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Effect of Tillage and Nutrient Management on NPK Content in Seed and Stover of Mustard

Shashank Tyagi*, Vinod Kumar, M.K. Singh, Mahendra Singh

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ABSTRACT

A field experiment was conducted in *rabi* season 2016-17 and 2017-18 to find out the effect of tillage and nutrient management on N, P and K content in seed and stover of mustard. It consisted of main plot with three tillage strategies viz., conventional, zero and reduced tillage, three S doses (0, 20 and 40 kg ha^{-1}) in sub plots and three B doses (0, 1.0 and 2.0 kg ha^{-1}) in sub sub plots were laid out in split split plot design replicated thrice. Results revealed that T_1S_3 was found the best in terms of highest N content in seed (3.78 and 3.75%) during 2016-17 and 2017-18, respectively. S_3B_3 was found the best in terms of highest N content in seed (3.74%) during 2017-18. T_1S_3 was found the best in terms of highest N content in stover (0.54 and 0.52%) during 2016-17 and 2017-18, respectively. Conventional tillage significantly enhanced the P content in seed of mustard during both the years. 40 kg S ha^{-1} produced significantly highest P content (0.70 and 0.68 %) over control and was at par with 20 kg S ha^{-1} during 2016-17 and 2017-18, respectively. 2.0 kg B ha^{-1} produced significantly highest P content in seed (0.69 and 0.67%) over control during both the years. In first year only, 2.0 kg B ha^{-1} was at par with 1.0 kg B ha^{-1}. Conventional tillage gave higher P content in stover over zero tillage, however, difference between conventional and reduced tillage was at par during first year only. 40 kg S ha^{-1} produced significantly highest P content in stover over control during both the years. In second year only, 40 kg S ha^{-1} was at par with 20 kg S ha^{-1}. Significantly highest P content in stover (0.45 and 0.46%) was recorded with 2.0 kg B ha^{-1} over remaining B levels during 2016-17 and 2017-18, respectively. T_1B_3 was the best in terms of highest K content in seed (1.14 and 0.93%) during 2016-17 and 2017-18, respectively. While T_1S_3 recorded significantly highest K content in seed (0.88%) during 2017-18.

Keywords Boron, NPK content in seed/stover, Sulfur, Tillage.

Shashank Tyagi*, M.K. Singh
Assistant Professor, Department of Agronomy, Bihar Agricultural College, Sabour, Bhagalpur 813210, Bihar, India

Vinod Kumar
PhD Scholar, Department of Agronomy, Bihar Agricultural College, Sabour, Bhagalpur, Bihar, India

Mahendra Singh
Assistant Professor, Department of Soil Science & Agricultural Chemistry, Bihar Agricultural College, Sabour, Bhagalpur, Bihar, India
Email : drshashank_tyagi@rediffmail.com
*Corresponding author

INTRODUCTION

In 'Rapeseed and Mustard' group of oil seeds, Indian mustard occupies the prime position in India. Oilseed crops are energy rich crops and require higher amount of nutrients including secondary and micronutrients per unit production as compared to cereals and puls-

Table 1. Effect of tillage, sulfur and boron on nitrogen, phosphorus and potassium content of mustard.

Treatments	N (%) in seed		N (%) in stover		P (%) in seed		P (%) in stover		K (%) in seed		K (%) in stover	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
Tillage practices												
T_1-Conventional tillage	3.59	3.56	0.51	0.49	0.70	0.68	0.42	0.44	0.98	0.78	2.31	1.83
T_2- Zero Tillage	3.24	3.22	0.42	0.40	0.62	0.59	0.37	0.39	0.80	0.60	2.22	1.75
T_3-Reduced Tillage	3.39	3.39	0.47	0.45	0.67	0.64	0.40	0.41	0.82	0.62	2.27	1.80
SEm±	0.027	0.025	0.007	0.004	0.007	0.009	0.007	0.015	0.012	0.012	0.015	0.014
CD (P = 0.05)	0.11	0.10	0.03	0.02	0.03	0.03	0.03	NS	0.05	0.05	0.06	0.05
Sulfur levels (kg ha^{-1})												
S_1-0	3.28	3.26	0.42	0.40	0.62	0.59	0.35	0.37	0.69	0.50	2.22	1.73
S_2-20	3.43	3.40	0.47	0.45	0.67	0.65	0.40	0.42	0.88	0.68	2.27	1.81
S_3-40	3.51	3.51	0.50	0.48	0.70	0.68	0.44	0.45	1.03	0.82	2.30	1.84
SEm±	0.041	0.029	0.006	0.008	0.011	0.013	0.004	0.010	0.023	0.010	0.021	0.015
CD (P = 0.05)	0.13	0.09	0.02	0.03	0.03	0.04	0.01	0.03	0.07	0.03	0.06	0.05
Boron levels (kg ha^{-1})												
B_1-0	3.21	3.19	0.41	0.39	0.61	0.59	0.34	0.35	0.68	0.48	2.21	1.73
B_2-1.0	3.46	3.43	0.47	0.45	0.68	0.65	0.40	0.42	0.90	0.69	2.28	1.81
B_3-2.0	3.56	3.56	0.52	0.50	0.69	0.67	0.45	0.46	1.03	0.82	2.30	1.84
SEm±	0.028	0.019	0.004	0.004	0.004	0.004	0.006	0.008	0.015	0.012	0.010	0.009
CD (P = 0.05)	0.08	0.05	0.01	0.01	0.01	0.01	0.02	0.02	0.04	0.04	0.03	0.03
Interaction												
T×S	S	S	S	S	NS	NS	NS	NS	NS	S	NS	NS
T×B	NS	NS	NS	NS	NS	NS	NS	NS	S	S	NS	NS
S×B	NS	S	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
T×S×B	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

