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Utilization of nutrients by mustard (*Brassica juncea* L) genotypes as affected by plant spacing

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ABSTRACT

A field experiment was conducted during winter seasons of 2017-18 and 2018-19 at the Private Research Farm, Benda-Semaria Road, Rewa (M.P.) to study the effect of plant spacings yield and uptake of nutrients by mustard genotypes. The treatments comprising of five genotypes and four spacings were evaluated in factorial randomized block design with three replication. The genotype JTC-1(Karan Rai) recorded highest N, P, K and S contents in seed and straw, followed by Pusa Tarak, Swarn Jyoti and then Pusa Jai Kisan. Swarn Jyoti producing total biomass of 41.72 q ha^{-1} utilized the maximum amount of nutrients (48.0 kg N, 13.3 kg P, 51.1 kg K and 19.5 kg S ha^{-1}. Amongst the plant spacings, 60 x 15 cm recorded almost significantly higher N, P, K and S contents in seed and straw. But the closest spacing (30 x 15 cm) producing total biomass of 40.22 q ha^{-1} has drawn the maximum amount of nutrients (45.9 kg N, 12.7 kg P, 49.3 kg K and 18.5 kg S ha^{-1}) from the soil. The best treatment combinations (Swarn Jyoti or JTC-1 with 30 x 15 cm plant spacing) further augmented the uptake of these nutrients. The findings suggest that due to increased withdrawal of nutrients by mustard genotypes as a result of improved production technology, the sowing of succeeding crop must be nourished properly based on soil test values.

Keywords: Nutrient, uptake, quality, plant spacing, mustard genotypes

INTRODUCTION

Mustard (*Brassica juncea* L.) is an important oil seed winter season crop of north India. The average productivity of rapeseed and mustard in Madhya Pradesh is below satisfaction which can be raised by growing high yielding genotypes. The adoption of high-yielding mustard genotypes resulted in heavy withdrawal of nutrients from the soil. Genotypic variations exist in sensitivity to plant spacing. Differential response of cultivars to spacing in generally controlled and is a heritable character. The recently available high-yielding mustard genotypes are being grown in different soil types having variable in their soil fertility and productivity. The response of a certain mustard genotype towards the optimum special arrangement is highly inconsistent, location and even site specific (Patel *et al.* 2012, Sondhiya *et al.* 2019). Limited work has been done in Rewa region on the response of newly developed mustard genotypes towards the optimum plant spacings. In view of this fact, the present research was taken up to study the effect of spacing on mustard genotypes in Rewa region of M.P.

MATERIALS AND METHODS

The field experiment was conducted at the Private Agriculture-Research Farm, Benda-Semaria Road, Rewa (M.P.) during 2017-18 and 2018-19. The soil of the experimental field was silty-clay-loam having pH 7.5, electrical conductivity 0.32 dS/m, organic carbon 8.6 g kg^{-1} %, available N, P_2O_5 and K_2O 230,13.8 and 372 kg ha^{-1}, respectively. The rainfall received during the rainy season was 772 mm. The treatments comprised five genotypes (Pusa Tarak, Swarn Jyoti, Pusa Jai Kisan, Pusa Agrani and JTC-1) and four plant spacings (30 x 15, 40 x 15, 50 x 15 and 60 x 15 cm). Thus, the twenty treatment combinations were laid out in the field in a factorial randomized block design keeping three replications. The mustard genotypes were sown on 25 and 15 November in 2017 and 2018, respectively @ 6 kg ha^{-1} in rows 30 cm. The sulphur WAS applied as basal through elemental sulphur. The common dose of 40 kg N, 30 kg P_2O_5 and 20 kg K_2O /ha was applied in all the treatments. The crop was raised as per recommended package of practices. The genotypes were harvested on 9 April, 2018 and 29 March, 2019. The N, P, K and S contents in seed and straw were analysed by adopting

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standard analytical procedures (Jackson, 1973). The nutrients uptake per hectare was calculated by multiplying the seed or straw yield with the per cent nutrient content in seed or straw.

