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Effect of Different N Levels with and without P and K on Growth, Yield and Acquisition of Nutrients by Mustard (*Brassica juncea*)

Achin Kumar[1]*, Satendra Kumar[1], Surya Kant[1], Anil Kumar Shukla[2], Vipin Kumar[2] and Yogesh Pal[2]

[1]Department of Soil Science Sardar Vallabhbhai Patel University of Agriculture and Technology, Modipuram, Meerut - 250 110 (U.P.), India.
[2]Department of Soil Science & Agricultural Chemistry, Institute of Agricultural Sciences Banaras Hindu University, Varanasi - 221 005, (U.P.), India.

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A field experiment was conducted in *Rabi* 2011-12 to study the effect of different N levels with and without P and K on growth, yield and acquisition of nutrients by mustard (*Brassica juncea* L). The experiment was laid out in randomized block design (RBD) with 12 treatments. The results revealed that highest significant grain yield of 20.78 q ha-1 were recorded in the treatment T_{12} ($N_{120}P_{50}K_{50}$) as compared to all other treatments. Addition of different N levels with and without P and K, caused significant increase in plant height, number of branches plant^{-1} (primary and secondary), number of siliquae plant^{-1}, number of seed siliquae^{-1}, 1000-seed weight, biological yield, seed yield, stover yield q ha^{-1}, nutrient content and uptake. On the basis of results obtained it can be concluded that the balanced fertilization and high dose of nitrogen with P and K was found superior than alone application of treatments due to synergetic effect of N with P and K by mustard in terms of growth and yield parameters significantly.

Keywords: NPK, growth, yield, acquisition, balanced fertilization and mustard.

India is amongst the largest vegetable oil economies in the world, next to USA and China. The oilseed forms an essential part of human diet. Besides, it produces basic raw material for agro-based industries. The present average per capita consumption of oils and fats has not been more than 11g /day as against the nutritional standard of 30g /day for a balanced diet. Currently, India accounts for about 13% of world's oilseeds area, 7% of world's oilseed output and 10% of world's edible oil consumption. At global level rape-seed mustard crops are cultivated in 53 countries spreading over to 6 continents. In India, mustard occupies annually 6.51 million hectare area contributing to 7.67 million tons with average productivity of 1182 kg per hectare. Production of mustard in India has increased from 2.7 million tons in 1986-87 to 7.67 million tons in 2010-11, while the estimated demand for vegetable oilseeds is expected to be around 34 million tons by 2020 AD. To meet out this demand, the production of mustard has to be increased to at least 14 million tons for maintaining a minimum nutritional requirement of 12.0 kg per capita per year as against present 8.5 kg per capita per year by 2020 AD (Anonymous, 2010).

Brassica juncea is one of the oil yielding and promising crop in India. According to state wise, Rajasthan have the largest area and Uttar

* To whom all correspondence should be addressed.
E-mail: achinrana1@gmail.com

Pradesh have the third place in rape-seed mustard with area 0.6 mha with production of 0.68 million tons and productivity of 1113 kg ha^{-1} (Agriculture statistics, 2011). India oilseed scenario recently presented a picture of virtual stagnation. The technology mission on oilseed (TMO) launched by government of India in 1986 has impacted to overall production of oilseed significantly. The oilseed production which was only 12.8 million tons in 1984-85 increased to 24.35 million tons in 1996-97, this has been achieved not only through increase in productivity from 684kgha^{-1} in 1884-85 to 926 kg ha^{-1} in 1996-97 and 1182 kg ha^{-1} in 2009-10. The transformation in rapeseed-mustard scenario is commonly known as "Yellow–Revolution" the quantum jump in production of rapeseed- mustard is to be attributed to the development of improved technology.

The decline soil fertility is the main cause of low productivity of the cultivated lands. The adequate and balanced supply of plant nutrients is of critical importance in improving the productivity of oilseeds, which in India is only 935 kg ha^{-1} as compared to the world level of 1632 kg ha^{-1} due to the prohibitive cost of chemical fertilizer. Nitrogen is the most important nutrient, which determines the growth of the mustard crop and increases the amount of protein and the yield. Phosphorus and potash are known to be efficiently utilized in the presence of nitrogen. It promotes flowering, setting of silliqua and increase the size of silliqua and yield (Singh and Meena, 2004).

