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Effect of foliar application of water soluble fertilizer on growth, yield and quality of Indian mustard (*Brassica juncea* L. Czern and Coss)

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A B S T R A C T

A field experiment was conducted during *Rabi* season of 2019-20 at Main Oilseeds Research Station, Junagadh Agricultural University, Junagadh, India to study the effect of foliar application of water-soluble fertilizer on growth, yield and quality of mustard (*Brassica juncea* L. Czern and Coss). The experiment was laid out in Randomized Block Design with three replications and comprised of 10 treatments. Different concentrations of water-soluble fertilizers in different combinations along with the recommended dose of fertilizers (RDF) were applied through foliar nutrition to the crop. Among the treatments, application of water soluble fertilizer i.e. 75 % RDF(37.5:37.5:15 kg N:P2O5:S/ha)+ foliar spray of 19:19:19 @ 2% at 30, 45 and 60 DAS was recorded significantly higher values of growth parameters *viz*., plant height and number of branches/plant and yield attributes *viz*., number of siliquae/plant, number of seeds/siliquae, length of siliqua and yield *viz*., seed yield (2616 kg/ha) and stover yield (5228 kg/ha); quality parameters *viz*., oil content, oil yield and protein content. However, it remained at par with 75 % RDF (37.5:37.5:15 kg N:P2O5:S/ha) + foliar spray of 19:19:19 @ 2% at 30 and 45 DAS and 75 % RDF (37.5:37.5:15 kg N:P2O5:S/ha) + foliar spray of 19:19:19 @ 1% at 30, 45 and 60 DAS. The control (no fertilizer) were recorded significantly lowest plant height, siliqua per plant, seed per siliqua, test weight, seed yield, stover yield.

Introduction

Mustard crop occupied 36.54 million hectares area, 72.80 million metric tonnes production with the productivity of 1990 kg/ha in the world during the year 2018-2019 (USDA, 2019). In India, Rajasthan, Uttar Pradesh, Madhya Pradesh, Haryana and Gujarat are the highest sown states accounting for about more than 70 per cent of total mustard acreage in the country. Area production and productivity of mustard in India accounted for about 7.20 million hectares, 8.00 million metric tons, 1110 kg/ha, respectively in the year 2018- 2019 (USDA, 2019). Among all these species Indian mustard (*Brassica juncea*) predominates in the country accounting for more than 70 % of the area and production of oilseed *Brassicas.* Amongst the agronomic factors known to augment crop production, fertilizer stands first and is considered as one of the most productive inputs in agriculture. Of the major elements, various

losses in form of volatilization, leaching and fixation However, the wastage of nutrients can be reduced by foliar applications of dilute solutions of nutrients to supplement the basal applications. Furthermore, foliar fertilization is theoretically more environmental friendly, immediate and target-oriented than the soil fertilization as the nutrients can be directly delivered to the plant tissues during critical stages of plant growth. Foliar application is highly efficient in terms of absorption as nutrients are not subjected to various losses that occur with soil application. Nutrients applied through foliage play a pivotal role in increasing the seed yield in pulses and oilseeds (Chandrasekhar and Bangarusamy, 2003).

Supplemental foliar nutrition of major and micronutrients is more advantageous than soil application due to better translocation from the leaves to the developing seeds and efficient utilization of nutrients (Manonmani and Srimathi, 2009). Recently, new generation fertilizers in the form of specialty fertilizers have been introduced exclusively for foliar feeding. Poly feed nutrient 19:19:19 fertilizer is a hundred per cent water soluble complete fertilizer containing nitrogen in three forms of namely, NO3-N (45.0%), NH4-N (4.5%) and NH2-N (10.5%) including water soluble phosphorus and potassium each containing 19 per cent with low salt index.

Therefore, it causes rapid and healthy crop growth and alleviates nutrients deficiencies quickly. It increases resistance against pest and diseases by keeping plants healthy, ultimately causing reduced use of pesticides and fungicides and uniform flowering with their reduced droppings resulting in higher crop yield. Foliar feeding is an effective method for correcting nutrients deficiencies and overcoming the soil's inability to transfer nutrients to the crop plant. Hence, the present study was conducted to with the objective to evaluate the effect of application of water soluble nutrients through foliar sprays along with soil application is able to supplement the nutritional requirements, yield and quality of crops.

