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EFFECT OF PHOSPHORUS AND SULPHUR ON GROWTH, YIELD AND ECONOMICS OF INDIAN MUSTARD (*BRASSICA JUNCEA* COSS.)

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Abstract

A field experiment entitled "Effect of phosphorus and sulphur on growth, yield and economics of Indian mustard (*Brassica juncea coss*.)" was carried out at Farmer field of Ballia District (U.P.), India during the *rabi* season of 12-13. The experiment was laid out in Randomized Block Design having three levels of phosphorus (20, 40 and 60 kgha^{-1}) and sulphur (20, 30 and 40 kg ha^{-1}) each with three replications. The phosphorus and sulphur were applied through SSP and gypsum, respectively. Indian mustard variety Varuna was sown on 26th October, 2012 with the seed rate of 5.0 kg ha^{-1}. The plant height, dry weight per plant, no. of siliqua plant^{-1}, seed yield and stover yield increased significantly at 60 kg phosphorus and 40 kg sulphur ha^{-1}, over lower doses of phosphorus and sulphur. Application of 60 kg phosphorous and 40 kg sulphur ha^{-1} gave the higher plant height (100.38 and 101.00 cm), dry weight plant^{-1} (16.96 and 17.04 g), no. of siliqua plant^{-1} (570.54 and 566.55), no. of seed siliqua^{-1} (13.09 and 13.49), seed yield (15.44 and 15.62 qha^{-1}), stover yield (35.26 and 35.67 qha^{-1}) and net return (Rs. 32,891.6 ha^{-1}), respectively. Oil content increased significantly with the application of 60kg phosphorus ha^{-1} and 40 kg sulphur ha^{-1} (39.32 and 39.40).

Key words : Phosphorus, sulphur, Indian mustard.

In India, rapeseed mustard is grown in about 7.06 million hectares of area with a production and productivity of 4.71 million tonnes and 6.67 qha^{-1}, respectively. Rajasthan has the highest production of mustard having an area of 3.28 million hectares, production of 2.19 million tonnes and a productivity of 6.20 qha^{-1}. Phosphorus is an essential element for rapeseed and mustard and indicated that phosphorus application in general had beneficial effect on improving plant vigour, resistance of plant against insect pest and diseases and in increasing the vegetative growth and seed yield of rapeseed and mustard. Phosphorus applied in combination with sulphur and potassium, increased the yield, significantly has been reported by Maini and Nagi (2003). In a field trial, significant increase in oil content and yield contributing characters such as number and length of siliqua, seed siliqua^{-1} and 1000-seed weight with every increase in the level of sulphur upto 40 kg ha^{-1} was reported by Singh *et al*. (2002). Keeping these facts in view, an experiment entitled "Growth, yield attributes, grain yield and economics of Indian mustard (*Brassica juncea coss*.)" as affected by phosphorus and sulphur levels was conducted on sandy loam soils of eastern U.P.

A field experiment including three levels of phosphorus (20, 40 and 60 kg ha^{-1}) and sulphur (20, 30 and 40 kg ha^{-1}) each was conducted in R. B. D. with three replications during winter season (*rabi*) of 2012-2013 on Indian mustard at Farmer field in Ballia district (U.P.), India. The soil of the experimental field was sandy loam, in texture having pH 7.5, organic carbon 0.43% with the available nitrogen, phosphorus and potassium at 185.5 kg, 28.0 kg and 160 kg ha^{-1}, respectively. The crop was fertilized with 100 kg nitrogen and 40 kg potassium ha^{-1} with the due levels of phosphorus and sulphur. The nitrogen, phosphorus, potassium and sulphur were applied through urea, single super phosphate, mutriate of potash and gypsum, respectively. Except nitrogen, all the nutrients were applied as basel dose while half dose of nitrogen was applied as basel and remaining half dose of nitrogen was applied by top dressing at 60 DAS. The crop was sown on 26th October, 2012, maintaining the spacing of 30 cm × 10 cm. The five plants were selected randomly from each plot and tagged for recording the data on growth and yield attributes. The crop was harvested on 4th March, 2013 (125 DAS) and oil content was extracted by soxhlet extraction method.

Table 1 : Effect of P and S levels on plant height, dry weight, no. of siliqua plant^{-1}, no. of seed siliqua^{-1} and oil content.