MATERIALS AND METHODS

The field experiment was conducted in *rabi* season of 2011-2012 at Crop Research Centre, Chirori of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) India, to evaluate the effect of different N level with and without P and K on growth and yield attributes of mustard. The experiment was arranged in randomized block design with three replications, each plot size being 4.5m x 3m (Table 1). Soil collected from research farm was analysed for various initial physic-chemical properties given in parentheses, viz. bulk density (1.57 g cm^{-3}), particle density (2.39 g cm^{-3}), pH (1:2; 8.18), EC (0.18 dSm^{-1}), organic C (0.34%), porosity (35%), available N (155.84 kg ha^{-1}), available P (15.76 kg ha^{-1}) and available K (148.96 kg ha^{-1}) was analysed by standard procedure. All the treatments comprising of different levels of N, P and K i.e. N @ 0, 80 and 120 kg ha^{-1}, P and K @ 0 and 50 kg ha^{-1} respectively, were applied to mustard through urea, single super phosphorus and Mureate of potash, respectively. Full dose of P, K, and half dose of N were surface applied as basal dose and incorporated in the soil. The remaining half of the dose of N was applied as top dressing at 30 and 60 DAS after completion of the first weeding. Intercultural operations viz., weeding, irrigation, and insecticide spray were done as and when required. The height of plant, number of branches $plant^{-1}$ (primary & secondary), pod $plant^{-1}$, seed pod^{-1}, 1000-seed weight and yield and yield contributing characters were recorded from all plots at pertinent stages.

The grain and stover samples from each plot were chemically analyzed for N, P and K concentration. Micro kjeldahl method (H_2S0_4, digestion) was followed for N determination (Subbiah and Asija, 1956) and the HNO_3 - $HC1O_4$ (4:1) digestion was made for P and K (Jackson, 1973). Nitrogen concentration was determined by titration method, the P concentration by colorimetric method and K concentration by flame photometer method. The nutrients uptake was calculated from the crop yield and nutrients concentration data. All obtained data from experiment were statistically analyzed by analysis of variance (ANOVA) according to randomized block design as prescribed by (Panse and Sukhatme, 1978). Standard error of mean in each case and critical difference only for significance cases were computed at 5% levels of probability.

RESULTS AND DISCUSSION

Growth attributes

Plant height

The plant height was significantly highest in treatment T_{12} during all the growth stages of mustard (Table 2). In general plant height picked up with advancement in crop age and increases with increasing nitrogen levels. The highest plant height at 30, 60 and 159 DAS, was recorded 30.46, 139.73 and 187.70 cm, respectively and found statistically at par with treatment T_{10} ($N_{120}P_{50}K_0$), and significantly superior to rest of the treatments. Plant height increases by 10.80, 24.42, 16.80 and

24.60% in T_5, T_6, T_7 and T_8 over control due to application of 80 kg N ha^{-1} with different combination of P and K application. With the further increase in N, the plant height also increases by 34, 36.30, 26.90 and 37.02% in T_9, T_{10}, T_{11} and T_{12} under different treatments. Plant height increases with application of N levels at every observation. Minimum plant height 22.23, 100.56 and 157.53 cm were recorded in T_1 (control) at all the stages, respectively. The similar results were also reported by (Khan *et al.,* 2000; Jat *et al.,* 2000; Saleem *et al.,* 2000; Cheema *et al.,* 2001; Oad *et al.,* 2001 and Dongarkar *et al.*, 2005).

