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Fertilizer management studies on growth and productivity of hybrid Indian mustard *Brassica juncea* (L.)

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Abstract

A field experiment, consisting of four levels of recommended dose of fertilizer (NPK & S: 80, 40, 0 & 60 kg/ha) viz. 75 %, 100 %, 125 % & 150 % of RDF and four varieties of Indian mustard [*Brassica juncea* (L) Czern & Coss.] *viz*. DMH-1, NRC-HB 506, PAC-437 and Kranti (National Check), was carried out in split plot design with three replications during *rabi* 2009-10 and 2010-11. Hybrid cultivar DMH-1 performed best in terms of yield and yield attributing characters, followed by NRC-HB 506, which were found significantly higher over the PAC-436 and Kranti (NC) under different fertility levels. Application of 100 % RDF (80 kg N + 40 kg P_2O_5) produced significantly higher seed yield (2372 kg/ha) and other yield attributes *viz*. number of primary branches / plant (4.55), number of secondary branches / plant (9.40), number of siliquae / plant (195.35), seed weight (8.27 g/plant) test weight (4.63), stover yield (4771 kg/ha), oil content (41.30%) , oil yield (933 kg/ha), total N uptake (114.94 kg/ha), total P uptake (27.21 kg/ha), net return (Rs.36776) and B:C ratio (2.62) as compared to 75 % RDF and found statistically at par with 125 % & 150 % RDF. Hence, the farmer's could economically benefited by using DMH-1 Indian mustard hybrid variety with recommended doses of fertilizers.

Key words: *Indian mustard, fertility, productivity, hybrid*

Introduction

India is one of the largest oil seeds producing country that covers one fifth of the entire area under this group of crops and also yields one-fifth of the total oilseed production in the world. In India, oilseeds are the second largest agricultural commodity after cereals, which occupy about 13.5% of the gross cropped area in the country, and account for 5% of GNP and 10% of the value of all agricultural products (Rai *et al*., 2002). Among oilseeds, rapeseed- -mustard occupies a prestigious position and ranks second after groundnut in area and production, contributing 23% of the total oilseed production. It is estimated that 58 million tons of oilseeds will be required by the year 2020, wherein the share of rapeseed-mustard will be around 24.2 million tons (Bartaria *et al.*, 2001). Indian mustard [*Brassica juncea* (L.) Czern & Coss.] is the most important winter season oilseed crop, which thrives best in light to heavy loam soil in areas having 25-40 cm of rainfall.

Indian mustard is nutritionally very rich and its oil content varies from 37-49%. The seed and oil are used as a condiment in the preparation of pickles, flavouring curries and vegetables as well as for cooking and frying purposes. Its oil is used in many industrial products, cake as cattle feed and manure and green leaves for vegetable and green fodder. Though the productivity of rapeseed-mustard of Rajasthan is yet far below than the productivity of other states in the country (Chauhan *et al*., 2012). This calls for a study to identify new genotypes of mustard with perfect plant type and proper nutritional support particularly nitrogen, phosphorus and sulphur.

Materials and Methods

To study the impact of genotypes and fertilization on yield and quality of Indian mustard, a field experiment was conducted at Agricultural Research Station, Ummedganj Farm, Kota during *rabi* 2009-10 and 2010-11. The soil of the experimental field was clay loam in texture, medium in organic carbon (0.56 %) and potassium (282.0 kg/ha) and low in available phosphorus (23.5 kg/ha) and sulphur (10.0 kg/ha). The experiment consisted of three released Indian mustard hybrids viz., DMH-1, NRCHB 506, PAC-437 and one variety as check i.e. Kranti in main plots and four fertilizer levels (75 %, 100 %, 125 % and 150 %) of the recommended dose of N and P in sub-plots was laid out in split plot design with three replications. The gross plot size was 6.0 m x 5.0 m. Different genotypes were sown on October 09, 2009 & October 27, 2010 with hand plough at a row to row distance of 30 cm. Thinning was done after two weeks of sowing date to maintain plant to plant spacing of 15 cm. Nitrogen was applied through urea in two splits (half as basal and half at flowering) and phosphorus at seeding through di-ammonium phosphate. The crop received only one post sowing irrigation at flowering. All other recommended package of practices was followed for raising the healthy crop. The crop was harvested on March 02, 2010 and March 8, 2011. Yield and yield attributes, oil content were recorded to draw some valuable conclusions. Ten randomly, equally comparative plants, were selected for recording yield and yield attributing traits. Oil content was estimated with help of NIR (Bruker Model Metrix-I) to draw same valuable conclusion.

