The Pharma Innovation Journal 2022; SP-11(2): 563-565

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(2): 563-565

www.thepharmajournal.com
Received: 03-12-2021
Accepted: 05-01-2022

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Quality and nutrient uptake in Indian mustard influenced as nutrient management

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Abstract
A field experiment was conducted during *rabi* season of 2017-18 at Agriculture Farm, Bhagwant University, Ajmer to study the effect of nutrient management on growth yield and quality of mustard. The experiment comprising total 10 treatments in randomized block design with three replications. Results indicated that oil content and oil yield and nutrients uptake improved with application of nutrient management treatments. Application of 100% RDF + 2% urea + 2% Multiplex spray gave significantly higher oil content oil yield and nitrogen and phosphorus uptake by seed and straw as well as total uptake as compared to control and water spray.

Keywords: Mustard, nutrient, urea, multiplex and oil

Introduction
Indian mustard (*Brassica juncea* (L.) Czern. & Coss) is the second most important oilseed crop after soybean in the country and has also been cultivated on significant area in north India since last one decade. The contribution of rapeseed-mustard to the total oilseed production in India is 26.0 percent. Domestic productions of edible oils meet only 50% of the total requirements, while rest is imported. The huge gap between the consumption and domestic production of edible oils can be filled up by either increasing the area under oilseed crops like rapeseed and mustard, sunflower and soybean or increasing production per unit area. The major fatty acids of rapeseed and mustard oil are oleic, linoleic, linolenic, ecosenoic and erucic acid in oil of Indian mustard variety is quit high (Chauhan *et al.* 2007) [4]. Each gram of fats and oil supplies 9 kilocalories of energy, whereas, per gram of carbohydrate/ protein supplies about kilocalories of energy (Alam *et al.* 2014) [2]. Fat and oils are also a source of essential fatty acids. Fats and oils are used to synthesize phospholipid, which are important components of active tissues viz. brain, nerves and liver of human beings and other animals.
To produce the additional quantity of oilseed, the only option to enhance productivity under limited resource conditions. The imbalanced and inadequate supply of fertilizers accompanied by restricted use of organic manures not only leads to limit the yield potential but soils also get deficient in the nutrients which deteriorate the soil health with decline in crop response. The differential trends in seed yield of Indian mustard under a particular agro-climatic condition have been noticed due to varying moisture and nutrient status of soil. It is responsive to plant nutrients especially nitrogen phosphorus and sulphur. Nutrients play a pivotal role in increasing the seed yield in mustard. Foliar application of major nutrients like nitrogen and potassium was found to be as good as soil application. Nitrogen is the most important nutrient, which determines the growth of the mustard crop and increases the amount of protein and yield. Phosphorus and potash are known to be efficiently utilized in the presence of nitrogen. Sulphur is a crucial element for rapeseed-mustard in determining its seed yield, oil content, quality and resistance to various biotic and abiotic stresses. Besides promoting chlorophyll formation and oil synthesis, it is an important constituent of seed protein, amino acids, various enzymes and glucosinolate. The favourable influence of zinc application on yield of mustard may be attributed to its role in various enzymatic reactions, growth processes, hormone production and protein synthesis and also the translocation of photosynthates to seed thereby leading to higher seed yield (Bhadauria *et al.*, 2012) [3]. Boron helps to maintain balance between sugar and starch, translocation of sugar and carbohydrates, pollination and seed reproduction, cell division, nitrogen metabolism, protein formation as well as cell wall formation etc. (Trivedi, 2015) [18]. The objectives of this study were to examine the effect of nutrient management on quality and nutrient uptake by crop.

Material Methods

The field experiments were conducted at Agriculture Farm, Bhagwant University, Ajmer, Rajasthan, India (24° 40'N latitude and 82° 12'E longitude at an altitude of 113 meters above mean sea level) during *rabi* season of 2017-18. The soil of experimental field was sandy clay loam, slightly alkaline in reaction (pH 7.1) having 190.50 kg/ha available N (Alkaline permanganate method (Subbiah and Asija, 1956) [16], medium level of available phosphorus (19.30 kg/ha, Olsen's method (Olsen *et al*., 1954 [9] and medium in available potassium (210.13 kg/ha, Flame photometric method (Metson, 1956) [8] in 0-15 cm soil depth at the start of the experiment. The experiment comprising total 10 treatment combinations such as control, water spray, 2% urea spray, 100% RDF, 50% RDF + 2% urea spray, 50%RDF + 2% Multiplex spray, 50% RDF + 2%urea + 2% Multiplex spray, 100% RDF +2% urea spray, 100%RDF + 2% Multiplex spray and 100% RDF + 2%urea + 2% Multiplex spray in randomized block design with three replications. Recommended dose of fertilizer-40 kg N, 20 kg P_2O_5, 20 kg K_2O and 20 kg S per hectare. Indian mustard variety 'Varuna' was sown on 10.11.2017 with using 5.0 kg seed ha^{-1} at the row spacing of 45 cm. All the recommended package of practices was followed to raise the crop. Experimental data recorded in various observations were statistically analyzed with the help of Fisher's analysis of variance technique (Fisher, 1950) [6]. The analysis of data of the various treatments was compared together using CD at 5% significant levels.

Oil content

Oil content in seed was determined by Soxhlet's Ether Extraction Method (A.O.A.C., 1960) [1].