Number of branches plant^{-1}

The maximum number of primary branches recorded in T_{12} ($N_{120}P_{50}K_{50}$) at 30 and 60 DAS was 2.73 and 8.45 significantly superior to rest of the treatments, respectively (Table 2). The Numbers of primary branches at 30 DAS increases by 28.79, 32.46, 29.84 and 42.93% in T_9, T_{10}, T_{11} and T_{12}, similarly at 60 DAS the numbers of primary branches increases by 36.37, 45.45, 39.27 and 53.63% in T_9, T_{10}, T_{11} and T_{12} respectively over control due to application of 120 kg N ha^{-1} with alone and different combination of P, K and PK. The primary branches increases with application of N levels at every observation. Minimum primary branches 1.91 and 5.50 was recorded in T_1 (control) at both stages respectively. The similar results were also reported by (Parihar and Tripathi, 1989; Patil *et al.,* 1996; Khan *et al.,* 2000; Pandey and Bharti, 2005 and Jat *et al.,* 2000).

Table 1. Details of the pot experiment and treatment

Experimental details	
Crop	: Mustard (*Brassica Juncia L.*) Cv. Kranti
Experimental design	: Randomized Block Design (RBD)
Number of treatments	: 12
Number of replication	: 3
Number of plots	: 36 (12 × 3)
Spacing	: 40 × 15 cm
Treatment	: N - 0, 80 &120 kg ha^{-1}, P - 0 &50 kg ha^{-1} and K - 0 & 50 kg ha^{-1}
Treatments details	: Control plot $T_1(N_0P_0K_0)$, $T_2(N_0P_{50}K_0)$, $T_3(N_0P_0K_{50})$, $T_4(N_0P_{50}K_{50})$, $T_5(N_{80}P_0K_0)$, $T_6(N_{80}P_{50}K_0)$, $T_7(N_{80}P_0K_{50})$, $T_8(N_{80}P_{50}K_{50})$, $T_9(N_{120}P_0K_0)$, T_{10} ($N_{120}P_{50}K_0$), T_{11} ($N_{120}P_0K_{50}$), and T_{12} ($N_{120}P_{50}K_{50}$) kg ha^{-1}

Table 2. Effect of different N levels with and without P and K on plant height, numbers of primary and secondary branches

Treatments	Plant height (cm.)			Primary branches		Secondary branches	
	30 DAS	60 DAS	At harvest	30 DAS	60DAS	60 DAS	At harvest
T1	22.23	100.56	157.53	1.91	5.50	11.33	12.50
T2	24.43	109.80	166.66	2.17	6.46	13.55	16.00
T3	23.36	105.63	162.96	2.07	6.30	12.83	15.16
T4	24.93	111.96	173.93	2.22	6.83	14.40	17.66
T5	24.63	118.50	174.13	2.25	6.33	14.00	16.45
T6	27.66	117.70	176.03	2.32	7.13	17.35	20.00
T7	25.83	116.10	174.86	2.30	6.50	16.07	18.83
T8	27.70	123.73	181.70	2.45	7.75	17.65	21.66
T9	29.89	124.96	180.70	2.46	7.50	17.88	20.91
T10	30.30	128.50	183.73	2.53	8.00	21.44	24.33
T11	28.23	125.06	181.36	2.48	7.66	20.03	22.85
T12	30.46	139.73	187.70	2.73	8.45	25.90	29.58
SEm±	0.670	1.440	2.151	.025	0.026	0.535	0.871
CD (0.05)	1.977	4.252	6.348	.073	0.078	1.580	2.570

The data of secondary branches counted at 60 and 159 DAS (harvest) were affected significantly are presented in (Table 2). It is apparent from the result show in the table that the significantly higher number of secondary branches at 60 DAS was 25.90 increases by 89.23, 76.78 and 128.59% in T_{10}, T_{11} and T_{12} over control and at 159 DAS was 29.58 increases by 94.64, 82.80 and 136% in T_{10}, T_{11} and T_{12} over control due to application of 120 kg N ha^{-1} with different combination of P, K and PK, while significantly lowest number of secondary branches per plant (11.33) at 60 and (12.50) at 159 DAS were recorded in T_1 (control).The result is supported by (Parihar and Tripathi, 1989; Patil *et al.,* 1996; Jat *et al.,* 2000; Tripathi and Tripathi, 2003; Pandey and Bharti, 2005).

