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RESEARCH PAPER

Effect of phosphorus and sulphur level on growth, yield and oil content of mustard (*Brassica juncea* L.)

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Abstract : A field experiment entitled "Effect of phosphorus and sulphur level on growth and yield of Mustard (*Brassica juncea coss.*)" variety Varuna, was conducted at the research plot of Kulbhaskar Ashram Post graduate farm Allahabad (U.P.)during the *Rabi* Season 2008-09 and 2009 - 10 India . The experiment was laid out in a Factorial Randomized Block Design having four levels of phosphorus (0, 25, 50 and 75 kg ha^{-1}) and sulphur (0, 20, 40 and 60 kg ha^{-1}) each with three replications. The phosphorus and sulphur were applied through DAP and gypsum, respectively. Indian mustard variety Varuna was sown on 11[th] October, 2008 with the seed rate of 5.0 kg ha^{-1}. The plant height, dry weight per plant, number of siliqua plant^{-1}, seed yield and stover yield increased significantly at 50 kg phosphorus and 40 kg sulphur ha$^{-1.}$ Over without P and with 25 and 75kg ha$^{-1.}$ P. and without S with 20kg and 60 kg S ha^{-1}, respectively.

Key Words : Phosphorus, Sulphur, Stover

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INTRODUCTION

Oilseed crop has been the backbone agriculture economy of India from time immemorial. Amongst the various oilseeds, rapeseed and mustard (*Brassica* spp.) are the third most impotent oilseed crop after groundnut and soybean in India occupying 6.18 Mha acreage, 7.36 Mt production and 1109 kg hectare productivity (Singh and Pal, 2011).In India *Brassica* species are mostly grown in North India Region Consisting of Rajasthan, Uttar Pradesh, Parts of Madhya Pradesh, Gujarat, Punjab, Haryana Part of Himanchal Pradesh and are adopted to varies agro-climatic condition. Mustard is also called as raj raya or Laha it is supposed to be native of India. Among India Sates, Rajasthan First Ranks First Both Area and production of mustard with 2.33 Mt and 2.70 Mt, respectively it is followed the state of Uttar Pradesh where mustard is grown on 12.95 lakh/ha with 8.00 lakh ton seed production and 730. kg /ha productivity (Economic survey 2008-2009). However, Gujarat states highest productivity of mustard (1510 kg/ha) in the country. *Brassica* species are commonly believed to have high requirement for phosphorus. Many soils provide

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much, although not at the entire requirement the rapeseed and mustard crop for this nutrient. The effect of phosphorus and fertilizer on is yield and usually small and much less than that of Nitrogen but notice evely grater then that of Potassium. The function of phosphorus of fundamental to many of the chemical transformation that take place in plant. Organic phosphorus compound are involve in energy transfer reaction and respiration. Phosphorus is a Consistent of nucleic acid and nucleoproteins and, therefore intimately involve in the transformation of hereditary characteristics. Deficiency of phosphorus restricts growth of roots and of aerial parts of rapeseed and mustard plants and in extreme cases can prevent flowering. The crop remaining dwarf with small leaves and no inflorescence. Where phosphorus deficiency is slight, growth is restricted in the rosette stage but the crop tence to recover and the flowering stage may be little affected. Floring may be delayed by a day or two by slight phosphorus deficiency as may ripen of the seed.

Sulphur is a secondary plant nutrient which plays a significant role in increasing production specially in oil seed. Sulphur is Essential for synthesis of sulphur containing amino acids *viz.*, methionine, systine and chlorophyll. It is also responsible for synthesis of coenzyme-A. Sulphur deficiencies are occurring with greater frequency at various location in India.

Generally, oilseeds crop respond to the application of phosphorus and sulphur, even in marginally deficiency and medium soils. Phosphorus and sulphur are two important nutrients for better growth and yield of oil seed crops. A relative change in their levels bring about a considerable effect on growth and yield of oil seed crop. Phasphorus and sulphur inter – relationship in promoting mutual uptake and there by influencing yield and growth of rapeseeds and mustard has been studied by many researchers. Thus the proper nutrition of phosphorus and sulphur may be helpful in increasing the productivity of mustard crop.

Therefore keeping these facts in view a field experiment entitled, ''Effect of phosphorus and sulphur level on growth, yield and oil content of mustard (*Brassica juncea* L.)'' was planned and conducted during *Rabi* season of 2008-09 and 2009-10 at crop research farm of Kulbhaskar Ashram Post Graduate College, Allahabad.

