1. *Salient characteristics of the tested genotypes*

Name of the genotypes	Characteristics	Yield potential (t ha^{-1})	References
TBM 143	Duration 100 days; seed colour yellow: oil content 36%	1.4 - 1.6	Dutta *et al.* (2017)
TBM 204	Duration 110 days; seed colour yellow; oil content 40%	1.6 - 1.8	Dutta *et al.* (2017); Dutta *et al.* (2019)
Kranti (National check)	Duration 110 days; seed colour brown; oil content 38%	1.5 - 1.8	Banerjee *et al.* (2017); Dutta *et al.* (2017)
Pusa Bold (Zonal check)	Duration 107 days; seed colour brown; oil content 40%	1.8 - 2.0	Banerjee *et al.* (2017); Dutta *et al.* (2017)

Days from sowing to 50% flowering were recorded when 50% of plants in each plot had produced flowers. The date of maturity was recorded when 80% of the siliqua in a plot had lost their green colouration. At harvest, again 5 plants from each plot were selected for recording yield components. Data on two measured yield components *viz.*, number of siliqua plant^{-1} and length of siliqua were recorded for each plant and then averaged to get the mean values. After proper sun-drying, seeds were de-shelled, and the other two yield components *viz.*, the number of seeds siliqua^{-1} and 1000-seed weight were recorded. Plants from the demarked net plot area were harvested and tied in bundles for sun-drying. Finally, grains were de-shelled from the siliqua and then dried properly to reduce the moisture content to 14%. Leaf chlorophyll content was determined colorimetrically as per the DMSO (Dimethyl sulphoxide) method as outlined by Shoaf and Lium (1976). Methodologies for the determination of leaf nutrient (NPK) content (%) and soil (initial and post-harvest) nutrient status were followed as mentioned in Ray *et al.* (2018).

Data on various parameters were subjected to analysis of variance (ANOVA) as a split-plot design (Gomez and Gomez, 1984). The significance of difference for sources of variance was tested by error mean square by Fisher Snedecor's 'F' test at a probability level of 0.05. For comparison of 'F' values and computation of critical difference (CD) at a 5% level of significance, Fisher and Yates' tables were followed.

RESULTS AND DISCUSSION

Growth attributes

The tested genotypes exhibited significant growth variation with respect to plant height and number of branches plant^{-1}, irrespective of the fertilizer levels (Table 2). Plant height (173 cm) and number of branches plant^{-1} (4.8) were significantly higher in the case of variety Pusa Bold. While the genotypes TBM 143 and TBM 204 produced short-statured plants with plant height at harvest being 138.3 and 150.5 cm, respectively. The number of branches plant^{-1} was lower in TBM 204 (3.8), as compared to the other genotypes. Improved growth characteristics of Pusa Bold and Kranti were also reported earlier by Dutta *et al.* (2019). As expected, NPK fertilization exerted a significant impact on the growth attributes of all mustard genotypes. Both the plant height (average 180 cm) and the number of branches plant^{-1} (average 5.5) were significantly higher in 150% RDF, accounting for an increase of 15.2% and 29.41%, respectively over that obtained with 100% RDF. This result suggests that, under conditions with the high photosynthetic activity of the sole crop of mustard during the winter season (high light intensity, optimum temperature and absence of water stress), the level of NPK-fertilizer application must also be high (Ray *et al.*, 2016; Banerjee *et al.*, 2017). On the contrary, nutrient-omission treatment (control plots) caused a serious reduction in both plant height (average 121.15 cm) and number of branches plant^{-1} (average 2.5) across all the mustard hybrids. The decrease in plant height and number of branches registered was 22.46% and 41.18%, respectively, compared to the treatment consisting of 100% RDF. Such observation highlights the essentiality of these macro nutrients and probable interactions among them for better growth of mustard hybrids (Ray *et al.*, 2016). Interaction effect (genotype x fertilizer) caused significant variation in plant height and number of branches plant^{-1} at harvest. The genotype Pusa Bold produced taller plants (197 cm) on receiving 150% RDF, and it was statistically at par with the plant height of Kranti (195 cm) obtained with the same fertilizer level (150% RDF). Similarly, Pusa Bold produced the highest number of primary branches plant^{-1} (6 cm) on receiving both 125% RDF and 150% RDF. With a lack of statistical significance, all other tested genotypes also produced a higher number of primary branches plant^{-1} on receiving both 125% RDF and 150% RDF (Table 2).