Yield attributes

Pod plant^{-1}

Pod plant^{-1} is a very important parameter because of its association with other important yield components such as number of grains and 1000 grain weight. Pod plant^{-1} varied significantly under different treatments. The maximum number of pod plant^{-1} was 510.54 recorded in T_{12} ($N_{120}P_{50}K_{50}$) at harvest, increases by 115.07, 106.42 and 128.70% in T_{10}, T_{11} and T_{12} over control due to application of 120 kg N ha^{-1} with different combination of P, K and PK, respectively was found significantly superior to rest of the treatments. Minimum and significantly lower numbers of pod plant^{-1} 223.23 were recorded in T_1 (control).

Number of seeds pod^{-1}

The number of seeds pod^{-1} significantly maximum (14.75) recorded in T_{12} ($N_{120}P_{50}K_{50}$) at harvest was found significantly superior to rest of the treatments The Numbers of seed siliqua^{-1} increases by 14.43, 24.43, 22.26 and 28.26% in $T_{9,}$ T_{10}, T_{11} and T_{12} over control due to application of 120 kg N ha^{-1} alone and with different combination of P, K and PK respectively. Where significantly minimum numbers of seed siliqua^{-1} (11.50) was found in T_1 (control).Similar results were also reported by (Singh and Dixit, 1989; Parihar and Tripathi, 1989; Khan *et al.,* 2000; Saleem *et al.*, 2000; Reager *et al*., 2006 and Mir *et al.,* 2010).

1000 - Seed weight

The maximum 1000-seed weight (5.81gm) recorded in T_{12} ($N_{120}P_{50}K_{50}$) after harvest was found significantly superior to rest of the treatments (table).Most of the treatments related to 1000-seed weight was found statistically differ to each other. The 1000-seed weight increases by 5.58, 9.24, 7.70 and 11.94% in $T_{9,}$ T_{10}, T_{11} and T_{12} over control due to application of 120 kg N ha^{-1} alone and with different combination of P, K and PK respectively. While Minimum and significantly lower 1000-seed weight (5.19gm) was recorded in T_1 (control).

Table 3. Effect of different N levels with and without P and K on silliqua plant^{-1}, seed silliqua^{-1}, 1000-Seed weight, grain yield, stover yield, biological yield and harvest index

Treatments	Silliqua plant^{-1}	Seed silliqua^{-1}	1000-Seed weight (g)	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})	Biological yield (q ha^{-1})	HI %
T1	223.23	11.50	5.19	10.10	45.24	55.34	18.24
T2	262.91	12.50	5.31	11.39	51.97	63.36	17.97
T3	241.58	12.14	5.30	11.06	50.65	61.71	17.92
T4	281.14	12.66	5.36	12.11	55.13	67.24	18.01
T5	329.92	12.83	5.35	12.53	57.26	69.79	17.93
T6	386.80	13.50	5.43	13.75	62.30	76.05	18.08
T7	349.88	13.25	5.39	13.11	60.04	73.15	17.92
T8	427.13	14.41	5.51	15.22	68.82	84.05	18.10
T9	432.08	13.16	5.48	15.42	70.80	86.23	17.87
T10	489.32	14.31	5.67	17.98	78.77	96.75	18.58
T11	461.93	14.06	5.59	17.42	77.16	94.58	18.41
T12	510.54	14.75	5.81	20.78	89.17	109.96	18.89
SEm±	4.976	0.209	.016	0.103	0.461	0.564	0.199
CD (0.05)	14.689	0.618	.046	0.303	1.361	1.664	0.586

Yield

Grain yield

It is clear from the result yield characters were significantly affected by by different N levels with and without P and K levels are presented in (Table 4). The grain yield increased ranging from 10.10 to 20.78 q ha^{-1} under different treatments. The highest grain yield (20.78) qha^{-1} recorded in T_{12} ($N_{120}P_{50}K_{50}$) at harvest was found significantly superior to rest of the treatments. The grain yield increases by 52.67, 78.01, 72.47 and 105.74% in T_9, T_{10}, T_{11} and T_{12} over control due to application of 120 kg N ha^{-1} alone and with different combination of P, K and PK, while minimum grain yield (10.10 q ha^{-1}) was found in T_1 (control). The positive effect of N, P and K application on mustard grain yield had been reported by (Roy *et al*., 1981; Singh *et al.,* 1985; Kulia *et al,*. 1992; Thakuria and Gogoi 1996; Khan *et al.,* 200; Singh *et al.* 2002; Khan *et al.*, 2011; Mozaffari *et al.*, 2012 and Mir *et al.*, 2010).

