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Growth and yield of rapeseed (*Brassica campestries* var. toria) influenced by NPK and sulphur under rainfed condition

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Abstract

A field experiment was conducted during two consecutive years, 2016-17 and 2017-18 in the *Rabi* season at Instructional Cum Research Farm of Assam Agricultural University, Jorhat, Assam, India to find the effect of different fertilizer (NPK) and sulphur (S) levels on growth and yield of rapseed (*Brassica campestries* var. toria). The experiment comprised of 3 levels of NPK *viz.* F_1: 30.00-26.25-11.25 kg N- P_2O_5 - K_2O/ha (75% of RDF), F_2: 40.00-35.00-15.00 kg N- P_2O_5 - K_2O/ha (100% of RDF), F_3: 50.00-43.75-18.75 kg N- P_2O_5 - K_2O/ha (125% of RDF) and 5 levels of sulphur *viz.* S_1: 0 kg S ha^{-1}, S_2: 5 kg S ha^{-1}, S_3: 10 kg S ha^{-1}, S_4: 15 kg S ha^{-1}, and S_5: 20 kg S ha^{-1} . Result revealed that all the growth characters as well as yield attributing characters increased with increasing level of NPK upto 50.00-43.75-18.75 kg N-P_2O_5-K_2O (125% of RDF) but at par with 40.00-35.00-15.00 kg N-P_2O_5-K_2O (100% of RDF). Similarly, the highest seed yield of 824.53 kg ha^{-1} and 799.3 kg ha^{-1} during 2016-17 and 2017-18 was recorded by application of 125% of RDF which was at par with the yield (796.60 kg ha^{-1}, 766.40 kg ha^{-1}) obtained from 100% of RDF. Similar trend was also observed in case of stover yield, oil content and oil yield. Moreover, with increase in dose of sulphur from 0-20 kg ha^{-1} all the growth characters viz., plant height, number of branches per plant and leaf area index were increased and the highest seed yield (910.89 kg/ha, 885.49 kg/ha) was recorded with the application of 20 kg S ha^{-1} in both the years.

***Key words** : NPK, rapeseed-mustard, stover yield, sulphur*

Introduction

Rapeseed-mustard is the major group of oilseed crops cultivated in Assam occupying an area of 302 thousand hectare with total production of 187 thousand tonnes and productivity of 619 kg/ha (Anon, 2016-2017). The average seed and oil yield of the state is low as compared to the national average mainly because of cultivation of 90% of the crop under marginal and sub-marginal lands of delayed sowing and rainfed conditions. Under this circumstance lack of proper nutrition is one of the reasons for low yield. In case of rapeseed and mustard the nitrogen, phosphorus and potassium fertilization plays a vital role in crop production. Moreover, sulphur also plays an important role in oilseed crop because under the deficient of this element, the efficiency of NPK fertilizers may be severely affected and reduction in crop yield and quality may occur (Ahmad *et al*., 1994). Therefore substantial increase in crop yield and oil content of the crop could be achieved by application of appropriate dose of NPK fertilizers along with proper dose of sulphur fertilizer. Keeping this in view an experiment was conducted to find out effect of NPK fertilizers and sulphur nutrition of toria in rice fallow under rainfed condition.