Phenophases

There was significant variation in tested genotypes with respect to their phenophases (Table 2). The genotype TBM 143 took a much lesser duration to attain 50% flowering (44.5 days) and maturity (81.5 days) compared to the other tested genotypes, while Pusa Bold took the maximum duration to reach 50% flowering (53 days) and maturity (90 days). Early maturity of both the genotypes TBM 143 and TBM 204 was previously reported by Dutta *et al.* (2017). The longer time taken by Pusa Bold to100% flowering and maturity was also reported by Banerjee *et al.* (2017). The effect of NPK fertilization on the phenophases of all the genotypes was non-significant. As shown in Table 2, the interaction effect (genotype x fertilizer) exhibited non-significant variation in phenophases.

Yield attributes and yield

All the measured yield attributes varied significantly among tested genotypes, except the length of siliqua and the number of seeds siliqua^{-1} (Table 2). The variety Kranti produced significantly the highest number of siliqua plant^{-1} (243.5), while 1000-seed weight (4.89 g) was significantly higher in the case of Pusa Bold. Although the length of siliqua (6.08 cm) and the number of seeds siliqua^{-1} (13.5) were higher in the case of TBM 143, it was statistically at par with other tested genotypes. The above results are true irrespective of fertilizer levels. On the other hand, all the above-mentioned yield-attributing traits were significantly influenced by NPK fertilization practices. Application of 150% RDF brought about significant improvement in siliqua number plant^{-1} (202.98), siliqua length (5.87 cm), seeds siliqua^{-1} (13.33) and 1000-seed weight (4.28 g) for all the mustard genotypes, accounting for an increase of 15.17%, 2.09%, 2.31% and 0.47% in these yield attributes, respectively as compared to 100% RDF. On the other hand, nutrient-omission treatment (control) significantly reduced all the above four yield components of the tested genotypes, registering 58.72%, 3.48%, 19.23% and 13.85% respectively less values than 100% RDF. The two yield components namely, siliqua number plant^{-1} and 1000-seed weight were significantly affected by the interaction of genotype x fertilizer. The Kranti genotype produced a higher number of siliqua plant^{-1} (368) due to the application of 150% RDF, while a higher 1000-seed weight (5.75 g) was obtained in Pusa Bold with the same dose (Table 2). But the interaction (genotype x fertilizer) effect failed to exhibit any significant variation in the other two yield attributes, namely, the length of siliqua and number of seeds siliqua^{-1}.

Irrespective of fertilizer levels, the genotype TBM 143 produced the highest seed yield (1.29 t ha^{-1}) and it was statistically at par with the seed yield of Kranti (1.28 t ha^{-1}). Dutta *et al.* (2017) also recorded a higher seed yield of TBM 143 in comparison to Kranti and Pusa Bold in six different locations of West Bengal. Banerjee *et al.* (2017) opined that the number of siliqua on a branch is one of the most important yield-determining factors in rapeseed-mustard, and in the present study, it was also observed that Kranti produced higher seed yield as a result of a higher number of siliqua plant^{-1}. As expected, NPK fertilization caused significant improvement in seed yield and 150% RDF produced higher seed yield (1.77 t ha^{-1}), registering 30.15% more seed yield than in 100% RDF. Ray *et al.* (2015) opined that high NPK rates application in mustard crops can substantially increase the yield. Such an increase in yield is nothing but the cumulative effect of higher yield traits of tested mustard hybrids realized at higher fertilization rates (Banerjee *et al.*, 2017). On the contrary, the average yield of mustard genotypes declined significantly due to lack of nutrients in control plots, registering an 83.09% lower yield than 100% RDF. Ray *et al.* (2016) also recorded a similar trend of results. As shown in Table 2, the interaction (genotype x fertilizer) effect caused significant variation in seed yield. The genotype Kranti produced the highest seed yield (1.85 t ha^{-1}) at 150% RDF and it was statistically at par with the seed yield of TBM 143 at the same dose (1.84 t ha^{-1}) of fertilizer.