Stover yield

The Stover yield was also found significantly superior over control in all the treatments, the yield of Stover increased ranging from 45.24 to 89.17qha^{-1} under different treatments. The highest Stover yield (89.17qha^{-1}) recorded in T_{12} ($N_{120}P_{50}K_{50}$) at harvest was found statistically superior to rest of the treatments. The Stover yield increases by 56.49, 74.11, 70.55 and 97.10% in T_9, T_{10}, T_{11} and T_{12} over control due to application of 120 kg N ha^{-1} alone and with different combination of P, K and PK respectively , while minimum Stover yield (45.24 qha^{-1}) was found in T_1 (control). These results are supported by (Verma *et al.,* 2011; Dongarkar *et al*., 2005 and Reager *et al.,* 2006).

Biological yield

The biological yield was found significantly, and maximum biological yield (109.96 qha^{-1}) recorded in T_{12} ($N_{120}P_{50}K_{50}$) at harvest was found statistically varied and significantly superior to rest of the treatments. The biological yield increases by 74.82, 70.90 and 98.69% inT_{10}, T_{11} and T_{12} over control due to application of 120 kg N ha^{-1} with different combination of P, K and PK respectively, while minimum biological yield (55.34 qha^{-1})was recorded in T_1 (control). All the treatments differ significantly among themselves.

Nutrients content and uptake

NPK Content

Nitrogen content of grain varied from 2.31 to 2.80% under different treatments. The maximum N content (2.80%) was found in T_{12} ($N_{120}P_{50}K_{50}$) which was statistically at par to T_6 ($N_{80}P_{50}K_0$), T_8 ($N_{80}P_{50}K_{50}$), T_{10} ($N_{120}P_{50}K_0$) and T_{11} ($N_{120}P_0K_{50}$) and significantly superior to rest of the treatments, while minimum N content (2.31%) was recorded in T_1 control. Phosphorus content of grain also varied significantly under different treatments and it ranged from 0.29 to 0.48% the highest being recorded in T_{12} while lowest in control. The

Table 4. Effect of different N levels with and without P and K on nutrients acquisition by mustard

Treatments	Nutrients content (%) in grain			Nutrients uptake in grains (kg ha^{-1})			Nutrients content (%) in stover			Nutrients uptake (kg ha^{-1}) in stover		
	N	P	K	N	P	K	N	P	K	N	P	K
T1	2.31	0.29	0.58	23.40	3.03	5.84	0.29	0.100	1.04	13.77	4.54	47.16
T2	2.39	0.35	0.61	27.31	4.07	6.94	0.34	0.113	1.11	17.90	5.87	57.95
T3	2.37	0.36	0.67	26.25	4.00	7.40	0.34	0.111	1.21	17.38	5.63	61.46
T4	2.48	0.39	0.73	30.13	4.80	8.84	0.36	0.116	1.29	20.28	6.14	71.46
T5	2.50	0.38	0.62	31.32	4.88	7.75	0.42	0.108	1.16	24.29	6.20	66.43
T6	2.66	0.42	0.68	34.66	5.80	9.34	0.42	0.125	1.28	26.72	7.78	80.09
T7	2.52	0.42	0.79	32.69	5.57	10.34	0.42	0.116	1.37	25.41	6.98	82.47
T8	2.66	0.44	0.84	40.51	6.81	12.78	0.44	0.128	1.45	30.80	8.82	100.36
T9	2.62	0.43	0.70	40.47	6.74	10.79	0.44	0.118	1.31	31.76	8.37	92.82
T10	2.70	0.46	0.76	48.55	8.33	13.66	0.45	0.129	1.41	35.69	10.17	111.52
T11	2.67	0.45	0.85	46.63	7.93	14.79	0.45	0.128	1.46	35.33	9.86	112.92
T12	2.80	0.48	0.89	58.20	10.09	18.49	0.48	0.132	1.49	42.94	11.82	132.94
SEm ±	0.050	0.001	0.014	0.261	0.046	0.221	0.001	0.001	0.002	0.212	0.081	0.588
CD (0.05)	0.147	0.003	0.042	0.770	0.135	0.651	0.004	0.004	0.007	0.626	0.240	1.737