Treatments	Plant height (cm) 60DAS	Dry weight (g)	No. of siliqua plant^{-1}	No. of seed siliqua^{-1}	Seed yield qha^{-1}	Stover yield qha^{-1}	Oil content (%)
Phosphorus (kgha^{-1})							
20	98.50	16.09	524.90	11.32	12.67	29.39	36.16
40	99.91	16.32	547.60	12.34	14.73	33.18	38.08
60	100.38	16.96	570.54	13.09	15.44	35.26	39.32
CD (P = 0.05)	0.57	0.62	2.50	0.76	0.50	0.62	0.85
Sulphur (kg ha^{-1})							
20	98.45	15.91	531.53	11.26	12.98	29.84	37.02
30	99.33	16.42	541.96	12.00	14.24	32.32	37.13
40	101.00	17.04	566.55	13.49	15.62	35.67	39.40
CD (P = 0.05)	0.57	0.62	2.50	0.76	0.5	0.62	0.85

Table 2 : Economics of different treatments.

Treatment	Grain yield (q/ha)	Stover yield (q/ha)	Cost of cultivation (Rs./ha)	Gross retrun (Rs./ha)	Net retrun (Rs./ha)	Benefit cost ratio
(Phosphorus 20 kg + Sulphur 20 kg)	11.2	27.0	11264.40	30,700.0	19,435.6	2.72
(Phosphorus 20 kg + Sulphur 30 kg)	11.8	27.3	11354.44	32,230.0	20,875.56	2.83
(Phosphorus 20 kg + Sulphur 40 kg)	14.1	32.0	11448.40	38,450.0	27,001.6	3.35
(Phosphorus 40 kg + Sulphur 20 kg)	13.0	29.8	11264.40	35,480.0	24,215.6	3.35
(Phosphorus 40 kg + Sulphur 30 kg)	14.6	33.3	11354.44	39,830.0	28,475.56	3.50
(Phosphorus 40 kg + Sulphur 40 kg)	15.6	34.4	11448.40	42,440.0	30,991.6	**3.70**
(Phosphorus 60 kg + Sulphur 20 kg)	13.9	30.9	11264.40	37,840.0	26,575.6	3.35
(Phosphorus 60 kg + Sulphur 30 kg)	15.4	34.4	11354.44	41,194.0	29,839.56	3.62
(Phosphorus 60 kg + Sulphur 40 kg)	16.2	38.4	11448.40	44,340.0	32,891.6	3.87

Note : Cost of urea Rs. 5.04 /kg, SSP Rs. 3.60 /kg, MOP Rs. 4.44 /kg, gypsum Rs. 2.00 /kg, grain Rs. 2500 /q, stover Rs. 100/q, labour Rs. 100 /day.

The perusal of data given in table 1 reveal that increasing dose of phosphorus and sulphur increased the plant height, dry weight, no. of siliqua, no. of seeds siliqua, seed yield, stover yield and oil content. The maximum value of plant height (100.38 cm) and dry weight (16.96g) recorded at 60 DAS. No. of seed siliqua^{-1} 13.09 and no. of silique plant^{-1} were recorded with 60 kg ha^{-1} phosphorus, which was significantly higher over the 40 and 20 kg P ha^{-1}. The seed and stover yield was also recorded significantly higher due to 60 kg phosphorus ha^{-1} might be become of the higher growth and yield attributes at this level of phosphorus. The oil content (39.32%) was also recorded significantly higher at 60 kg ha^{-1} phosphorus might be due better metabolic process took place in the plant. These result are also in conformity with the work of Vidhya (2001) and Vir and Verma (2004). Among the different sulphur level, significantly higher values were recorded with plant height (101.00 cm), dry matter (17.04g) recorded at 60 DAS as well as yield attributes and of seed and stover, this might be due to the fact that soil was deficient to supply sufficient quantity of sulphur to the crop resulted to this 40 kg ha^{-1} sulphur applied enhanced the plant growth and development of the mustard plant, which ultimately improved the oil content significantly also over lower dose applied sulphur. Similar results have also been reported by Brijendra and Shukla (2004).

As far as the economic analysis of P and S application on the rapeseed mustard was concerned, the highest

values of net return (Rs. 32891.6 ha^{-1}) and BCR (Rs. 3.87) were recorded with the application 60 kg phosphorus + 40 kg sulphur ha^{-1} and 40 kg P + 40 kg S ha^{-1} (Rs. 30991.6 and Rs. 3.70) and 60 kg P + 30 kg S ha^{-1} (Rs. 29839.56 and Rs. 3.62). This might be due to the higher seed and stover yield of rapeseed mustard recorded at the seed P & S treatments.

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