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Effect of NPK nutrition on growth and yield of canola type mustard (*Brassica juncea* L.)

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ABSTRACT

Among the edible oilseeds cultivated in India, rapeseed-mustard contributes nearly 30 per cent in the total production of oilseeds. Rajasthan, Uttar Pradesh, Haryana, Madhya Pradesh, and Gujarat cover more than 80% of acerage under mustard. India holds a premier position in rapeseed-mustard economy of the world with 2nd and 3rd rank in area and production, respectively. This crop accounts for nearly one-third of the oil produced in India, making it the country's key edible oilseed crop. Toria is a short duration winter crop cultivated largely in eastern India. Gobhi sarson and karan rai are the new emerging oilseed crops having limited area under cultivation. Gobhi sarson (Brassica napus) is a long duration crop confined to Punjab, Himachal Pradesh and some parts of Haryana. Traditional mustard oil accumulates high amount of erucic acid (C22:1) comprising 40-57per cent of total fatty acids. Winter rape (Brassica napus) with canola quality, i.e. low-glucosinolate, low-erucic acid varieties, represents one of the world's major sources of vegetable oil. Since early 1970s, the 'canola' quality oil has gained acceptance worldwide as a healthy edible oil cooking medium. 'Canola' which is a registered trade mark of Canadian Oil Association denotes the seeds having less than 2 per cent erucic acid in its oil and less than 30 micro -moles of glucosinolate per gram of its deoiled meal. Canola is only a quality standard and not a classification based on biological attributes. Varieties with canola quality are also termed as 'double low' or '00' rapeseed-mustard (LEAR) has also been released recently. Indian varieties under cultivation have high erucic acid (about 50%) and high glucosinolates (e" 100 moles/g defatted seed meal). Efforts have been made to develop zero erucic rapeseed- mustard at, PAU Ludhiana, TERI, New Delhi, IARI, New Delhi, DRMR, Bharatpur and GBPUAT, Pantnagar. Although, agro-climatic conditions for canola cultivation are congenial in all rapeseed mustard growing states, there is need to improve seed quality as well as oil content of canola varieties to improve production potential. Hence, the present investigation was carried out to study the effect of NPK on different varieties for seed yield and its attributes.

Keywords : Canola, erucic acid, NPK, rapeseed-mustard, seed quality and yield

Among the oilseed crops grown in India, mustard is an important edible oilseed crop next to soybean and groundnut. Traditional mustard oil accumulates high amount of erucic acid (C22:1) comprising 40-57 per cent of total fatty acids. Winter rape (*Brassica napus*) with canola quality, *i.e*. low-glucosinolate, low-erucic acid varieties, represents one of the world's major sources of vegetable oil. Since early 1970s, the 'canola' quality oil has gained acceptance worldwide as a healthy edible oil cooking medium. Though the nutritional advantages of rapeseed-mustard oil available in India outdo many other edible oils (lowest amount of harmful saturated fatty acids, and contains two essential fatty acids – linoleic and linolenic), the presence of erucic acid and glucosinolates are considered to be undesirable. Hence, efforts were made to develop varieties low in erucic acid (<2%) as well as low in glucosinolates (<30µmol/100g of free seed meal). 'Canola' which is a registered trade mark of Canadian Oil Association denotes the seeds having less than 2 per cent erucic acid in it's oil and less than 30 micro -moles of glucosinolate per gram of it's deoiled meal. Canola is only a quality standard and not a classification based on biological attributes. Indian varieties under cultivation have high erucic acid (about 50%) and high glucosinolates ($\geq$ 100 moles g^{-1} defatted seed meal).

At present the cultivation of canola quality gobi sarson and low erucic acid Indian mustard is done on limited scale in Punjab state only. Although, agro-climatic conditions for canola cultivation are congenial in all rapeseed mustard growing states, there is need to improve seed quality as well as oil content of canola varieties to improve production potential. Hence, the present investigation was carried out to study the effect of NPK on different varieties for seed yield and its attributes.