es. Parihar *et al.* (2016) observed that deep tillage significantly increased N, P, K and S content of grain and straw in mustard. Ray *et al.* (2014) observed that nutrient content in straw increased significantly with each successive increase in S level. Piri *et al*. (2011) reported that 30 kg S ha^{-1}, being at par with 15 kg S ha^{-1}, significantly increased nutrient content in seed over no sulfur, whereas nutrient content increased with increasing S dose up to 30 kg ha^{-1}. Neha *et al.* (2014) reported that 60 kg S ha^{-1} improved nutrient concentration in seed and stover. Similarly, 40 kg S ha^{-1} recorded 13.6 and 38.2% higher nutrient concentration over 20 kg S ha^{-1} and control, respectively. Hussain and Thomas (2010) reported that grain nutrient concentration increased from 19.96 µg g^{-1} in control to 45.99 µg g^{-1} and 51.29 µg g^{-1} under 1.0 kg and 2.0 kg B ha^{-1}, respectively. Kumararaja *et al.* (2015) reported that nutrient content in stem, leaves and seed increased significantly with increase in B application. Choudhary and Bhogal (2013) found that the release of nutrients in soil solution depends upon intensity capacity of soil to supply these nutrients. Tillage practices, levels of S and B enhanced supply of nutrients and increased N, P, K, S and B content for their effective uptake.

Keeping these issues in view, the present investigation was undertaken to find out the effect of tillage and nutrient management on N, P and K content in seed and stover of mustard.

MATERIALS AND METHODS

A field experiment was conducted during *rabi* season 2016-17 and 2017-18 to find out the effect of tillage and nutrient management on N, P and K content in

Table 2. Interaction effect of tillage and sulfur on N content (%) in seed of mustard (2016-17).

Tillage practices	Sulfur levels (kg ha^{-1}) S_1-0	S_2-20	S_3-40
T_1- Conventional tillage	3.49	3.49	3.78
T_2- Zero tillage	2.88	3.14	3.47
T_3- Reduced tillage	3.33	3.37	3.69
SEm±		0.05	
CD (P=0.05)		0.15	

Table 3. Interaction effect of tillage and sulfur on N content (%) in seed of mustard (2017-18).

Tillage practices	Sulfur levels (kg ha^{-1}) S_1-0	S_2-20	S_3-40
T_1- Conventional tillage	3.46	3.46	3.75
T_2- Zero tillage	2.88	3.11	3.42
T_3- Reduced tillage	3.34	3.41	3.66
SEm±		0.03	
CD (P=0.05)		0.10	

seed and stover of mustard. The experiment comprised of three tillage practices viz., conventional tillage, zero tillage and reduced tillage in main plot and three doses of sulfur i.e. 0, 20 and 40 kg ha^{-1} in sub plots and three doses of boron i.e. 0, 1.0 and 2.0 kg ha^{-1} in plots laid out in split plot design having three replications. Conventional tillage was done through one ploughing followed by harrowing twice and leveling with planker. In reduced and zero tillage, tillage operations are minimized only restricted to seed bed preparation. Fertilizer dose (40:20: 20 kg NPK ha^{-1}) was applied as per critical stages of the crop. Full N dose and full P and K dose were applied at sowing. Sulfur and boron were applied at sowing time as per treatment wise schedule.