MATERIAL AND METHODS

The experiment was conducted at the research plot of Kulbhaskar Ashram Post Graduate College farm, Allahabad during the *Rabi* season of the year 2008-09 and 2009-10. The Farm is situated on the east side of the Medical College-Rambagh Road (0, 20, 40 and 60 kg ha^{-1}) each was conducted in Factorial Randomized Block Design with three replications during winter *Rabi* season of the year 2008-09 and 2009-10. The soil of the experimental field was alluvial loamy in texture having pH 7.2, determined by pH meter method in a A field experiment including four levels of phosphorus (0, 25, 50 and 70 kg ha^{-1}) and sulphur soil pH was determined by glass electrode pH (Piper, 1967). Electrical Conductivity with Solu-bridge method (Black, 1965), Organic carbon 0.57%was determined walkley and Black rapid titration method (1934), with the available nitrogen 127 kg ha^{-1} alkaline $KMnO_4$ method (Subbiah and Asija, 1956), available phosphorus 10.7 it was estimated by Olsen's method. kg ha^{-1} and available Sulphur (Exraction was done by using 0.15% $CaCl_2$ as extractant following the procedure of Williams and Steing berg, (1959) 8.25 kg ha^{-1}, respectively. After preparation of the field nitrogen and Potassium were applied at the rate of 60 kg and 40 kg kg ha^{-1} through Urea and murate of potash, respectively. Phosphorus was applied through DAP and Sulphur Through Zypsum. Half dose of nitrogen full dose of potassium and all different doses of phosphorus and sulphur as per treatment were applied as besal dressing and rest of nitrogen was applied as top dressing, maintaining the spacing of 30 cm x 10 cm. Harvesting was done by manual labour. It was tied in bundles and labeled properly the bundle were left for sun drying in respective treatment plots. For yield data like

Number of siliqua:

Taken number of siliquae present on the respective branches from five randomly selected plants were separated, counted and reported on $plant^{-1}$ basis.

Siliquae length :

A total of 20 siliquae were taken from different branches of the plants. There length was measured and average value was recorded I cm for each treatment plot.

Number of seed $silquae^{-1}$:

The seeds of 20-selected siliqua from respective branches, counted and averaged number of seed $siliquae^{-1}$.

Thousand seed weight :

The waight of thousand seeds was recorded in gram after counting the seeds obtained from the different branches.

Oil content :

Oil content (%) in seeds was determined by Soxlet apparatus using petroleum ether as solvent for oil extraction (Kartha and Sethi, 1957).

RESULTS AND DISCUSSION

Phosphorus application increased the number of siliqua plant^{-1}, Seeds siliqua^{-1} and 1000 seed waight significantly upto 50 kg P_2O_5 ha^{-1} during both year (Table 1). The increase in number of siliqua plant^{-1}. Thus the optimum phosphorus application was maximized number of siliqua plant^{-1}. The result are in accordance with findings of Singh *et al.* (2007); Khatkar *et al.* (2011) and Sahu *et al.* (2011). Increased the Number of seed siliqua^{-1} and 1000 seed waight due to increase application of phosphorus might be due to the reason that phosphorus leads synthesis and deposition of seeds resources (starc, lipid, protein and phytin) that ultimately produce more number of seeds siliqua^{-1} (Jat *et al.*, 2000). Besides, it might also be due to the reason that large amount of phosphorus is found in the seed and siliqua. Which is considered essential for seed formation and boldness of seeds these result support the finding of Kumar and Yadav (2007) and Lone *et al.* (2010).

Increasing level of sulphur application increased number of siliqua plant^{-1} upto 40 kg S ha^{-1} beyond which a significant reduction was observed at highest dose of 60 kg S ha^{-1} (Table 1). This might be due to an adequate supply of S which resulted in higher production of photosynthates and their translocation from Source to sink (Rana *et al.*, 2005). Reduction in number of siliqua plant^{-1} at highest dose of 60 kg S ha^{-1} application might be associated with antagonistic effect of P and S as it is clear from significant interaction effect of P x S on number of siliqua plant^{-1} (Table 2). Increase in siliqua length seeds siliqua^{-1} and 1000 seeds weight was recorded with sulphur application upto 60 kg ha^{-1}, but increase beyond 40 kg S ha^{-1} was not significant in any case (Table 1). It might be explained due to overall improvement in plant growth, vigor production of sufficient photo synthates. The result are in agreement to those of Singh *et al.* (2007); Parmar *et al.* (2010) and Verma and Abdi (2009).

The interaction effect of P x S was found significant on no. of siliqua plant^{-1} during both year of study (Table 2). It indicates that increasing level of sulphur reduced siliqua number significantly beyond 40 kg S ha^{-1} when applied with phosphorus, but without phosphorus siliqua number did not reduce at 60 kg S ha^{-1} significantly. It might be due to antagonistic effect of phosphorus with sulphur has also been reported by Aulakh *et al.* (1990) in case of soybean crop.

