VOL. 6, NO. 2, FEBRUARY 2011 ISSN 1990-6145
ARPN Journal of Agricultural and Biological Science

www.arpnjournals.com

EFFECT OF DIFFERENT LEVELS OF PHOSPHORUS AND SULPHUR ON YIELD AND AVAILABILITY OF N P K, PROTEIN AND OIL CONTENT IN TORIA (*Brassica sp.*) VAR. P.T.–303

Ram Bharose, Sunil Chandra, Tarence Thomas and Dharambir Dhan
Department of Soil Science and Agricultural Chemistry, Deemed University, Allahabad, U. P., India
Department of Soil Water Land Engineering and Management, Allahabad Agricultural Institute- Deemed University, Allahabad, Uttar Pradesh, India
E-Mail: dharambirdhan@hotmail.com

ABSTRACT

A field experiment was conducted during Rabi season 2008 to Study the effect of different levels of phosphorus and sulphur on availability of N, P, K, protein and oil content in Toria (Brassica Sp.)Var.P.T.-303 on crop research farm Department of Soil Science and Agricultural Chemistry, Allahabad Agricultural Institute- Deemed University, Allahabad. The area is situated on the right bank adjacent to Yamuna river in south of Allahabad city, which is located at 25^0.80' N Latitude and 81^0.50' E Longitude and 98 meter above the mean sea level having the mean temperature during the growing period was 4.7 to 37.2 ^{0}C. The soil of experimental area falls in order Inceptisol and the experimental field is alluvial in nature. The design applied for statistical analysis was carried out with 3^2 factorial randomized block design having two factors with three levels of Phosphorus 0, 25, and 50 kg ha^{-1}, and three levels of Sulphur 0, 20, and 40 kg ha^{-1}, respectively. Treatments were T_0 - 0 kg P_2O_5 + 0 kg S ha^{-1} , T_1- 25 kg P_2O_5 + 0 kg S ha^{-1} , T_2- 50 kg P_2O_5 + 0 kg S ha^{-1} , T_3- 0 kg P_2O_5 + 20 kg S ha^{-1}, T_4- 25 kg P_2O_5 + 20 kg S ha^{-1}, T_5- 50 kg P_2O_5 + 20 kg S ha^{-1}, T_6- 0 kg P_2O_5 + 40 kg S ha^{-1}, T_7-25 kg P_2O_5 + 40 kg S ha^{-1}, T_8-50 kg P_2O_5 + 40 kg S ha^{-1} that were replicated thrice. The chemical analysis was done in the laboratory of Soil Science and Agriculture Chemistry, A.A.I.-DU, Allahabad. During the course of experiment, observations were recorded as mean values of the data showed that there was significant increase in % Nitrogen, %Phosphorus, % Potassium, % protein and oil content in treatment combination T_5 - (50.00 kg Phosphorus + 40.00 kg Sulphur ha^{-1}) and followed by T_4 - (25.00 kg Phosphorus + 20.00 kg Sulphur ha^{-1}), respectively over than T_0 - (Control).

Keyword: toria, yield, oil content, phosphorus, sulphur, N P K uptake, protein.

INTRODUCTION

India is amongst the largest vegetable oil economies in the world, next only to USA and China. 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. The oilseed forms an essential part of human diet. Besides, it produces basic raw material for agro-based industries. Despite cultivation over a large area covering 20.7 million hectare under various oilseeds of different agro-climatic zones of this country, In Uttar Pradesh Toria crop was grown on an area of about 0.64 million hectare with a production of 0.53 million tones and the productivity of 831 kg ha^{-1} (Anonymous, 1999). 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. This has been primarily due to phenomenal increase in human population and lower rate of productivity of this crop.