Materials and Methods

The experiment was conducted for two consecutive years (2016-17 and 2017-18) at the Instructional-cum-Research (ICR) Farm, Assam Agricultural University, Jorhat situated at 26°45'N latitude, 94°12'E longitude and at an altitude of 87 m from the mean sea level. The region is located at sub-tropical humid with maximum temperature in the range 34-37°C in general, during summer and the minimum temperature range falls between 8-10°C during winter. The experimental site was sandy loam in texture, medium in with organic carbon (0.5-0.48%), medium in available N (313.6 and 298.28 kg/ha), low in available P_2O_5 (20.51 and 19.95 kg/ha), medium in available K_2O (174.72 and 170.00kg/ha) and low in available S (16.24 and 15 kg/ha). The experiment comprised of 3 levels of NPK *viz.* F_1: 30.00-26.25-11.25 kg N- P_2O_5 - K_2O/ha (75% of RDF), F_2: 40.00-35.00-15.00 kg N- P_2O_5 - K_2O/ha (100% of RDF), F_3: 50.00-43.75-18.75 kg N- P_2O_5 - K_2O/ha (125% of RDF) and 5 levels of sulphur *viz.* S_1: 0 kg S ha^{-1}, S_2:5 kg S ha^{-1}, S_3: 10 kg S ha^{-1}, S_4: 15 kg S ha^{-1}, and S_5: 20 kg S ha^{-1}. The experiment was laid out in factorial RBD with three replications. The land was preparad thorougly and well decomposed FYM @ 2 t/ha was uniformly broadcasted over the experimental area and thoroughly incorporated with soil at the time of final land preparation. As per treatment full dose of P_2O_5 as diammonium phosphate (DAP), K_2O as muriate of potash (MOP) and S as gypsum were applied by broadcasting one day before sowing and incorporated into the soil. In case of N, the requirement amount of urea as per treatment was found out by subtracting the amount of nitrogen supplied through DAP and uniform half dose of urea was applied as basal one day before sowing and remaining half was applied 20 days after sowing along with weed control operation. The required amount of borax @ 10kg/ha (as per recommendation) was also applied in each plot along with the fertilizers. Seeds of rapeseed variety JT-90-1 (Jeuti) were sown on 9th December, 2016 and 12th December, 2017, respectively @ 13 kg/ha in furrows uniformly at a depth of 4-5 cm keeping a distance of 30 cm between the furrows. Then the seeds were covered with a thin layer of soil. Intercultural operations and plant protection measures were taken as and when required. All the growth parameters and yield was recorded and statistically analyzed.

Results and Discussion

Growth characters

Data pertaining to growth characters *viz.* Plant height, number of branches per plant, leaf area index at various growth stages as influenced by NPK and S is presented in Table 1. In both the years, the plant height increased successively with the advancement of crop growth and significantly the highest plant height (115.13 cm and 107.63 cm) was registered at harvest with the application of 125% of recommended dose of fertilizer which was found to be at par with application of 100% of RDF. Similar result was obtained in case of number of branches per plant^{-1} and highest value of 7.34 and 8.27 was obtained with the application of 125% RDF during 2016-17 and 2017-18. Greater plant height and number of branches per plant may be due to receiving of adequate and balanced fertilization which led to better metabolic activities performed by the crop at optimum fertility levels. However, the leaf area index sharply increased upto 40 DAS after that it gradually decreased during later stage of crop growth irrespective of treatments. The higher leaf area index (1.32 1nd 1.37) was also reported by application by 125 % of RDF during both the years which was found to be at par with 100% of RDF. Similar finding was also reported by Deka *et al.* (2018).

Similarly, all the growth characters were also influenced significantly due to application of sulphur (Table1). The plant height was increased with increasing sulphur levels and maximum was recorded by application of 20 kg S ha^{-1} at harvest (118.56 cm, 114.44cm) in both the years. Similar results were also obtained in case of number of branches per plant. In case of leaf area index the higher values of 1.37 and 1.41, respectively were obtained with the application of 20 kg S ha^{-1} at 40 DAS which sharply decreased upto 0.80 and 0.84 during later stage of crop growth during both the years. These results are in conformity with those reported by Kumar and Yadav (2007). Increase in various growth parameters like plant height, leaf area index was also reported by Begum *et al.* (2012).

Table 1: Effect of NPK and Sulphur on growth characters of toria

Treatments	Plant height At harvest (cm)		Number of branches per plant at 90 DAS		Leaf area index (LAI) 40 DAS		Leaf area index (LAI) 60 DAS	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
F_1: 30.00-26.25-11.25 (75% of RDF)	99.93	96.07	5.01	5.94	1.09	1.13	0.60	0.65
F_2: 40.00-35.00-15.00 (100% of RDF)	111.41	105.96	6.95	7.95	1.24	1.27	0.69	0.73
F_3: 50.00-43.75-18.75 (125% of RDF)	115.13	107.63	7.34	8.27	1.32	1.37	0.75	0.79
S.Em.±	2.64	2.50	0.22	0.24	0.033	0.035	0.022	0.022
C.D.(P=0.05)	7.63	7.23	0.65	0.69	0.10	0.10	0.06	0.06
S_1: 0	105.11	96.59	5.09	6.02	1.13	1.18	0.56	0.61
S_2: 5	105.78	99.49	6.25	7.18	1.17	1.21	0.64	0.69
S_3: 10	105.89	100.89	6.39	7.52	1.18	1.23	0.68	0.72
S_4: 15	108.79	104.67	6.79	7.62	1.22	1.27	0.71	0.75
S_5: 20	118.56	114.44	7.65	8.58	1.37	1.41	0.80	0.84
S.Em.±	3.40	3.26	0.29	0.31	0.043	0.044	0.029	0.029
C.D.(P=0.05)	9.86	9.33	0.84	0.89	0.12	0.13	0.08	0.08