maximum P content (0.48%) was found in T_{12} ($N_{120}P_{50}K_{50}$) which was statistically at par to T_{10} ($N_{120}P_{50}K_0$)and T_{11} ($N_{120}P_0K_{50}$) and significantly superior to rest of the treatments, but treatment T_6 ($N_{80}P_{50}K_0$) was found statistically at par to treatment T_7, ($N_{80}P_0K_{50}$), while minimum P content (0.29%) was recorded in T_1 (control) which significantly lower than all other treatments. The potassium content in grain at harvest increased from 0.58 to 0.89%. The maximum potassium content (0.89%) in grain was found in T_{12} ($N_{120}P_{50}K_{50}$) which was statistically at par to treatment T_{11} ($N_{120}P_0K_{50}$) and followed by all other treatments respectively. Lowest potassium content (0.58%) was found in T_1 (control). The result are supported by (Reddy and Sinha, 1989; Jahan *et al.*, 1992; Patel *et al.*, 1992; Jain *et al.*, 1995; Patel *et al.*, 1996; Shukla and Kumar, 1997; Puri *et al.,* 1999; Bhartendu and Gajendra, 2004; Malik *et al.,* 2006 and Reager *et al.*, 2006).

It is clear from the data that the NPK content in stover were affected significantly by different N levels with and without P and K. Stover N content varied by 0.29 to 0.48% significantly under different treatments. The maximum N content (0.48%) was found in T_{12} ($N_{120}P_{50}K_{50}$) which significantly higher by all other treatments, while minimum (0.29%) recorded in T_1 (control). Most of the treatments related to nitrogen content in Stover were found statistically at par. Stover phosphorus content ranges from 0.10 to 0.132% significantly under different treatments. Maximum phosphorus content (0.132%) was found in T_{12} ($N_{120}P_{50}K_{50}$) followed by all other treatments, while minimum phosphorus content (0.100%) was found in T_1 (control). Most of the treatments related to phosphorus content in Stover were found statistically at par. The potassium content in stover ranges from 1.04 to 1.49% significantly under different treatments. The maximum potassium content (1.49%) was found in T_{12} ($N_{120}P_{50}K_{50}$) and minimum (1.04%) recorded in T_1 (control) respectively. The result are supported by (Reddy and Sinha, 1989; Jahan *et al.*, 1992; Patel *et al.*, 1992; Jain *et al.*, 1995; Patel *et al.*, 1996; Shukla and Kumar, 1997; Puri *et al.*, 1999; Bhartendu and Gajendra, 2004; Malik *et al.,* 2006 and Reager *et al.*, 2006).