Materials and Methods

A field experiment was carried out at Main Oilseeds Research station, JAU, Junagadh, Gujarat, India during *Rabi* season of 2019-20 to examine the "Effect of foliar application of water soluble fertilizer on growth, yield and quality of mustard (*Brassica juncea* L. Czern and Coss)". The experimental site was located at south Saurashtra agro-climatic region of Gujarat state with the 21.50 N latitude and 70.50 E longitude and altitude of 60 m above the mean sea level. The initial soil pH was 8.08 with electrical conductivity 0.40 dSm-1 and an organic carbon content of 3.60 g kg-1 while the available N, P and K contents were 116.4, 24.2 and 164.0 kg/ha, respectively. The experiment was laid out in randomized block design with 10 treatments. Each treatment was replicated 3 times. The treatments details T1- Control (No fertilizer), T2- 100 % RDF (50-50-20 kg N-P2O5-S/ha), T3- 50 % of RDF + 1.0 % WSF at 30 and 45 DAS, T4- 50 % of RDF + 2.0 % WSF at 30 and 45 DAS, T5- 50 % of RDF + 1.0 % WSF at 30, 45 and 60 DAS, T6- 50 % of RDF + 2.0 % WSF at 30, 45 and 60 DAS, T7- 75 % RDF + 1.0 % WSF at 30 and 45 DAS, T8- 75 % RDF + 2.0 % WSF at 30 and 45 DAS, T9- 75 % RDF + 1.0 % WSF at 30, 45 and 60 DAS and T10- 75 % RDF + 2.0 % WSF at 30, 45 and 60 DAS. The mustard variety GDM 4 was sown on 18th November, 2019 using a seed rate of 4 kg ha-1 at a row spacing of 45cm x 15cm. The recommended fertilizer dose of 50-50-20 N-P2O5-S kg/ha was applied. Full dose of P2O5, S and half N were applied as basal at planting and half dose of N was top-dressed at 40 days after planting of the crop in the form of urea, dia-ammonium phosphate and bentonite sulphur pellet fertilizers, respectively. Water Soluble Fertilizer (WSF) were applied in form of 19:19:19 (N: P2O5: K2O) as foliar application. Foliar spray was done with Knapsack sprayer using Flat Fan nozzle with 500 Littre of water ha-1. The crop was harvested manually at physiological maturity stage as per treatments. Growth, yield attributes, seed yield, quality parameter and available nutrient uptake were workout as per standard statistical procedure and

using formulae. Gross and net returns were calculated based on the seed and straw yield and prevailing market prices of mustard. The benefit: cost ratio was calculated by dividing the net returns from the total cost of cultivation.

Results and Discussion

Growth and development characters

The results revealed that the different treatments had significant influence on growth parameters *viz*., plant height at 45, 75 DAS and at harvest (Table 1), number of branches per plant at harvest (primary and secondary branches). While all the treatments had equal effect on days to 50% flowering and days to maturity. Application of 75% of RDF + 2.0% water soluble fertilizer at 30, 45 and 60 DAS (T10) recorded significantly higher plant height at 45, 75 DAS and at harvest, but it was remained at par with treatments of T8, T9, T2 and T7. Minimum was recorded under treatment (control). It might be due to foliar spray increase absorption of nutrient solution which might have accelerated photosynthetic rate, thereby increasing the supply of carbohydrates, resulted in increased cell division and elongation leading to increased plant height. These results broadly corroborate the findings of (Siddiqui *et al.,* 2008). These nutrients play vital role as a component of many metabolically important compounds (Marschner, 2002) which would involve directly or indirectly in cell division, cell enlargement and tissue and organ formation resulting in improvement in values for growth parameters.

Yield attributing characters and yield

Foliar feeding of water soluble fertilizers along with recommended dose of fertilizer increased yield attributing characters and yields (Table 1 and 2). The total number of siliquae per plant, length of silique and number of seeds per siliquae significantly higher were observed with the application of 75% RDF + 2.0% WSF at 30, 45 and 60 DAS (T10). It was at par with treatments of T8 and T9. It might be due to foliar spray of which increase nutrient uptake, which might be enhance photosynthetic rate, thereby increasing the supply of carbohydrates, resulted in increased cell division, multiplication and elongation leading to increased siliqua per plant, seed per siliqua, test weight, seed yield, stover yield. Foliar application of fertilizers in many crops has been reported effective with respect to growth, yield, quality and shelf life. (Dutta *et al.*, 2000; Peyvasi *et al.,* 2009). Seed yield and Stover yield of mustard significantly increased with the application of water- soluble fertilizers (Table 2). Significantly higher seed yield (2616 kg/ha) and stover yield (5228 kg/ha) were found with application of 75% RDF + 2.0% WSF at 30, 45 and 60 DAS (T10), it was found statistically at par with the treatments T8 (75% RDF + 2.0% WSF at 30 and 45 DAS), T9 (75% RDF + 1.0% WSF at 30, 45 and 60 DAS) and T2 (100% RDF 50-50-00 kg N-P2O5-K2O/ha). The magnitude of increased in seed yield and stover yield under treatments of T10 to the tune of 30.34 and 28.39 per cent over control, respectively. However, significantly lower seed yield was observed in T1 (Control). The increase in yield was due to the additional supply of nutrients through foliar application. It ultimately helps in higher dry-matter accumulation which contributes higher yield attributing characters. The higher yield attributing characters increased the crop yield. Similar results were also reported by Dutta *et al.*, (2000); Peyvasi *et al.,* (2009) and Shukla *et al.*, (2020).