Table 2: Yield attributes as influenced by levels of NPK and sulphur

Treatment	No. of siliqua per plant		Siliqua length (cm)		No. of seeds per siliqua		1000- seed weight (g)	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
Levels of NPK (F) (N-P_2O_5-K_2O kg/ha)								
F_1: 30.00-26.25-11.25 (75% of RDF)	68.73	66.30	4.14	3.81	13.90	12.98	2.48	2.44
F_2: 40.00-35.00-15.00 (100% of RDF)	98.81	96.49	4.84	4.57	16.68	15.79	2.50	2.46
F_3: 50.00-43.75-18.75 (125% of RDF)	103.22	100.90	4.98	4.65	17.53	16.61	2.56	2.50
S.Em.±	2.58	2.57	0.18	0.16	0.41	0.40	0.05	0.04
C.D.(P=0.05)	7.46	7.44	0.51	0.47	1.19	1.15	NS	NS
Levels of sulphur (S) (kg/ha)								
S_1: 0	75.78	73.27	4.26	3.67	12.89	11.70	2.43	2.34
S_2: 5	80.44	78.12	4.47	4.21	15.23	14.38	2.45	2.42
S_3: 10	89.33	87.01	4.48	4.22	15.94	15.09	2.52	2.49
S_4: 15	94.56	92.24	4.65	4.49	17.28	16.48	2.54	2.51
S_5: 20	111.17	108.85	5.39	5.13	18.83	17.98	2.58	2.55
S.Em.±	3.33	3.32	0.23	0.21	0.53	0.51	0.06	0.06
C.D.(P=0.05)	9.63	9.61	0.66	0.61	1.53	1.49	NS	NS

Yield attributing characters

The yield attributing characters were also influenced significantly due to application of NPK in both the years (Table 2). Result revealed that application of 125% of RDF improved various yield attributing characters *viz.*, number of siliquae per plant (103.22, 100.90), number of seeds per siliqua (17.53 and 16.61), siliqua length (4.98 cm 4.65 cm) except 1000-seed weight which was found to be non-significant. However, the yield attributing characters obtained by application of 125% of RDF was at par with application of 100% of RDF. The adequate application of NPK especially nitrogen supply enables the crop to make rapid leaf growth to intercept more solar radiation to produce more filled siliqua. Tahir *et al.* (2003) also recorded higher number of siliqua per plant and number of seeds per siliqua. Increase in number of siliquae per plant, length of siliqua, seeds per siliqua, 1000-seed weight was also reported by Kumar et *al.* (2017) and Deka *et al*. 2018.

Similarly, the yield attributing characters except 1000-seed weight were significantly increased with the increasing level of S and the highest value was obtained with application of 20 kg S ha^{-1} (Table 2). The increase in the yield attributes might be due to increased absorption of sulphur from the soil resulting in formation of reproductive structure which plays a vital role in improving the vegetative structure for nutrient absorption and provides strong sink through the development of reproductive structure as well as the production of assimilates to fill economically important sink (Sharma and Singh, 2005). Increase in yield attribute along with increase in sulphur levels was also reported by Pratap *et al.* (2016), Islam *et al*. (2018).