Results and Discussions

Effect of genotypes

Among four genotypes evaluated, DMH 1 produced maximum number of primary (5.1) and secondary (10.6) branches at harvest, number of siliquae per plant (220.8), seed yield per plant (8.7 g), straw yield (5077 kg/ ha) and harvest index (32.5%). However the test weight was observed at par for all the genotypes with maximum in genotype Kranti and minimum in NRCHB 506 (Table 1). Genotype DMH 1 was also found superior in seed yield (2440 kg / ha) and oil yield (1000 kg/ha). Oil content (41.6%) in NRCHB 506 was maximum followed by Kranti, DMH 1 and PAC 437 (Table 2). The 1000-seed weight was maximum in Kranti (5.0), whereas, it was at par in other three genotypes. Number of primary branches at harvest was minimum (5.1) in DMH 1 followed by NRCHB 506, PAC 437, and Kranti. DMH 1 produced maximum number of secondary branches at harvest (10.6) followed by NRCHB 506 (9.2), Kranti (9.1) and PAC 437 (8.4).

Table 1. Fertilizer management studies in hybrid mustard on growth of Indian mustard (two years pooled data)

Treatments	No. of primary branches at harvest /plant	No. of secondary branches at harvest /plant	No. of siliquae /plant	Seed weight (g/plant)	Test weight (g)	Straw yield (kg/ha)	Harvest index (%)
A. Varieties							
DMH-1	5.1	10.6	220.7	8.7	4.6	5077	32.5
NRC-HB 506	4.6	9.2	195.8	8.3	4.2	4729	32.4
PAC-437	4.4	8.4	187.1	8.1	4.7	4588	32.4
Kranti	4.0	9.1	155.9	7.6	4.9	4229	32.2
SEm±	0.1	0.2	3.6	0.1	0.1	63.2	
C D (P=0.05)	0.2	0.7	11.0	0.4	0.2	194.6	NS
B. Fertility levels							
75 % RDF	3.9	8.2	154.0	7.4	4.3	4171	32.2
100 % RDF	4.6	9.4	195.4	8.3	4.6	4741	32.4
125 % RDF	4.7	9.7	200.6	8.4	4.7	4829	32.4
150 % RDF	4.8	10.0	209.4	8.5	4.8	4898	32.4
SEm±	0.1	0.2	4.1	0.1	0.05	69.2	
C D (P=0.05)	0.2	0.5	11.1	0.3	0.14	191.6	NS

Number of siliquae per plant was maximum in DMH 1(220.7) followed by NRCHB 506, PAC 437 and Kranti. The stover yield (kg/ha) and harvest index (%) was maximum in DMH-1 and minimum in kranti. Oil content was highest in NRCHB 506 (41.6%) which was significantly higher over DMH 1(41.0%) and PAC 437(40.7%). The net return (Rs. 40245/ ha) and B: C ratio (2.8) was highest and significantly recorded in DMH-1 over rest varieties.