Quality attributes characters

Data pertaining to oil, oil yield and protein content revealed that different treatments significantly influence all the three quality parameters (Table 2). Significantly higher oil content (41.03 %), oil yield (1073 kg/ha) and protein content (21.00 %) were found under the treatment T10 (75% RDF + 2.0% WSF at 30, 45 and 60 DAS), which remained statistically at par with the treatments T8, T9 and T2. However, significantly lower oil content (37.17 %), oil yield (700 kg/ha) and protein content (15.70 %) was found in treatment T1 (Control).

Table.1 Effect of different treatments growth and yield attributes characters of mustard

Treatments		Plant height (cm)			Number of branches per plant at harvest		No. of siliquae per plant	Length of siliqua (cm)	Number of seeds/ siliqua	1000-seed weight (g)
		At 45 DAS	At 75 DAS	At harvest	Primary	Secondary				
T1	Control (No fertilizer)	75.67	91.66	130.43	3.67	13.18	233	3.47	10.00	**3.81**
T2	100 % RDF (50-50-00 kg N-P2O5-K2O/ha)	90.00	113.00	141.71	7.33	16.49	245	4.50	12.05	**4.40**
T3	50 % of RDF + 1.0 % WSF at 30 and 45	76.00	107.33	132.90	4.00	14.41	235	4.33	11.67	**3.93**
T4	50 % of RDF + 2.0 % WSF at 30 and 45	83.00	109.33	133.10	4.33	15.50	237	4.03	11.76	**4.02**
T5	50 % of RDF + 1.0 % WSF at 30, 45 and 60	85.67	109.01	136.60	5.33	15.30	240	4.17	12.33	**4.31**
T6	50 % of RDF + 2.0 % WSF at 30, 45 and 60	87.00	109.70	137.50	6.0	15.47	237	4.35	12.01	**4.32**
T7	75 % RDF + 1.0 % WSF at 30 and 45 DAS	88.00	118.03	139.21	7.0	16.11	241	4.23	12.33	**4.38**
T8	75 % RDF + 2.0 % WSF at 30 and 45 DAS	92.00	119.70	156.80	8.17	18.33	267	5.23	14.33	**4.74**
T9	75 % RDF + 1.0 % WSF at 30, 45 and 60	91.33	120.02	152.70	7.50	18.87	262	5.00	13.67	**4.76**
T10	75 % RDF + 2.0 % WSF at 30, 45 and 60	93.33	123.33	162.12	8.33	19.12	278	5.97	15.00	**4.90**
S.Em.±		2.24	4.59	6.43	0.92	1.08	9.52	0.25	0.87	**0.28**
C. D.at 5%		6.65	13.65	19.11	3.01	3.00	28.0	1.00	3.0	**NS**
C. V. %		**4.50**	**7.10**	**7.84**	**15.78**	**11.41**	**6.67**	**9.57**	**12.0**	**10.9**

Table.2 Effect of different treatments on yield and quality characters of mustard

Treatments		Seed yield (kg/ha)	Stover yield	Oil content (%)	Oil yield (kg/ha)	Protein content (%)
T1	Control (No fertilizer)	1883	37.17	700	15.70	**3820**
T2	100 % RDF (50-50-00 kg N-P2O5-K2O/ha)	2304	38.87	895	20.00	**4593**
T3	50 % of RDF + 1.0 % WSF at 30 and 45 DAS	2024	38.00	769	16.07	**4112**
T4	50 % of RDF + 2.0 % WSF at 30 and 45 DAS	2089	38.67	808	18.07	**4097**
T5	50 % of RDF + 1.0 % WSF at 30, 45 and 60 DAS	2138	39.00	834	18.00	**4332**
T6	50 % of RDF + 2.0 % WSF at 30, 45 and 60 DAS	2151	38.50	828	19.77	**4301**
T7	75 % RDF + 1.0 % WSF at 30 and 45 DAS	2203	39.10	861	19.80	**4400**
T8	75 % RDF + 2.0 % WSF at 30 and 45 DAS	2554	39.80	1016	20.77	**5076**
T9	75 % RDF + 1.0 % WSF at 30, 45 and 60 DAS	2464	39.50	973	20.17	**4935**
T10	75 % RDF + 2.0 % WSF at 30, 45 and 60 DAS	2616	41.03	1073	21.00	**5228**
S.Em.±		132	259	0.57	42.0	**0.68**
C. D.at 5%		391	771	2.06	125	**2.12**
C. V. %		**10.17**	**10.02**	**2.52**	**8.46**	**6.21**

On the basis of findings of the present study it may be concluded that yield and quality of mustard can be achieved with the application of 75% recommended dose of fertilizers along with 3 foliar sprays of 2.0 % water soluble fertilizers (19-19-19) at 30, 45 and 60 DAS under semi-arid condition of Saurashtra region of Gujarat.

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