The decline soil fertility is the main cause of low productivity of the cultivated lands. So far the emphasis has been to supplement the soil with the major nutrients Viz., N, P, K, S and micronutrients (Zn, Fe, Cu, and Mn) could be met from the soil reserve. According to soil test finding use of high analysis fertilizers, limited recycling of plant residues and gap between the removal and supplementation of secondary and micro-nutrients have resulted in widespread multiple nutrient deficiencies, especially of N, P, K, S and Zn along with other nutrients (Fe and Cu). In recent years sulphur deficiency has been aggravated in the soil due to continuous crop- removal and use of sulphur and zinc free high analysis NPK fertilizers. Leaching and erosion losses also contribute to sulphur deficiencies (Jayalalitha and Narayanan, 1995); Saalbach (1973) reported that sulphur deficiency tends to affect adversely the growth and yield of oil seed crops, which reduce the crop yield to an extent of 10-30%.

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} (Mandal *et al*., 2002). Due to the prohibitive cost of chemical fertilizer, Indian farmers, who are mostly marginal and small, do not apply the recommended dose of nutrients to these energy- rich crops.

Nitrogen is the most important nutrient, which determines the growth of the Toria 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 siliqua and in increase the size of siliqua and yield. Sulphur is also an important nutrient and plays an important role in physiological functions like synthesis of cystein, methionine, chlorophyll and oil content of oil seed crops. It is also responsible for synthesis of certain vitamins (B, biotin and thiamine), metabolism of carbohydrates, proteins and oil formation of flavoured compounds in

crucifers. *Brassica* has the highest sulphur requirement owing to the presence of sulphur rich glucosinolates.

Oilseed crops respond to sulphur application remarkably depending on soil type and source of its use. The functions of sulphur within the plant are closely related to those of nitrogen and the two nutrients are synergistic. There is a negative balance of sulphur in our soils as its addition through various sources is much lower than the removal. Phosphorus and sulphur is generally deficient in majority of our Indian soils and needs much attention for maintenance of phosphorus and sulphur in soils.

In views of these problems an investigation was undertaken to investigate the interaction effect of phosphorus and sulphur on the yield and their NPK uptake as well as the Protein and oil content in Toria crop.

MATERIALS AND METHODS

A field experiment was conducted during Rabi season 2008 to Study the effect of different levels of phosphorus and sulphur on availability of N, P, K, protein and oil content in Toria (*Brassica Sp.*) Var.P.T.-303.on crop research farm Department of Soil Science and Agricultural Chemistry, Allahabad Agricultural Institute-Deemed University, Allahabad, India. The area is situated on the right bank adjacent to Yamuna river in south of Allahabad city, which is located at 25^0.80' N Latitude and 81^0.50' E Longitude and 98 meter above the mean sea level having the mean temperature during the growing period was 33.3 to 5.9 ^{0}C. The soil of experimental area falls in order Inceptisol and the experimental field is alluvial in nature. The design applied for statistical analysis was carried out with 3^2 factorial randomized block design having two factors with three levels of Phosphorus 0, 25, and 50 kg ha^{-1}, and three levels of Sulphur 0, 20, and 40 kg ha^{-1} ,respectively, treatments were T_0 - 0 kg P_2O_5 + 0 kg S ha^{-1} , T_1- 25 kg P_2O_5 + 0 kg S ha^{-1} , T_2- 50 kg P_2O_5 + 0 kg S ha^{-1} , T_3- 0 kg P_2O_5 + 20 kg S ha^{-1}, T_4- 25 kg P_2O_5 + 20 kg S ha^{-1}, T_5- 50 kg P_2O_5 + 20 kg S ha^{-1}, T_6- 0 kg P_2O_5 + 40 kg S ha^{-1}, T_7-25 kg P_2O_5 + 40 kg S ha^{-1}, T_8-50 kg P_2O_5 + 40 kg S ha^{-1} and the treatments was replicated thrice. The source of nitrogen, phosphorus, potassium and sulphur as Urea, DAP, MOP and Gypsum respectively. Basal dose of fertilizer was applied in respective plots according to treatment allocation unifurrows opened by about 5cm. depth before sowing seeds in soil at the same time sowing of seeds was sown on well prepared beds in shallow furrows, at the depth of 5cm, row to row distance was maintained at 30cm and plant to plant distance was 10cm. During the course of experiment, observations were recorded as mean values of the data.