Oil content in seed was increased with each increasing dose of P application significantly upto 50 kg P_2O_5 ha^{-1} during both the years (Table 3). The increase

Table 1 : Effect of phosphorus and sulphur levels on yield attributes of mustard

Treatments	No. of siliqae plant			Siliqua Length (cm)			No. of seeds siliaqua			1000 seed weight (g)		
	2008-09	2009-10	Mean	2008-09	2009-10	Mean	2008-09	2009-10	Mean	2008-09	2009-10	Mean
P Levels (kg ha)												
0	286.23	293.05	289.64	8.42	8.46	8.44	8.56	8.69	8.63	3.98	4.03	4.01
25	302.97	307.38	305.18	8.64	8.65	8.65	8.83	8.94	8.89	4.08	4.13	4.11
50	324.79	322.65	323.72	8.75	8.87	8.81	9.05	9.17	9.11	4.18	4.23	4.30
75	308.38	307.36	307.87	8.86	8.85	8.86	9.16	9.35	9.26	4.28	4.32	4.30
S.E.±	2.43	2.85	-	0.17	0.26	-	0.09	0.11	-	0.05	0.05	-
C.D.(P=0.05)	4.97	5.82	-	0.34	NS	-	0.18	0.22	-	0.11	0.10	-
S Level (kg ha)												
0	267.26	269.27	268.27	8.21	8.01	8.11	8.42	8.64	8.53	3.96	4.01	3.99
20	304.17	306.14	305.16	8.61	8.64	8.63	8.87	8.99	8.93	4.10	4.15	4.13
40	331.06	332.55	331.81	8.92	9.02	8.97	9.10	9.22	9.16	4.20	4.26	4.23
60	319.87	322.45	321.16	8.95	9.00	8.98	9.32	9.41	9.37	4.36	4.39	4.38
S.E.±	2.43	2.85	-	0.17	0.26	-	0.09	0.11	-	0.05	0.05	-
C.D.(P=0.05)	4.97	5.82	-	0.34	0.54	-	0.18	0.22	-	0.11	0.10	-

NS=Non-significant

Table 2 : Effect of PxS interaction on number of siliqua plant^{-1}

P Level (kg ha^{-1})	S Level (kg ha^{-1})			
	0	20	40	60
2008-09				
0	244.33	281.42	311.35	307.8
25	263.95	301.15	331.65	315.12
50	287.65	324.65	315.95	334.9
75	273.12	309.45	329.29	321.65
S.E.±	4.87		C.D.(P=0.05)	9.94
2009-10				
0	248.41	287.51	318.12	318.05
25	262.51	303.25	338.71	325.03
50	288.12	325.71	347	329.75
75	278.05	308.1	326.35	316.95
S.E.±	5.70		C.D.(P=0.05)	11.64

Table 3 : Effect of phosphorus and sulphur levels on oil content in seed

Treatments	Oil content in seed (%)		
	2008-09	2009-10	Mean
P Levels (kg ha)			
0	37.04	38.38	37.71
25	38.90	38.99	38.95
50	39.79	39.83	39.81
75	40.24	40.34	40.29
S.E.±	0.27	0.29	-
C.D.(P=0.05)	0.56	0.59	-
S Level (kg ha)			
0	36.04	37.38	36.71
20	38.70	38.78	38.74
40	40.34	40.44	40.39
60	40.89	40.98	40.94
S.E.±	0.27	0.29	-
C.D. (P=0.05)	0.56	0.59	-

in oil content due to successive increase in P application might be probably because P is a constituent of phospholipids and is essential for its synthesis. These result corroborate with the finding of Sharma *et al.* (2002); Pandey and Bharti (2005) and Faujdar *et al.* (2008).

Oil content in seed was also influenced significantly by successive increasing level of sulphur application upto 40 kg S ha^{-1} increase in oil content with increase in S level might be due to the involvement of sulphur in electron - transport chain (Kumar and Yadav, 2007). The increase in oil content was mainly due to increase in glucoside formation and also sulphur as a constituent of multi - enzyme complex. It was also stated by Singh (2009); Ghosh *et al.* (2000); Prakash and Singh (2002); Chandel *et al.* (2003) and Shri Krishna *et al.* (2005) that sulphur is involved in the synthesis of glucoside in mustard oil.

Conclusion :

The growth and yield of Mustard responded significantly uptp 50 kg P_2O_5 and 40 kg S ha^{-1}. The interaction of P x S had antagonistic effect on growth and crop yield at higher level of 75 kg P_2O_5 ha^{-1} and 60 kg S ha^{-1}. However the combination of 50 kg P_2O_5 + 40 kg S ha^{-1} gave highest value of crop growth and yield. The optimum dose of P and S were estimated from the response equation as 54.87 kg P_2O_5 and 49 kg S ha^{-1} with maximum seed yield of 21.60 and 19.81 q ha^{-1}, respectively. Application of P and S increased seed oil content significantly upto 50 kg P_2O_5 and 40 kg S ha^{-1}.

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