The data on nutrient content (N, P and K) in seed and stover at harvest stage of mustard were recorded. Data were statistically analyzed separately to interpret the results. The mean data for each parameter has been presented for comparison of 'F' value and for determination of critical difference at 5% level of significance.

RESULTS AND DISCUSSION

N content in seed

Increasing intensity of tillage from zero tillage to conventional tillage enhanced the N content in seed of mustard during both the years (Table 1). In 2016-17, significantly highest N content (3.51%) was recorded with 40 kg S ha^{-1} over control and was at par with 20 kg S ha^{-1} (3.43%) while in 2017-18, 40 kg S ha^{-1} gave significantly highest N content (3.51%) over rest of S doses.

Significantly highest N content (3.56 and 3.56%) was recorded with 2.0 kg B ha^{-1} over control and 1.0 kg B ha^{-1} during 2016-17 and 2017-18, respectively. Treatment combination of T_1S_3 was found the best in terms of highest N content in seed (3.78 and 3.75%) during 2016-17 and 2017-18, respectively (Tables 2 and 3). Treatment combination of S_3B_3 was found the best in terms of highest N content in seed (3.74%) during 2017-18 (Table 4).

N content in stover

Increasing intensity of tillage from zero tillage to conventional tillage caused significant increase in N content in stover of mustard during both the years (Tables 5 and 6). Application of 40 kg S ha^{-1} produced significantly highest N content (0.50 and 0.48%) in stover over control plot during both the years. In second year only, 40 kg S ha^{-1} was statistically at

Table 4. Interaction effect of sulfur and boron on N content (%) in seed of mustard (2017-18).

Sulfur levels	Boron levels (kg ha^{-1}) B_1-0	B_2-1.0	B_3-2.0
S_1-0	3.03	3.30	3.44
S_2-20	3.25	3.43	3.51
S_3-40	3.27	3.55	3.74
SEm±		0.04	
CD (P=0.05)		0.11	

Table 5. Interaction effect of tillage and sulfur on N content (%) in stover of mustard (2016-17).

Tillage practices	Sulfur levels (kg ha^{-1}) S_1-0	S_2-20	S_3-40
T_1- Conventional tillage	0.47	0.53	0.54
T_2- Zero tillage	0.35	0.38	0.49
T_3- Reduced tillage	0.44	0.45	0.53
SEm±		0.01	
CD (P=0.05)		0.03	

Table 6. Interaction effect of tillage and sulfur on N content (%) in stover of mustard (2017-18).

Tillage practices	Sulfur levels (kg ha^{-1}) S_1-0	S_2-20	S_3-40
T_1- Conventional tillage	0.45	0.51	0.52
T_2- Zero tillage	0.33	0.36	0.48
T_3- Reduced tillage	0.42	0.43	0.51
SEm±		0.01	
CD (P=0.05)		0.03	

par with 20 kg S ha^{-1}. Application of 2.0 kg B ha^{-1} produced significantly highest N content in stover (0.52 and 0.50%) over control plot and 1.0 kg B ha^{-1} during 2016-17 and 2017-18, respectively (Table 1). Only Interaction effect between tillage and sulfur (T×S) was significant for N content in stover during 2016-17 and 2017-18. Treatment combination of T_1S_3 was found the best in terms of highest N content in stover (0.54 and 0.52%) during 2016-17 and 2017-18, respectively (Tables 5 and 6).

P content in seed

Increasing intensity of tillage from zero tillage to conventional tillage significantly enhanced the P content in seed of mustard during both the years (Table 1). Application of 40 kg S ha^{-1} produced significantly highest P content (0.70 and 0.68 %) over control plot and was at par with 20 kg S ha^{-1} during 2016-17 and 2017-18, respectively. Application of 2.0 kg B ha^{-1} produced significantly highest P content in seed (0.69 and 0.67%) over control plot during both the years (Table 1). In first year only, 2.0 kg B ha^{-1} was statistically at par with 1.0 kg B ha^{-1}.

P content in stover

Tillage practices resulted marked improvement in P content in stover of mustard significantly during 2016-17 only (Table 1). Conventional tillage gave higher P content in stover over zero tillage, however, difference between conventional and reduced tillage was at par during first year only.

Application of 40 kg S ha^{-1} produced significantly highest P content in stover over control during both the years. In second year only, 40 kg S ha^{-1} was statistically at par with 20 kg S ha^{-1}. Significantly highest P content in stover (0.45 and 0.46%) was recorded with 2.0 kg B ha^{-1} over remaining B levels during 2016-17 and 2017-18, respectively (Table 1).