Leaf chlorophyll and nutrient content

Chlorophyll ‘a’ as well as total chlorophyll content was found to be significantly higher in leaves of Kranti (53.61 and 76.82 mg 100 g^{-1}, respectively), irrespective of the fertilizer levels. However, it was statistically at par with the corresponding values recorded in TBM 143 (51.81 and 76.42 mg 100 g^{-1}, respectively), (Table 3). It indicated less contribution of leaf area in sink development, which might be compensated by high chlorophyll content in this variety (Banerjee *et al.*, 2019). On the other hand, Chlorophyll ‘b’ content was significantly higher in leaves of TBM 143 (25.65 mg 100 g^{-1}). There was a significant improvement in total chlorophyll content as well as chlorophyll ‘a’ and ‘b’ contents due to NPK fertilizer application over the control (-NPK). Application of 150% RDF resulted in maximum leaf chlorophyll contents (51.5, 25.75 and 75.9 mg 100 g^{-1} for chlorophyll ‘a’, ‘b’ and total, respectively) in all the tested genotypes. Kong *et al.* (2017) opined that higher N rates can lead to significant changes in the content of chlorophyll in plants. At lower NPK rates, the decrease in leaf chlorophyll content could be the result of poor assimilation of nutrients especially nitrogen (Ahmad *et al.*, 2022). Interaction effect (genotype x fertilizer) influenced total leaf chlorophyll content as well as chlorophyll ‘a’ and ‘b’

Table 2. *Growth indicators, phenophases, yield components and yield of mustard as influenced by genotype and fertilizer (pooled data over 2 years)*

Variety	Fertilizer	Plant height at harvest (cm)	Primary branch count $plant^{-1}$	Days to 50% flowering	Days to maturity	Siliqua count $plant^{-1}$	Length of siliqua (cm)	No. of seeds $siliqua^{-1}$	1000 seed weight (g)	Seed yield ($t\ ha^{-1}$)
TBM 143	Control (Without NPK)	111	4	45	82	81	5.83	11	4.17	0.34
	100% RDF	139	4	45	81	157	5.97	13	4.66	1.29
	125% RDF	149	5	44	82	262	6.17	14	4.94	1.69
	150% RDF	154	5	44	81	283	6.33	16	5.03	1.84
	Mean	138.3	4.5	44.5	81.5	195.8	6.08	13.5	4.7	1.29
TBM 204	Control (Without NPK)	119	2	48	89	51	5.87	11	3.68	0.29
	100% RDF	146	4	48	90	210	5.97	12	4.22	1.36
	125% RDF	163	4	47	90	229	6.08	14	4.27	1.46
	150% RDF	174	5	48	90	251	6.33	15	4.29	1.64
	Mean	150.5	3.8	47.8	89.8	185.3	6.06	13	4.12	1.19
Kranti	Control (Without NPK)	100	1	51	87	43	5.17	10	2.97	0.15
	100% RDF	175	5	51	87	209	5.17	14	3.37	1.51
	125% RDF	177	5	52	87	354	5.53	15	3.59	1.59
	150% RDF	195	6	49	87	368	6.03	15	3.61	1.85
	Mean	161.8	4.3	50.8	87	243.5	5.48	13.5	3.39	1.28
Pusa Bold	Control (Without NPK)	155	3	51	90	116	5.33	10	3.85	0.13
	100% RDF	165	4	55	89	129	5.90	13	4.77	1.29
	125% RDF	175	6	52	90	225	5.93	15	5.18	1.61
	150% RDF	197	6	54	91	279	6.27	15	5.75	1.75
	Mean	173.0	4.8	53	90	187.3	5.86	13.3	4.89	1.19
Variety (V)	SEm±	0.57	0.13	0.46	0.20	4.84	0.21	0.43	0.05	0.019
	CD (P=0.05)	2.03	0.45	1.63	0.71	17.07	NS	NS	0.18	0.065
Fertilizer (F)	SEm±	1.25	0.19	0.50	0.19	5.67	0.12	0.39	0.06	0.021
	CD (P=0.05)	3.67	0.56	NS	NS	16.65	0.37	1.14	0.16	0.043
V × F	SEm±	2.21	0.25	0.99	0.38	9.68	0.41	0.86	0.10	0.045
	CD (P=0.05)	6.67	1.51	NS	NS	34.62	NS	NS	0.33	0.099
F × V	SEm±	1.15	0.35	0.92	0.40	10.95	0.30	0.80	0.10	0.049
	CD (P=0.05)	7.44	1.07	NS	NS	33.42	NS	NS	0.33	0.098

RDF, Recommended dose of fertilizer *i.e.*, 80 kg N, 40 kg P_2O_5 and 40 kg K_2O ha^{-1}; NS, non-significant contents. Application of 150% RDF resulted in higher chlorophyll 'a' content (60.12 mg 100 g^{-1}) in leaves of the Kranti genotype, and it was statistically at par with chlorophyll 'a'content in leaves of TBM 143 at the same dose of fertilizer application (59.85 mg 100 g^{-1}). However, greater improvement in chlorophyll 'b' (37.87 mg 100 g^{-1}) and total chlorophyll contents (95.23 mg 100 g^{-1}) in leaves of TBM 143 were observed with the application of 150% RDF (Table 3). In a study, the chlorophyll content of leaves was found to be higher in nitrogen treatments than in no-nitrogen treatments (Wang *et al.*, 2021). They opined that chlorophyll is very much associated with nitrogen levels and determines the final yield of a specific variety of a crop. The increase of nitrogen application can increase the chlorophyll content of crops, and then increase the photosynthetic rate of plants, ultimately resulting into higher seed yield.