NPK Uptake

The data on NPK uptake by grain of mustard significantly affected by different treatments are presented in Table 4. The nitrogen uptake of grain varied from 23.40 to 58.20 kg ha^{-1} under different treatments. The maximum nitrogen uptake (58.20 kg ha^{-1}) was recorded in T_{12} ($N_{120}P_{50}K_{50}$) that was significantly higher by all other treatments. The minimum nitrogen uptake (23.40 kg ha^{-1}) was recorded in T_1 (control). The uptake of phosphorus by mustard grain varied significantly from 3.03 to 10.09 kg ha^{-1} under different treatments. Maximum phosphorus uptake (10.09 kg ha^{-1}) was recorded in T_{12} ($N_{120}P_{50}K_{50}$) which was significantly higher by all other treatments. The lowest (3.03 kg ha^{-1}) recorded in T_1 (control). Most of the treatments differ significantly among then selves in respect of phosphorus removal by mustard grain, but some treatments were found at par. Uptake of potassium by mustard grain was also affected significantly by different treatments. The data revealed that the potassium uptake increased significantly over control ($N_0P_0K_0$) in all the treatments. The potassium uptake of grain varied from 5.84 to 18.49 kg ha^{-1} under different treatments. The maximum nitrogen uptake (18.49 kg ha^{-1}) was recorded in T_{12} ($N_{120}P_{50}K_{50}$) which significantly higher by all other treatment, but treatment T_7 ($N_{80}P_0K_{50}$) was found statistically at par to treatment T_9 ($N_{120}P_0K_0$). The minimum nitrogen uptake (5.84 kg ha^{-1}) was recorded in T_1 (control) respectively. The result are supported by (Reddy and Sinha, 1989; Jahan *et al.,* 1992; Patel *et al.,* 1992; Jain *et al.*, 1995; Patel *et al.*, 1996); Shukla and Kumar, 1997; Puri *et al.*, 1999; Bhartendu and Gajendra, 2004; Malik *et al.*, 2006 and Reager *et al.*, 2006).

The NPK uptake by mustard stover was affected significantly by different treatments. The result shows that the nitrogen uptake by mustard stover varied from 13.77 to 42.94 kg ha^{-1} significantly under different treatments. The maximum N uptake by Stover (42.94 kg ha^{-1}) was recorded in T_{12} ($N_{120}P_{50}K_{50}$) which significantly higher to rest of the treatments, while minimum N uptake by Stover (13.77 kg ha^{-1}) recorded in T_1 (control). Most of the treatments related to nitrogen uptake by Stover were found statistically differ to each other respectively. It is apparent from the results that the phosphorus uptake by mustard stover increased significantly over T_1 (control). The result shows that the phosphorus uptake by mustard Stover varied from 4.54 to 11.82 kg ha^{-1} significantly under different treatments. The maximum phosphorus uptake (11.82 kg ha^{-1}) was obtained in T_{12} ($N_{120}P_{50}K_{50}$) followed by all other treatments, but treatment T_2 ($N_0P_{50}K_0$) was found at par to treatment T_3 ($N_0P_0K_{50}$), and treatment T_4 ($N_0P_{50}K_{50}$) at par to treatment T_5 ($N_{80}P_0K_0$) respectively. The minimum phosphorus uptake was found in T_1 (control) showing value 4.54 kg ha^{-1}. The uptake of potassium by mustard Stover was also affected significantly by different treatments. The results show that the potassium uptake by mustard Stover varied from 47.16 to 132.94 kg ha^{-1} significantly under different treatments. The maximum potassium uptake by Stover (132.94 kg ha^{-1}) was recorded in T_{12} ($N_{120}P_{50}K_{50}$) which was significantly higher to rest of the treatments, but treatment T_{10} ($N_{120}P_{50}K_0$) was found statistically at par to treatment T_{11} ($N_{120}P_0K_{50}$), while minimum potassium uptake by Stover (47.16 kg ha^{-1}) recorded in T_1 (control). Most of the treatments related to potassium uptake by stover were found statistically differ to each other respectively. The result are supported by (Reddy and Sinha, 1989; Jahan *et al.*, 1992; Patel *et al.*, 1992; Jain *et al.*, 1995; Patel *et al.*, 1996; Shukla and Kumar, 1997; Puri *et al.*, 1999; Bhartendu and Gajendra, 2004; Malik *et al.,* 2006 and Reager *et al.*, 2006).

CONCLUSION

On the basis of the finding of present investigation, it can be concluded that the treatment T_{12} ($N_{120}P_{50}K_{50}$), where 120 kg N was applied with 50 kg P and K each, were found significantly superior with highest grain yield 20.78 qha^{-1} among all the treatments, while minimum grain yield 10.10 qha^{-1} was recorded in the treatment T_1 (control). The combination of N, P and K was found superior than alone application of treatments in terms of growth, yield, uptake and other parameters of mustard crop. The best result was found in balanced fertilization and high dose of nitrogen due to synergetic effect of N with P and K.

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