K content in seed

Conventional tillage gave significantly highest K content in seed over reduced tillage and zero tillage during both the years, however, the difference between reduced tillage and zero tillage was statistically at par (Table 1). Parihar *et al*. (2016) observed in mustard (*Brassica juncea* L.) with deep and conventional tillage and reported that deep tillage significantly increased N, P, K and S contents of grain and straw.

Significantly highest K content in seed (1.03 and 0.82%) was recorded with 40 kg S ha^{-1} over remaining S levels during 2016-17 and 2017-18, respectively. Significantly highest K content in seed (1.03 and 0.82%) was recorded with 2.0 kg B ha^{-1}

Table 7. Interaction effect of tillage and boron on K content (%) in seed of mustard (2016-17).

Tillage practices	Boron levels (kg ha^{-1}) B_1-0	B_2-1.0	B_3-2.0
T_1- Conventional tillage	0.75	1.05	1.14
T_2- Zero tillage	0.59	0.81	0.90
T_3- Reduced tillage	0.69	0.83	1.04
SEm±		0.03	
CD (P=0.05)		0.09	

Table 8. Interaction effect of tillage and boron on K content (%) in seed of mustard (2017-18).

Tillage practices	Boron levels (kg ha^{-1}) B_1-0	B_2-1.0	B_3-2.0
T_1- Conventional tillage	0.54	0.84	0.93
T_2- Zero tillage	0.39	0.60	0.70
T_3- Reduced tillage	0.49	0.62	0.83
SEm±		0.02	
CD (P=0.05)		0.06	

Table 9. Interaction effect of tillage and sulfur on K content (%) in seed of mustard (2017-18).

Tillage practices	Sulfur levels (kg ha^{-1}) S_1-0	S_2-20	S_3-40
T_1- Conventional tillage	0.61	0.83	0.88
T_2- Zero tillage	0.40	0.59	0.72
T_3- Reduced tillage	0.47	0.61	0.86
SEm±		0.02	
CD (P=0.05)		0.06	

over remaining B levels during 2016-17 and 2017-18, respectively. Interaction effect between tillage and sulfur (T×S) during second year and interaction between tillage and boron (T×B) during both the years was significant for K content in seed of mustard. Treatment combination of T_1B_3 was the best in terms of highest K content in seed (1.14 and 0.93%) during 2016-17 and 2017-18, respectively (Tables 7 and 8). While interaction between tillage practices and sulfur levels, treatment combination of T_1S_3 recorded significantly highest K content in seed (0.88%) during 2017-18 (Table 9).

K content in stover

Conventional tillage gave significantly higher K content in stover over zero tillage during both the years, however, difference between conventional tillage and reduced tillage was at par (Table 1). Lu *et al.* (2010) reported that the effects of tillage were limited for nutrient concentrations but had significant effect on heavy metals. Significantly highest K content in stover (2.30 and 1.84 %) was recorded with 40 kg S ha^{-1} over control and was at par with 20 kg S ha^{-1} (2.27 and 1.81%) during 2016-17 and 2017-18, respectively. Significantly highest K content in stover (2.30 and 1.84 %) was recorded with 2.0 kg B ha^{-1} over control and was at par with 1.0 kg B ha^{-1} (2.28 and 1.81 %) during 2016-17 and 2017-18, respectively.

Nitrogen, phosphorus and potassium in seed and stover increased with increasing levels of S and BA close examination of the data revealed marked effect of different doses of S and B on N, P and K content in seed and stover. This might be attributed to greater availability of nutrients due to better soil properties. In general, higher concentration of N and P were recorded in seed than straw suggesting efficient translocation of nutrients to the sink i.e. seed. Higher levels of S and B assured the availability of nutrients in adequate amount. Hence, under 40 kg S ha^{-1} and 1.0 kg B ha^{-1}, there was more healthy and vigorous plant growth as evident by taller plants, more number of branches and dry matter production. This accompanied with better nutrient content in mustard with increasing levels of S and B up to 40 kg S ha^{-1} and 2.0 kg B ha^{-1}. These results are in close conformity with the findings of Kumar and Trivedi (2012). The release of nutrients in soil solution depends upon intensity capacity of soil to supply these nutrients. Tillage practices, levels of S and B enhanced supply of nutrients and increased N, P and K content for their effective uptake.

CONCLUSION

Thus, it might be concluded that application of 40 kg S ha^{-1}, 2.0 kg B ha^{-1} and conventional tillage resulted into maximum nutrient (N, P and K) content in seed and stover part of mustard.

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