The field experiment was carried out during *rabi* 2015-16 at A-B Block Farm, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal to study the effect of NPK on eleven canola type and four mustard (*Brassica juncea* L.) varieties for seed yield and its attributes. Experiment was laid out in split-plot design with first factor at Varieties *viz*. V_1 (Varuna), V_2 (PM 25), V_3 (PM 21), V_4 (Pusa LES 39), V_5 (Pusa Bold), V_6 (PM 27), V_7 (P Tarak), V_8 (PM 22), V_9 (JD-6), V_{10} (Kranti), V_{11} (PM 24), V_{12} (PM 30), V_{13} (PM 29), V_{14} (PM 28) and V_{15} (PM 26) as main plot treatments. Varuna, Pusa Bold, JD-6 and Kranti are mustard

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Table1 : Growth and yield attributes of canola type mustard as influenced by NPK nutrition

Treatments	Growth attributes				Yield attributes and yield			
	50% flowering (Days)	Maturity (Days)	Plant height (cm)	Primary branch plant^{-1}	No. of pod plant^{-1}	No. of seeds pod^{-1}	1000 seed weight (g)	Seed yield (kg ha^{-1})
Varietal effects								
V_1	57.2	117.6	170.91	6.33	95.92	12.42	4.52	1289.40
V_2	43.9	108.0	164.74	5.83	117.83	14.08	4.28	1789.54
V_3	62.6	123.7	179.50	6.92	104.17	13.33	3.79	868.39
V_4	51.3	111.5	196.68	6.83	148.25	14.75	3.76	1387.72
V_5	56.5	116.6	185.87	6.42	116.33	13.83	5.24	1392.49
V_6	48.0	110.9	181.57	6.67	127.00	13.42	4.95	1097.20
V_7	52.9	113.0	193.17	6.33	123.75	13.08	4.66	1568.30
V_8	61.2	119.4	223.55	7.00	116.33	11.83	4.41	1196.53
V_9	50.6	110.3	192.90	6.42	146.17	13.00	4.08	1348.80
V_{10}	53.9	114.1	196.72	6.75	103.75	12.83	3.84	1689.85
V_{11}	54.7	115.0	180.03	6.67	129.92	12.58	3.36	1331.35
V_{12}	56.3	117.0	214.68	6.58	131.17	13.42	4.38	1578.15
V_{13}	59.8	120.2	210.72	6.75	118.92	12.17	4.38	1537.93
V_{14}	44.3	104.3	180.52	6.00	125.33	14.83	5.67	1634.88
V_{15}	43.2	103.0	171.30	6.50	134.00	14.08	5.47	1807.34
SEm (±)	**0.24**	**0.31**	**1.26**	**0.407**	**1.215**	**0.209**	**0.013**	**49.99**
LSD (0.05)	**0.67**	**0.86**	**3.52**	**1.140**	**3.402**	**0.585**	**0.037**	**140.02**
NPK Nutrition								
T_1	54.2	114.6	165.84	5.33	85.20	12.49	4.42	685.75
T_2	50.4	110.2	189.38	6.58	122.84	13.60	4.44	1527.33
T_3	51.9	112.8	201.21	6.89	144.04	13.33	4.40	1711.13
T_4	55.8	117.0	201.65	7.33	138.27	13.82	4.55	1813.89
SEm (±)	**0.12**	**0.16**	**0.65**	**0.210**	**0.627**	**0.108**	**0.007**	**25.82**
LSD(0.05)	**0.35**	**0.45**	**1.82**	**0.589**	**1.757**	**0.302**	**0.019**	**72.30**
Interaction (VXT)								
SEm (±)	**0.48**	**0.63**	**2.52**	**0.814**	**2.430**	**0.418**	**0.026**	**99.993**
LSD(0.05)	**1.35**	**1.75**	**7.05**	**2.280**	**6.805**	**1.171**	**0.074**	**280.03**