The chemical analysis of plant was done in the laboratory of Soil Science and Agriculture Chemistry, A.A.I.-DU, Allahabad with following standard methods, for % Nitrogen and Protein micro Kjeldhal digestion and distillation method as described by Jackson (1958), % phosphorus Vanadomolybdo method Kitson and Milton (1994), potassium by flame photometer method as described by Toth and Prince (1949) and % Oil content was estimated treatment wise by Soxhlet extraction method as described by Chopra and Kanwar (1999).

RESULTS AND DISCUSSIONS

The results given in (Table-1) indicate some of the important parameters of Yield q ha^{-1}, % Nitrogen, % Phosphorous, % Potassium, Oil and Protein content in Toria crop. The interactive effects of Phosphorus and Sulphur generally influenced the yield q ha^{-1}, % nitrogen, % phosphorus, % potassium, oil and protein content of Toria crop.

Increase in the level of phosphorus from 25 kg ha^{-1} to 50 kg ha^{-1} resulted in a significant increase in the seed yield of Toria from 11.90 to 12.30 q ha^{-1}. Application of varying doses of sulphur had significant effect on the seed yield of Toria. The seed yield increased from 11.80 to 15.89qha^{-1} progressively with increase in level of sulphur from 0.00 to 20.00 kg ha^{-1} and yield decreases with the application of higher dose of sulphur (40.00 kg ha^{-1}). The result is in conformity with the findings of Singh *et al*. (1997), Tomar *et al*., (1996).

The magnitude of phosphorus and sulphur response depends on crop, soil and agro-climatic conditions (Badiger and Shivaraj, 1988).

% NPK uptake by crop

Data presented in the (Table-1) the % nitrogen, % phosphorus and % potassium increased in plants with increase in levels of phosphorus from P_0, P_1 to P_2. The highest uptake of N, P and K in Toria crop (2.89, 0.22 and 3.07) was found with application of 50.00 Kg P_2O_5 ha^{-1} and minimum with 0 kg P_2O_5 ha^{-1} which was (1.96, 0.13 and 2.67). Same in case of Sulphur application, % nitrogen, % phosphorus and % potassium uptake by Toria crop increases from S_0 to S_1 (2.89, 0.22 and 3.07) and uptake of NPK decreases at the level of S_2 (2.25, 0.17 and 2.71).

The interaction between phosphorus and sulphur showed a significant effect on % NPK, in plants. The maximum % nitrogen, % phosphorus and % potassium in plants were recorded in the treatment P_2 S_1 (50 kg P_2O_5 and 20 kg S ha^{-1}), which was greater among all the treatment combinations. Similar results have also been recorded by Singh *et al*., (1997), Tomar (1996), Tyagi and Rana (1992), Kachroo and Kumar (1999)

% Oil and Protein Content

Data presented in the Table-1 % oil and % protein content of seeds shows a significant variance among the treatments. It was found that in treatment T_5 (50 Kg P_2O_5 + 20 Kg S ha^{-1}) % oil and % protein content of seeds was maximum and the treatment T_4 (25 kg P_2O_5 ha^{-1} + 20 kg S ha^{-1}) is statistically at par with treatment T_5. The oil content and protein content was maximum due to the higher concentration of phosphorus and sulphur, which increased the number of seeds that's why oil and protein content further higher dose of S decreased the oil and

protein content. Similar results have also been presented by Tyagi and Rana (1992), Kachroo and Kumar (1999).

Table-1. Effect of different levels of phosphorus and sulphur on yield, (%) N, P, K, oil and protein content in toria crop.