Seed and stover yield

Application of graded levels of NPK resulted in significantly higher seed and stover yield in both the years of toria (Table 3). The seed yield increased significantly with increasing levels of NPK and the highest seed yield (824.53 kg ha^{-1} and 799.3 kg ha^{-1}) was recorded by application of 125% of RDF which was at par with the yield (796.60 kg ha^{-1}, 766.40 kg ha^{-1}) obtained from 100% of RDF. Increase in seed yield due to successive increase in the levels of NPK may be mainly due to increase in yield attributes *viz.*, higher number of siliquae per plant, seeds per siliqua and 1000-seed weight and their cumulative effect. Mir *et al.* (2010) also registered the highest seed yield with the application of higher doses of N-P_2O_5-K_2O kg ha^{-1}. Similarly, the highest stover yield of 1725.49 kg ha^{-1} and 1710.49 kg ha^{-1} during two consecutive years were recorded by 125% of RDF which was at par with 100% of RDF (1645.76 kg ha^{-1} and 1630.76 kg ha^{-1}). However, both seed yield and stover yield significantly reduced with application 75% of RDF in both the years. Increase in stover yield at higher NPK

Table 3: Seed and stover yield as influenced by levels of NPK and sulphur

Treatment	Seed yield (kg/ha)		Stover yield (kg/ha)		Harvest index (%)	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
Levels of NPK (F) (N-P_2O_5-K_2O kg/ha)						
F_1: 30.00-26.25-11.25 (75% of RDF)	587.80	566.05	1315.40	1301.40	30.31	29.68
F_2: 40.00-30.00-15.00 (100% of RDF)	796.60	766.40	1645.76	1630.76	32.62	31.99
F_3: 50.00-43.75-18.75 (125% of RDF)	824.53	799.33	1725.49	1710.49	32.32	31.83
S.Em.±	17.82	17.13	35.54	35.46	0.73	0.71
C.D.(P=0.05)	51.62	49.61	103.00	102.70	NS	NS
Levels of sulphur (S) (kg/ha)						
S_1: 0	588.33	566.79	1335.89	1322.55	29.85	29.20
S_2: 5	657.44	635.38	1449.10	1434.10	31.06	30.52
S_3: 10	723.33	701.27	1535.98	1520.98	31.99	31.52
S_4: 15	801.56	764.04	1637.41	1622.41	32.84	32.02
S_5: 20	910.89	885.49	1852.70	1837.70	33.00	32.56
S.Em.±	23.00	22.11	45.88	45.78	0.94	0.91
C.D.(P=0.05)	66.64	64.05	132.90	132.60	NS	NS

levels might be due to increase in plant height, number of branches, number of leaves and number of siliquae/plant. Higher seed and stover yield with increased level of N-P_2O_5-K_2O ha^{-1} was also reported by Tahir *et al.* (2003), Sharma (2013) and Deka *et al*. (2018).

In case of sulphur, each successive increase in sulphur levels increased the seed yield up to 20 kg S ha^{-1} (910.89 kg ha^{-1}, 885.49 kg ha^{-1}) which was significantly higher than other sulphur levels. The higher stover yield was also recorded with 20 kg S ha^{-1} (1852.70 kg ha^{-1}, 1837.70 kg ha^{-1}). The increase in number of siliquae per

Table 4: Oil content and oil yield of toria seed as influenced by levels of NPK and sulphur

Treatment	Oil content (%)		Oil yield (kg/ha)	
	2016-17	2017-18	2016-17	2017-18
Levels of NPK (F) (N-P_2O_5-K_2O kg/ha)				
F_1: 30.00-26.25-11.25 (75% of RDF)	34.45	33.11	205.22	190.02
F_2: 40.00-35.00-15.00 (100% of RDF)	38.06	36.86	303.83	283.09
F_3: 50.00-43.75-18.75 (125% of RDF)	38.63	37.57	319.79	301.79
S.Em.±	0.68	0.68	6.89	6.53
C.D.(P=0.05)	1.97	1.96	19.96	18.93
Levels of sulphur (S) (kg/ha)				
S_1: 0	34.97	33.70	210.99	196.24
S_2: 5	36.53	35.26	241.42	225.29
S_3: 10	36.99	35.72	269.20	252.14
S_4: 15	37.01	36.01	297.50	276.09
S_5: 20	39.74	38.55	362.29	341.75
S.Em.±	0.88	0.87	8.89	8.43
C.D.(P=0.05)	2.55	2.53	25.77	24.43

plant, seeds per siliqua and 1000- seed weight might have positively influenced the seed yield. The increasing levels of sulphur might have resulted in greater accumulation of carbohydrates, protein and their translocation to the productive organs, which in turn improved all the growth and yield attributing characters, resulting more seed yield (Pachuri and Trivedi, 2012). Increase in stover yield might be due to increase in various growth parameters like plant height, number of primary and secondary branches and yield attributing character like number of siliquae/plant. Sharma (2013) also recorded higher seed yield and stover yield with increasing sulphur levels.