RESULTS AND DISCUSSION

Nutrient contents in seed and straw

The data (Table 1) reveal that the N, P and S nutrient concentrations were, in general, higher in grain than in straw. In case of K content, it was higher in straw than in grain. The higher nutrient contents in grain than in straw may be due to the fact that seeds acted as a sink for photosynthates and nitrogen i.e. diverted more nutrients from vegetative parts towards the reproductive organs (sink). These results agree with those of other workers (Pandya *et al.*, 2005 and Singh*et al.*, 2015) Amongst the mustard genotypes, the N,P,K and S contents in seed and straw were higher in JTC-1 over other genotypes. The second best genotype was Pusa Tarak. This was followed by Swarn Jyoti and then Pusa Jai Kisan. The significantly lowest N, P, K and S contents were observed in Pusa Agrani genotype of mustard. The genotypic differences in nutrients concentrations might be owing to the differences in the absorption pattern of these nutrients which is deeply associated with the plant's root-shoot growth. The differences in the root-shoot growth and development among these genotypes are but natural because of the genetic variability inherited in them. Thus, the overall improvement in N, P, K and S concentration in seed and straw under the influence of genetic build up of genotypes could be due to stimulation of root growth, enhanced nutrients absorption, increased metabolic activities and chlorophyll content of leaves. These present findings are in consonance with those of Pandya *et al.* (2005), Singh *et al.* (2015) and Choudhary and Bhogal (2017).

Table 1**:** Nutrient content and yield of mustard genotypes as influenced by plant spacings(Pooled for 2 years)

Treatments	N-content (%)		P-content (%)		K-content (%)		S-content (%)		Seed yield (q ha^{-1})	Straw yield (q ha^{-1})	Total biomass (q ha^{-1})
	Seed	Straw	Seed	Straw	Seed	Straw	Seed	Straw			
Genotypes											
Pusa Tarak	2.28	0.50	0.48	0.25	0.87	1.47	0.75	0.33	12.25	20.93	33.18
Swarn Jyoti	2.26	0.48	0.45	0.24	0.86	1.45	0.71	0.32	15.75	25.97	41.72
Pusa Jai Kisan	2.23	0.46	0.42	0.23	0.85	1.43	0.67	0.30	13.05	22.45	35.50
Pusa Agrani	2.21	0.44	0.39	0.22	0.83	1.41	0.63	0.29	10.10	19.30	29.40
JTC-1(Karan Rai)	2.33	0.53	0.51	0.26	0.88	1.49	0.79	0.34	14.46	23.75	38.21
CD (P=0.05)	0.032	0.001	0.003	0.0007	0.0045	0.007	0.007	0.0053	0.04	0.07	0.11
Plant spacings (cm)											
30 x 15	2.25	0.47	0.44	0..23	0.85	1.44	0.69	0.31	15.02	25.20	40.22
40 x 15	2.26	0.48	0.45	0.24	0.86	1.45	0.70	0.32	13.64	23.59	37.23
50 x 15	2.26	0.48	0.45	0.24	0.86	1.45	0.71	0.32	12.50	21.61	34.11
60 x 15	2.27	0.49	0.46	0.24	0.86	1.46	0.72	0.32	11.32	19.49	30.81
CD (P=0.05)	0.028	0.0009	0.002	0.0007	0.0041	0.006	0.006	0.0048	0.03	0.06	0.09

The increasing spacing between plants from 30 x 15 cm to 60 x 15 cm increased the N, P, K and S nutrient contents almost significantly both in seed as well in straw. Thus, the significant differences persisted amongst the closer and wider spacings. This might be due to the fact that the increased spacing between plants provided enhanced space, sun-light, nutrients and soil moisture for increased photosynthesis, growth and development. In fact, the increase in N, P, K and S contents in seed and straw due to wider spacing between plants may be on account of increase in these nutrients in various parts of the plant at different stages of growth. The present results corroborate with the findings of Pandya*et al.* (2005) and Singh *et al.* (2015).