Oil yield

Oil yield was worked out by using the following formula:

$$\text{Oil yield (kg ha}^{-1}) = \frac{\text{Oil content (\%)} \times \text{Seed yield(kg/ha)}}{100}$$

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content in seed (\%)} \times \text{Seed yield (kg/ha)} + \text{Nutrient content in stover (\%)} \times \text{Stover yield (kg/ha)}}{100}$$

Results And Discussion

Effect of nutrient management treatments on quality parameters

Oil content

Data presented in table 1 indicated that oil content and oil influenced significantly due to application of nutrient management treatments. Significantly higher oil content of 38.7 per cent was recorded with the application of 100% RDF + 2% urea + 2% multiplex spray as compared to control, water spray, 2% urea spray, 100% RDF, 50% RDF + 2% urea spray, 50% RDF + 2% multiplex spray and 50% RDF + 2% urea + 2% multiplex spray, but it was at par with application of 100% RDF +2% urea spray and 100% RDF + 2% multiplex spray. It might be due to increased availability of S and Zn that involved in an increased conversion of primary fatty acids metabolites to the end products of fatty acid as supported by Tripathi *et al.*, (2010) [17]. These results are in close conformity with the findings of Shukla *et al.*, (2002) [14], Singh and Pal, (2011) [15], Shubhangi and Kachhave (2008) [13], Sharma *et al.* (2017) [12] and Saren and Saha (2018) [11].

Oil Yield

Results revealed (Table 1) that oil yield of mustard differed with application of nutrient management treatments. Significantly maximum oil yield of 370 kg/ha was obtained with the application of 100% RDF + 2% urea + 2% multiplex spray, but it was at par with application of 100% RDF +2% urea spray and 100%RDF + 2% multiplex spray as compared to control, water spray, 2% urea spray, 100% RDF, 50% RDF + 2% urea spray, 50% RDF + 2% multiplex spray and 50% RDF + 2% urea + 2% multiplex spray. Oil yield is the function of oil content and seed yield. Similar results also reported by Yadav *et al.* (2017) [19] and Sahoo *et al. (*2018) [10].

Nitrogen uptake

Results revealed (Table 1) that nitrogen uptake by mustard varied with application of nutrient management treatments. Significantly higher nitrogen uptake (37.26, 45.04 and 82.30 kg/ha, respectively) by seed and stover as well as total recorded with the application of 100% RDF + 2% urea + 2% multiplex spray as compared to control, water spray, 2% urea spray, 100% RDF, 50% RDF + 2% urea spray, 50% RDF + 2% multiplex spray, 50% RDF + 2% urea + 2% multiplex spray, 100% RDF +2% urea spray and 100% RDF + 2% multiplex spray, but it was at par with application of 100% RDF + 2% multiplex spray in case of nitrogen uptake by stover. The positive influence of application of 100% RDF + 2% urea + 2% multiplex spray on nutrient content in the crop appears owing to improved nutritional level both in the root zone and plant system. The increased availability of these nutrients in root zone coupled with increased metabolic activity at cellular level might increase nutrient uptake and their accumulation in vegetative plant parts. Increased accumulation of nutrients in vegetative plant parts with improved metabolism led to greater translocation of these nutrients to reproductive organs of the crop and ultimately increased the contents in seed and stover. Increased uptake of nitrogen seems to be due to the fact that uptake of nutrient is a product of biomass accumulated by particular part and its nutrient content. These results are in line with the findings of Chaurasia *et al.*, (2009) [5], Yadav *et al.* (2017) [19] and Sahoo *et al.* (2018) [10].

Phosphorus uptake

Data presented in table 1 showed that the application of nutrient management treatments had a significant effect on phosphorus uptake by mustard. Significantly higher phosphorus uptake (8.90, 4.49 and 13.39 kg/ha, respectively) by seed and stover as well as total recorded with the application of 100% RDF + 2% urea + 2% multiplex spray as compared to control, water spray, 2% urea spray, 100% RDF, 50% RDF + 2% urea spray, 50% RDF + 2% multiplex spray, 50% RDF + 2% urea + 2% multiplex spray, 100% RDF +2% urea spray and 100% RDF + 2% multiplex spray. The higher

amount of phosphorus uptake of these nutrient elements are closely correlated with their increased availability in soil. This was mainly due to the fact that better nutrient utilization by more healthy and vigorous plants under recommended and balanced level and resulting in more biomass production and yield, which ultimately increased the total uptake of phosphorus the observation are in agreement with those of (Mandal and Sinha, 2002) [7], Yadav *et al.* (2017) [19] and *Sahoo et al.* (2018) [10].

Table 1: Effect of nutrient management on quality and nutrient uptake by Indian mustard

Treatments	Oil content (%)	Oil yield (kg/ha)	N uptake (kg/ha)			P Uptake (kg/ha)		
			Seed	Stover	Total	Seed	Stover	Total
Control	35.0	159	30.39	38.20	68.59	3.41	2.23	5.64
Water Spray	35.3	161	32.42	40.79	73.21	3.76	2.55	6.31
2% urea spray	37.8	215	32.54	42.77	75.31	4.27	3.62	7.89
100% RDF	37.8	248	33.73	43.26	76.99	4.90	3.63	8.53
50% RDF + 2% urea spray	37.6	275	33.70	44.30	78	4.69	3.56	8.25
50% RDF + 2% multiplex spray	37.0	292	33.69	41.89	75.58	6.59	3.10	9.69
50% RDF + 2%urea + 2% multiplex spray	37.7	310	35.26	43.74	79	7.17	4.30	11.47
100% RDF +2% urea spray	38.3	351	35.54	43.59	79.13	6.75	3.55	10.3
100%RDF + 2% multiplex spray	38.0	351	36.15	44.73	80.88	7.60	3.88	11.48
100% RDF + 2% urea + 2% multiplex spray	38.7	370	37.26	45.04	82.3	8.90	4.49	13.39
SEm	0.25	15.5	0.15	0.17	0.35	0.16	0.22	0.28
L.S.D (p=0.05)	0.74	46.2	0.45	0.50	1.06	0.48	0.65	0.84

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