Irrespective of fertilizer levels, the leaf N and K content varied significantly among tested genotypes, while the variation in leaf P content was non-significant (Table 3). TBM 204 exhibited the highest leaf N content (3.75%) and it was statistically at par with the leaf N content of TBM 143 (3.60%). On the other hand, the leaf K content was higher in TBM 143 and it was statistically par with leaf K contents of Kranti (1%) and Pusa Bold (1.04%). Leaf nutrient concentrations (%), particularly N and K contents were found to be significantly influenced by NPK fertilization, while the effect of NPK fertilization on leaf P content was non-significant. Plants with zero NPK (control) recorded the lowest leaf N (2.53%), P (0.79%) and K (0.87%) content, registering a decrease in the nutrient contents by 11.54%, 9.19%, and 13.86%, respectively than in 100% RDF. As shown in Table 3, the interaction (genotype x fertilizer) effect was significant for leaf N and K content but non-significant for leaf P content. The N (4.13%) and K content (1.15%) were found maximum in the leaves of the TBM 204 variety when fertilized with 150% RDF. However, it had a non-significant difference with N and K contents in the leaves of other tested genotypes upon 150% RDF application.

Available nutrient status of post-harvest soil

Available N (96.6 kg ha^{-1}) and K status (138.8 kg ha^{-1}) of post-harvest soil was significantly higher in plots occupied by the genotype Pusa Bold (Table 3). Whereas the available P content of post-harvest soil (55.6 kg ha^{-1}) was more in plots engaged with the genotype Kranti, it was not significantly different from the available P content in plots of TBM 204 (50.8 kg ha^{-1}) and Pusa Bold (51.3 kg ha^{-1}). This clearly indicates that better utilization of nutrients by any cultivar resulted in lesser amount of residue in soil (Ray *et al.*, 2020). Application of varied levels of NPK fertilizer resulted in significant variation in the available nutrient (NPK) status of post-harvest soils. The higher available NPK contents (106.28, 60.73 and 144.25 kg ha^{-1}, respectively) were found in plots that received 150% RDF, accounting for an increase of 22.16%, 35.71%, and 22.24%, respectively over that of 100% RDF. Plots receiving zero NPK fertilizer (control plots) revealed lower nutrient (83.55, 43.23 and 111.68 kg ha^{-1} for N, P and K respectively) status in post-harvest soil, which was 3.97%, 3.40%, and 5.36% less than in 100% RDF, respectively. At higher NPK application rates, a combination of nutrient mineralization and excess fertilizer NPK during the cropping season might have resulted in an increase in soil-test NPK levels. This results corroborates with that of Ray *et al.* (2020), who also recorded higher available soil NPK content in the post-harvest soil with NPK fertilization up to 150% RDF, while poor NPK status was recorded in post-harvest soil of control plots (zero NPK). The interaction effect of genotype x fertilizer also results in significant differences in available N, P and K status of post-harvest soil (Table 3). The highest amount of available N (110.9 kg ha^{-1}), P (63.5 kg ha^{-1}) and K (171.1 kg ha^{-1}) were obtained in plots when TBM 204, Kranti and Pusa Bold were fertilized with 150% RDF, respectively.