Note: V_1 (Varuna), V_2 (PM25), V_3 (PM21), V_4 (Pusa LES39), V_5 (Pusa Bold), V_6 (PM27), V_7 (P Tarak), V_8 (PM22), V_9 (JD6), V_{10} (Kranti), V_{11} (PM24), V_{12} (PM30), V_{13} (PM29), V_{14} (PM28) V_{15} (PM26); T_1 : $NP_2O_5K_2O$- nil; T_2: $NP_2O_5K_2O$ @ 80:40:40 kg ha^{-1}; T_3: $NP_2O_5K_2O$ @ 100:50:50 kg ha^{-1} and T_4: $NP_2O_5K_2O$ @ 120:60:60 kg ha^{-1}

varieties. The second factor with four schedules of NPK *viz*. T_1: $NP_2O_5K_2O$- nil; T_2: $NP_2O_5K_2O$ @ 80:40:40 kg ha^{-1}; T_3: $NP_2O_5K_2O$ @ 100:50:50 kg ha^{-1} and T4: $NP_2O_5K_2O$ @ 120:60:60 kg ha^{-1} was laid out as sub plot treatments with three replications. 50% N, 100% P_2O_5, 100% K_2O was applied as basal and the remaining 50% N was applied at 30 DAS after thinning and weeding. Therefore, there were 60 different treatment combinations for each replication. Three lines of each individual treatment combination were sown. The row length was of 5 m with spacing 30 × 10 cm. The soil of the experimental site is clayey in texture with pH 6.5. The sowing was done on 19th November 2015 and harvested on 29th March, 2016. Recommended agronomic packages and plant protection practices were adopted for raising the crop. Observations were recorded on ten randomly selected plants from each plot of all replications to record data on the following characters *viz*. Plant height (cm), 50 per cent flowering (days), maturity (days), primary branch $plant^{-1}$, Siliqua $plant^{-1}$, Seeds $siliqua^{-1}$ and 1000 seed weight (g.). Seed yield (kg ha^{-1}) was estimated on plot basis. The mean values were subjected to statistical analysis. Data on various variables were analysed by analysis of variance (Panse and Sukhatme,1967).

Effects of varieties

Among the growth attributes *viz*. Plant height (cm), 50 per cent flowering (days), maturity (days), primary branch $plant^{-1}$ showed significant effects (Table 1). Highest Plant height of 223.5 cm was observed in V_8(PM22) followed by V_{12}(PM30) and V_{13}(PM29) and lowest Plant height of 164.7 cm was observed in V_2(PM25) followed by V_1(Varuna). The variety V_3 (PM21) recorded maximum days 50 per cent flowering and maturity of 63 and 124 days respectively. V_{15} (PM26) was earliest to mature (103 days) followed by V_2 (PM25). Among the yield attributes V_{15} (PM26) recorded highest seed yield of 1807 kg ha^{-1} followed by V_2 (PM25) 1789 kg ha^{-1}. This may be attributed due to high number of pod $plant^{-1}$, number of seed pod^{-1} and 1000 seed weight (Table1). Similar results were reported by Singh *et.al*. (2008).

Effects of NPK nutrition

Performance of mustard varied significantly due to different treatments of fertilizer application (Table1). The results revealed that application of $NP_2O_5K_2O$ @ 120:60:60 kg ha^{-1} (T_4) recorded highest seed yield of 1813.9 kg ha^{-1} followed by $NP_2O_5K_2O$ @ 100:50:50 kg ha^{-1} (T_3) with seed yield of 1711.1 kg ha^{-1}. Other yield attributes *viz*. Siliqua $plant^{-1}$, Seeds $siliqua^{-1}$ and 1000 seed weight (g.) were also higher in T_3 and T_4. This may be due to delayed maturity and high number of primary branch $plant^{-1}$ resulting higher photosynthetic activity and effective translocation of photosynthates to sink thereby resulted in better development of siliqua, good seed filling and consequently higher yield. Ghimire and Bana (2011) reported similar results of increase of seed and stover yields with increase of fertilizer (RDF).

The interaction effect of all the attributes recorded significant effect on all characters.

From the above investigation it can be concluded that for quality seed production of canola, application of $NP_2O_5K_2O$ @ 120:60:60 kg ha^{-1} is essential and among the canola type mustard, performance of V_2 (PM 25) is better than all other canola type mustard varieties under West Bengal condition.

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