Nutrients uptake

The data (Table 2) indicated that the uptake of N, P, K and S by the whole plants (seed + straw) was found highest in genotypes Swarn Jyoti and JTC-1. The total N, P, K and S uptake was 46.41-48.06, 13.36-13.80, 48.26-51.19 and 19.55-19.78 kg ha^{-1}, respectively. Thiswas followed by Pusa Jai Kisan and Pusa Tarak genotypes and then the lowest in case of PusaAgrani genotype of mustard. The higher uptake of these nutrients in Swarn Jyoti and then JTC-1

Table 2: Nutrients uptake (kg ha^{-1}) by mustard genotypes as influenced by plant spacings (Pooled for 2 years)

Treatments	Nitrogen			Phosphorus			Potassium			Sulphur		
	Seed	Straw	Total	Seed	Straw	Total	Seed	Straw	Total	Seed	Straw	Total
Genotypes												
Pusa Tarak	27.9	10.5	38.5	5.9	5.2	11.1	10.6	30.7	41.4	9.2	7.0	16.2
Swarn Jyoti	35.5	12.4	48.0	7.1	6.2	13.3	13.5	37.6	51.1	11.1	8.3	19.5
Pusa Jai Kisan	29.1	10.4	39.5	5.5	5.2	10.7	11.0	32.1	43.2	8.7	6.9	15.6
Pusa Agrani	22.2	8.6	30.9	4.0	4.2	8.3	8.4	27.3	35.8	6.3	5.6	12.0
JTC-1 (Karan Rai)	33.7	12.6	46.4	7.4	6.3	13.8	12.8	35.4	48.2	11.5	8.2	19.7
CD (P=0.05)	0.24	0.14	0.38	0.043	0.062	0.105	0.072	0.19	0.91	0.104	0.086	0.190
Plant spacings (cm)												
30 x 15	33.9	12.0	45.9	6.7	6.0	12.7	12.9	36.4	49.3	10.5	8.0	18.5
40 x 15	30.8	11.4	42.3	6.2	5.7	11.9	11.7	34.2	45.9	9.7	7.5	17.2
50 x 15	28.4	10.6	39.0	5.7	5.3	11.0	10.8	31.4	42.2	9.0	7.0	16.0
60 x 15	25.8	9.6	35.4	5.3	4.8	10.1	9.8	28.4	38.3	8.3	6.3	14.6
CD (P=0.05)	0.21	0.12	0.33	0.09	0.056	0.095	0.065	0.17	0.82	0.093	0.077	0.170

might be owing to higher grain and straw yield as well as higher nutrient contents in these genotypes as compared to others. The present findings are in accordance with those of Singh *et al.* (2015).The closest (30 x 15 cm) plant spacing enhanced the N, P, K and S uptake by seed and straw. At the closest spacing, the total biomass (seed + straw) produced was 40.22 q ha^{-1} which removed highest 45.99 kg N, 12.76 kg P, 49.39 kg K and 18.56 kg S/ha. The best treatment combination was Swarn Jyoti or JTC-1 grown with 30 x 15 cm spacing which produced maximum grain (16.88 to 18.56 q ha^{-1}) + straw (26.18 to 29.35 q ha^{-1}) and removed total N (40.48 kg ha^{-1} by seed + 13.80 kg ha^{-1} by straw), total P (8.32kg by seed and 6.90 kg by straw), total K (15.41 kg by seed +40.66 kg by straw) and total S (13.04 kg by seed + 9.11 kg ha^{-1} by straw).The higher uptake of these nutrients under different plant spacing may be due to increased seed and straw yields and increased N, P, K and S contents in seed and straw of mustard. The present results corroborate with the findings of several workers Pandya *et al.*, (2005) and Singh *et al.*, (2015).

Yield

The data (Table 1) showed that the Swarn Jyoti cultivar of mustard produced the maximum seed (15.75q ha^{-1}), straw (25.97q ha^{-1}) and biomass (41.72q ha^{-1}) followed by JTC-1 genotype of mustard. The lowest yields were recorded in Pusa Agrani genotype of mustard. The differential responses of various cultivars of mustard have also been reported by Choudhary and Bhogal (2017). The spacing of 30x15 cm proved superior to other spacing in respect of seed (15.02q ha^{-1}), straw (25.20q ha^{-1}) and biomass (40.22q ha^{-1}) yields. The lowest yields of mustard genotypes were recorded in 60x15 cm spacing. Similar results were also reported by Singh *et al.* (2015).

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