Among the genotypes, Kranti was superior with the highest number of siliqua $plant^{-1}$ and length of siliqua. The genotype Pusa Bold exhibited higher plant height, number of branches $plant^{-1}$, growth duration, 1000-seed weight, available N and K status of post-harvest soil. The genotype TBM 143 produced shorter plants with less time and higher length of siliqua, number of seeds $siliqua^{-1}$, leaf chlorophyll 'b' content and leaf K content. On the other hand, treatment consisting of 150% RDF brought about significant improvement in growth attributes, yield components, chlorophyll 'a', chlorophyll 'b', total chlorophyll content, leaf N and K content of all the genotypes, as well as available NPK content in post-harvest soil. Significant interaction effect showed that Kranti and TBM 143 produced statistically at par seed yields (1.85 and 1.84 t ha^{-1} respectively) with

Table 3. *Leaf chlorophyll and nutrient content of mustard leaf as well as available nutrient status of post-harvest soil as affected by genotype and fertilizer (pooled data over 2 years)*

Variety	Fertilizer	Chlorophyll content (mg 100 g^{-1})			Nutrient content (%)			Available nutrients in the soil (kg ha^{-1})		
		Chlorophyll 'a'	Chlorophyll 'b'	Total	N	P	K	N	P	K
TBM 143	Control (Without NPK)	35.73	18.38	53.38	3.33	0.83	0.99	81.6	41.3	107.3
	100% RDF	53.06	19.40	71.43	3.36	0.83	1.07	89.3	41.5	117.2
	125% RDF	58.58	26.96	85.63	3.82	0.84	1.07	101.6	46.2	129.8
	150% RDF	59.85	37.87	95.23	3.90	0.90	1.09	106.3	55.3	134.2
	Mean	51.81	25.65	76.42	3.60	0.85	1.06	94.7	46.1	122.1
TBM 204	Control (Without NPK)	17.78	19.22	36.58	3.50	0.82	0.56	80.1	40.5	117.7
	100% RDF	26.12	13.44	39.03	3.64	0.83	0.97	83.2	44.0	119.4
	125% RDF	33.45	14.30	47.10	3.72	0.86	1.08	92.4	57.7	129.8
	150% RDF	36.42	17.63	53.32	4.13	0.88	1.15	110.9	61.1	139.7
	Mean	28.44	16.15	44.01	3.75	0.85	0.94	91.65	50.8	126.7
Kranti	Control (Without NPK)	47.96	21.34	68.35	0.99	0.74	0.96	80.1	48.6	98.5
	100% RDF	52.16	24.58	75.70	1.38	0.79	0.97	81.6	49.2	106.7
	125% RDF	54.18	25.09	78.20	1.55	0.79	0.97	89.3	61.2	115.5
	150% RDF	60.12	26.10	85.03	3.76	0.83	1.11	106.3	63.5	132.0
	Mean	53.61	24.28	76.82	1.92	0.79	1.00	89.3	55.6	113.2
Pusa Bold	Control (Without NPK)	32.47	15.99	47.81	2.30	0.78	0.96	92.4	42.5	123.2
	100% RDF	40.97	16.42	59.14	3.05	0.81	1.03	93.9	44.3	128.7
	125% RDF	48.44	18.99	63.93	3.58	0.82	1.04	98.6	55.4	132.0
	150% RDF	49.61	21.39	70.02	3.86	0.83	1.13	101.6	63.0	171.1
	Mean	42.87	18.19	60.23	3.19	0.81	1.04	96.6	51.3	138.8
Variety (V)	SEm±	0.58	0.31	0.66	0.05	0.02	0.02	0.36	1.41	1.23
	CD (P=0.05)	2.00	1.09	2.29	0.18	NS	0.08	1.24	4.87	4.27
Fertilizer (F)	SEm±	0.83	0.62	1.06	0.09	0.02	0.03	1.27	1.64	0.96
	CD (P=0.05)	2.44	1.81	3.10	0.26	NS	0.09	3.72	4.80	2.79
V × F	SEm±	1.67	1.24	2.12	0.18	0.04	0.06	2.55	3.29	1.91
	CD (P=0.05)	4.87	3.62	6.20	0.51	NS	0.17	7.43	9.60	5.59
F × V	SEm±	1.56	1.12	1.95	0.16	0.04	0.06	2.23	3.18	2.07
	CD (P=0.05)	4.66	3.31	5.83	0.48	NS	0.17	6.55	9.61	6.43

RDF, Recommended dose of fertilizer *i.e.*, 80 kg N, 40 kg P_2O_5 and 40 kg K_2O ha^{-1}; NS, non-significant the application of 150% RDF.

Conclusively, both Kranti and TBM 143 may be recommended for cultivation with the application of 150% RDF (120 kg N, 60 kg P_2O_5 and 60 kg K_2O ha^{-1}) in the coastal belt of West Bengal for obtaining higher productivity in sole mustard cropping. Our results revealed that cultivation of suitable variety through site-specific macro-nutrient management is the key to increasing crop productivity, besides maintaining the soil fertility.

CONFLICTS OF INTEREST

There exist no conflicts of interest among the authors.

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