Treatment combination	Different levels	Yield q ha^{-1}	% N	% P	% K	% Oil content	% Protein content
T0- (P_0 S_0)	0 kg P_2O_5 ha^{-1} + 0 kg S ha^{-1}	11.50	2.31	0.18	2.70	27.05	7.00
T1- (P_1 S_0)	25 kg P_2O_5 ha^{-1} + 0 kg S ha^{-1}	11.90	2.26	0.20	2.89	28.57	7.20
T2- (P_2 S_0)	50 kg P_2O_5 ha^{-1} + 0 kg S ha^{-1}	12.30	2.30	0.19	2.77	28.11	7.21
T3- (P_0 S_1)	0 kg P_2O_5 ha^{-1} + 20 kg S ha^{-1}	11.80	1.96	0.13	2.67	29.06	7.01
T4- (P_1 S_1)	25 kg P_2O_5 ha^{-1} + 20 kg S ha^{-1}	14.20	2.59	0.21	2.97	31.40	7.30
T5- (P_2 S_1)	50 kg P_2O_5 ha^{-1} + 20 kg S ha^{-1}	15.89	2.89	0.22	3.07	33.01	7.40
T6- (P_0 S_2)	0 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1}	12.30	2.25	0.17	2.71	29.50	6.70
T7- (P_1 S_2)	25 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1}	13.70	2.51	0.20	2.90	30.80	7.20
T8- (P_2 S_2)	50 kg P_2O_5 ha^{-1} + 40 kg S ha^{-1}	11.50	2.47	0.18	2.84	27.04	7.00
F-test		S	S	S	S	S	S
S. Em. (±)		0.01	0.020	0.002	0.014	0.232	0.027
C. D. at 5%		0.04	0.060	0.005	0.041	0.695	0.087

ACKNOWLEDGEMENTS

The authors are thankful to the Head, Department of Soil Science and Agricultural Chemistry, Dean, College of Forestry and Environment of Allahabad Agricultural Institute - Deemed University, Allahabad, India for providing all necessary facilities.

REFERENCES

Anonymous. 1999. Economic Survey (1998-99), Ministry of Finance, Government of India.

Badiger M. K. and Shivaraj B. 1988. Priorities for sulphur research and development - Karnataka. Proceedings of the TSI - FAI Symposium on Sulphur in Indian Agriculture, New Delhi. PD - 11/4/1-8.

Chopra S. L. and Kanwar J. S. 1999. Analytical Agricultural Chemistry, 4th Ed. Kalyani Publishers, New Delhi.

Jackson M. L. 1958. Soil Chemical Analysis. Prentice Hall of Indian Private Ltd., New Delhi.

Jayalalitha K. and Narayanan A. 1995. The effect of sulphur deficiency on growth and mineral composition of hydroponically grown cotton plants. Indian Journal of Plant Physiology. 38: 309-312.

Kachroo D. and Kumar A. 1999. Seed weight, oil and protein contents of Indian mustard (*Brassica Juncea* L.) as influenced by nitrogen and sulphur fertilization. Ann. Agric. Res. 20(3): 369-371.

Kitson and Milton. 1944. Ind. Eng. Chem., A. E. Taken from Soil, Plant and water Analysis by P.C. Jaiswal. 16: 379.

Singh V. K. and Sharma H. C. 1996. Response of Indian Mustard (*Brassica juncea* L.) to levels and time of Sulphur application. Cruci. Newsletter. (18): 138-139.

Saalbach E. 1973. The effect of sulphur, Manganese and Sodium on yield and quality of agriculture crop. In: Pontificial Academical Scientiarum Scripta Varia. 38: 451-538.

Singh Man, Singh D. B., Ganandra Giri., Singh M. and Giri G. 1997. Annals of Agricultural Research. 18(2): 135-142.

Tomar R. K. S., Chourasia S. C. Raghu J. S. and Singh V. B. 1996. Growth, yield and net returns of mustard under different levels of Nitrogen and Sulphur application on clay loam soils. J. Oil Seed Res. 13(1): 13-17.

Toth S. J. and Prince A. L. 1949. Potassium determination in plant digests by flame photometer. Soil, Plant and water Analysis by P.C. Jaiswal. pp. 275-279.

Tyagi M. K. and Rana H. S. 1992. Indian Journal of Agronomy. 37(4): 841-842.

Upadhyay R. L. 1980. Evaluation of soil test for S and Zn and assessment of their critical limits for various crops Ph. D. Thesis C. S. A. Univ. of Agri. and Tech., Kanpur, India.