Effect of fertility levels

The maximum positive effect was observed with 150% RDF on seed yield (kg/ha), Oil content (%), primary and secondary branches per plant, siliquae per plant, seed yield per plant (g), Test weight (g), stover yield (kg/ha) and harvest index (%) followed by 125%, 100% and 75% for all the characters. The increase in seed and oil yield due to 100% over 75% of recommend fertilization was 6.6 and 9.1%, respectively. Seed yield (1980 kg/ ha) and number of siliquae per main shoot (41.3) were minimum at 75% of recommended fertilization, whereas it was at par at other fertility levels (Table 2). The number of seeds/pod was also less at 75% of recommended fertilizer which increased significantly at 125 and 150% recommended fertilization. The test weight, main shoot height and siliqua length were not influenced by different fertility levels. Oil content decreased significantly with each increment of fertilizer application beyond 75% of recommended dose (Table 2). The decrease in oil content at 150% recommended fertilization was 5.7% compared to 75% of recommend fertilization. The net return (Rs. 40245/ha) and B:C ratio (2.8) was highest and significantly recorded in 100 % RDF over 75 % RDF but statistically at par with in RDF 125 % and 150%.

Seed yield is probably the most difficult trait to predict accurately. Numerous attempts have been made to identify the most important yield component. Positive relationship have frequently been cited between the seed yield and the number of siliqua per plant and main raceme, as well as the number of seeds per siliqua and seed weight per siliqua. In the present investigation, the seed yield in different genotypes was a function of seed yield per plant which was governed by 1000 seed weight, number of pods per plant and seed numbers per pod. Among four genotypes PAC-437 produced maximum seed yield because of better yield attributes. These findings are in conformity with Phogat *et al*. (1997) and Bisht (2004). Oil yield is

Table 2. Fertilizer management studies in hybrid mustard on growth and productivity of Indian mustard (pooled data of two years)

Treatments	Seed yield (kg/ha)	Oil Content (%)	Oil yield (kg/ha)	Total N uptake (kg/ha)	Total P Uptake (kg/ha)	Net Return (Rs./ha)	B:C Ratio
A. Varieties							
DMH-1	2440	41.0	1000	131.9	31.3	40245	2.8
NRC-HB 506	2263	41.6	942	115.2	27.3	36052	2.5
PAC-437	2197	40.7	894	107.6	25.4	35107	2.5
Kranti	2005	41.5	831	91.3	21.5	30512	2.1
SEm$\pm$	33.27	0.1	13.1	3.1	0.8	726.82	0.05
C D (P=0.05)	102.48	0.3	40.2	9.6	2.4	2238.61	0.15
B. Fertility levels							
75 % RDF	1971	40.8	804	88.7	20.9	30551	2.3
100 % RDF	2281	41.1	933	114.9	27.2	36776	2.6
125 % RDF	2314	41.3	955	119.7	28.3	37164	2.6
150 % RDF	2350	41.5	975	122.7	29.1	37426	2.5
SEm$\pm$	27.98	0.1	12.1	2.6	0.7	630.48	0.04
C D (P=0.05)	77.49	0.3	33.5	7.2	1.9	1746.43	0.1

mainly a function of seed yield which is generally influenced by genetic structure of different genotypes. Oil yield was significantly higher in PAC-437 though the oil content was lower. Singh *et al*. (2003) and Bisht (2004) have also reported similar results.

Positive response of different genotypes in term of seed and oil yield was realized significantly only up to 100% of recommended fertilizer, whereas the oil content decreased significantly with each increment of fertilizer doses due to increase in test weight other than fatty acids. Similar results have been reported elsewhere (Trivedi and Sharma, 1997 and Bisht, 2004). Fatty acid composition was not much influenced by fertilization indicating that plant breeding and biotechnological approaches are only the emerging alternative and agronomic manipulation in terms of fertilization has limited scope in modifying fatty acid profile of oilseed *Brassicas* to the desired level.

Among four genotypes DMH 1 was found very responsive in producing the maximum value in the form of economic traits like seed and oil yield. However this genotype was also equally responsive for vegetative growth characters like primary and secondary branches per plant at harvest stage, number of siliquae per plant seed yield per plant straw yield and harvest index. The 150% RDF is most recommended level, which produces profuse vegetative plant type and successfully converted in economic yield as this level produces high values in all the characters.

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