Seed oil content and oil yield

Oil content and oil yield increased with increasing level of NPK in toria (Table 4). However, the seed oil content recorded by the application of 125% of RDF (38.63% and 37.57%) was at par with 100% of RDF (38.06%, 36.86 %) but superior over 75% RDF (34.45, 33.11) in both the years. The increase in oil content with increase in NPK levels might be due to better metabolic processes due to increase in phosphorus levels which positively influence the biosynthesis of fatty acids. Deka (2018) also recorded higher oil yield of toria at higher NPK levels.

The oil content increased significantly from 0 to 20 kg S ha^{-1} in both the years (Table 4). Increase in oil content along with increase in sulphur levels was also recorded by Kumar *et al.* (2016). Similarly, the oil yield also increased with increasing level of S from from 0 to 20 kg Sha^{-1}. Lakshman *et al.* (2017) also reported that oil yield was increased by increase in sulphur levels.

References

Begum F, Hossain F and Momdal IR. 2012. Influence of sulphur on morphological and yield parameters of rapeseed (*B. campestris*). *Bangladesh J Agric Res* **37**: 645-652.

Deka P, Pathak K, Sarma A, Medhi BK, Dutta PK and Saikia M. 2018. Productivity and economics of late sown rapeseed (*B. campestries* var. Toria) after winter rice under varying irrigation and nutrient levels. *J Oilseed Brassica* **9:** 59-64

Islam R, Hossain HMM, Karim F and Haque N. 2018. Yield and yield components of rapeseed as influenced by nitrogen and sulphur fertilization. *J Oilseed Brassica* **9:** 84-95.

Kumar H and Yadav DS. 2007. Effect of phosphorus and sulphur levels on growth, yield and quality of Indian mustard (*B. juncea*) cultivars. *Indian J Agron* **52**: 154-157.

Kumar V, Nath P, Kumar R., Kumar V, Verma JK and Naresh RK. 2016. Interactive effect of sulphur and nitrogen on growth, yield and quality of indian mustard (*B. juncea* L.). *Intl J Sci Naut* **7**: 57-61.

Kumar A, Mahapatra B S, Yadav A, Kumari U, Singh SP and Verma G. 2017. Effect of different fertility levels on growth, yield attributes, yield and quality of Indian mustard (*B. juncea*). *Ann Agric Res* **38**: 98-103.

Lakshman K, Vyas AK, Shivakumar BG, Rana DS, Layek J and Munda S. 2017. Direct and residual effect of sulphur fertilization on growth, yield and quality of mustard in a soybean–mustard cropping system. *Intl J Curr Microbiol App Sci* **6**: 1500-1512.

Mir MR, Mobin M, Khan NA, Bhat MA, Lone MA, Bhaf KA, Razvi SM,Wansi SM, Wani N, Akhter S, Rashid S, Masoodi NH and Payne WA. 2010. Effect of fertilizers on yield characteristics of mustard (*B. juncea*). *J Phytology* **62**: 20-24.

Pachuri, KR.and Trivedi SK. 2012. Effect of sulphur on growth, yield and quality of Indian mustard (*B. juncea*) genotypes. *Ann Agric Res New Series* **33**: 131-135.

Pratap T, Chaurasiya J, Singh G, Singh VD and Singh NP. 2016. Effect of sulphur levels on growth, yield and quality of mustard (*B. juncea*) varieties. *Eco Env Cons* **22**: 181-185.

Sharma OP and Singh GD. 2005. Effect of sulphur in conjunction with growth substances on productivity of clusterbean (*Cyamopsis tetragonoloba*) and residual effect on barley. *Indian J Agron* **50**: 16-18.

Sharma P. 2013. Response of mustard varieties to fertility levels in alluvial soils of Madhya Pradesh. *A J Multidisc Adv Res* **2**: 47-49.

Tahir M, Malik AM, Tanveer A and Ahmad R. 2003. Effect of NPK levels on seed yield and oil contents of canola. *Pakistan J Life Soc Sci* **1**: 127-132.