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EFFECT OF FYM, POTASSIUM AND ZINC ON YIELD, QUALITY AND UPTAKE OF NUTRIENTS IN FORAGE OAT IN ALLUVIAL SOIL

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ABSTRACT

A field experiment was carried out at the research farm, R.B.S. College, Bichpuri, Agra (U.P.) during rabi season to study the effect of FYM (0 and 5t ha^{-1}), potassium (0,30,60 and 90 kg K_2O ha^{-1}) and zinc (0,1,2 and 4 kg ha^{-1}) levels on the yield, quality and uptake of nutrients in forage oat (Avena sativa.). The experiment was laid out in split plot design with three replications. Data revealed that the plant height, green foliage and dry matter yields and content and yield of protein increased significantly with the application of 5t FYM, 90 kg K_2O and 4 kg Zn ha^{-1} over their respective controls. Application of 5t FYM ha^{-1} gave 20.1 and 20.3 per cent higher green foliage and dry matter yield of fodder oat over control, respectively. It also increased the uptake of nutrients by the forage crop over control. Application of 90 kg K_2O ha^{-1} was more effective in increasing plant height, green foliage and dry matter yields than those of 30 and 60 kg K_2O ha^{-1}. The higher green foliage (446.6q ha^{-1}) and dry matter yield (89.6q ha^{-1}) were recorded with 90 kg K_2O ha^{-1}, which was 50.8 and 39.1 % higher than that of control. The uptake of nutrients by the crop increased significantly up to 90 kg K_2O ha^{-1} over control. Potassium application tended to increase the content and yield of protein in oat. Application of zinc proved superior to control in terms of protein content and yield in oat. The uptake of nutrients by the crop increased significantly with Zn addition up to 4 kg Zn ha^{-1} over control. Green foliage (449.2q ha^{-1}) and dry matter yields (88.8 ha^{-1}) of oat were the highest with 4 kg zinc ha^{-1}.

Keywords: FYM, potassium, zinc, yield, uptake of nutrients, quality, oat

INTRODUCTION

Oat (*Avena sativa*) is an important cereal crop mainly for fodder during rabi season. Oat provides a very nutrious fodder (proteins 13-15%) especially suited to milch animals.The ever-rising demand for fodder and feed for sustaining livestock production can be met through increasing productivity of fodder. The various factors are responsible for low productivity such as poor fertilization and improper soil management of which poor fertilization is main factor for poor productivity of oat. Farmyard manure improves physical, chemical and biological properties of soil and sustains fertility and productivity of cultivated land. FYM has shown considerable increase in crop yield and helps in enhancing nutrient availability both from applied and native sources. Potassum is the most important essential nutrient after nitrogen and phosphorus and plays a vital role in plant cell sap, support enzymatic activity, photosynthesis and transportation of sugar, synthesis of protein and starch but does not bounds with carbon or oxygen. It also develops tolerance to drought condition and enhances plant ability to resist attacks of pest and diseases. Zinc plays an important role as a metal component of enzymes (alcohol dehydrogenase, super oxide dismutase, carbonic anhydrase and RNA polymerase) or as a functional, structural or regulator cofactor of a large number of enzymes (Marschner, 1986). It is considered to be the most yield limiting micronutrient in crop production in various parts of the world. Integration of K and Zn with FYM will not only sustain the crop production but also will be effective in improving soil fertility. As information is lacking on the effect of FYM, K and Zn on oat production in Agra region of Uttar Pradesh, the present study was therefore, planned to assess the effect of FYM, potassium and zinc on productivity of forage oat.

MATERIALS AND METHODS

The field experimental was conducted during rabi season at R.B.S.College Research farm Bichpuri, Agra (U.P.). The soil was sandy loam in texture having pH 7.8, EC 0.29 dSm^{-1}, organic carbon 3.6 g kg^{-1}, available N 165 kg ha^{-1}, P 8.5 kg ha^{-1}, K 110 kg ha^{-1} and Zn 0.51 mg kg^{-1}. The experiment was laid out in split plot design with two levels of FYM (0 and 5t ha^{-1}), four levels each of K (0, 30, 60 and 90 kg K_2O ha^{-1}) and Zn (0, 1, 2 and 4 kg Zn ha^{-1}) with three

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replications. A uniform dose of N and P @ 100 and 60 kg P_2O_5 ha^{-1} was applied through urea and diammonium phosphate, respectively at the time of sowing. Well decomposed FYM was applied before sowing of the crop. Potassium and Zn were applied through mutriate of potash and zinc sulphate, respectively at the time of sowing. Oat (cv Kent) was sown as fodder crop in last week of October in both the years. Other agronomic management practices were followed as per standard recommendation. The crop was harvested after 90 days of sowing.The plant samples were digested with di acid mixture of HNO_3 and HCl O_4 in 9:1 ratio. Phosphorus was determined by vanadomolybdate yellow colour method (Jackson, 1973), S by turbidimetric method (Chesnin and Yien 1951), K by flame photometer, Zn by atomic absorption spectrophotometer. Nitrogen in plants was determined by modified micro Kjeldahl method. The nutrient uptake was calculated by multiplying the nutrient concentration values with the dry matter yield. The data were statistically analysed using standard procedures of ANOVA at 5% level of significance.

RESULTS AND DISCUSSION

Effect of FYM

The plant height, green foliage and dry matter yields and protein content in fodder oat increased significantly with FYM application over control (no FYM). The mean maximum plant height (65.5 cm) green foliage (362.8 ha^{-1}), dry matter (78.8 ha^{-1}) yields, protein content (11.3%) were obtained at 5 t FYM ha^{-1}. The mean increases in green foliage and dry matter yield due to 5 t FYM ha^{-1} over control were 20.1 and 20.3 per cent, respectively. The increase in yield might be due to steady decomposition of FYM and release of nutrients throughout the crop growth period coupled with better assimilation of nutrients (Kumar *et al.,* 2015). The beneficial effect of FYM on yield was also reported by Singh *et al.,* (2013). The protein yield also significantly increased with FYM application from 681.2 kg ha^{-1}at control to 890.4 kg ha^{-1} at 5 t FYM ha^{-1}. Kumar and Singh (2013) also reported similar results. Application of 5 t FYM ha^{-1} significantly increased the uptake of N (151.9 kg ha^{-1}), P (22.4 kg ha^{-1}), K (126.0 kg ha^{-1}), S (14.1 kg ha^{-1}) and Zn (130.0 g ha^{-1}) by oat crop over control. The increase in nutrient uptake may be due to increase in nutrient content and dry matter yield. Higher uptake of N with FYM may be due to mineralization of N from FYM which sufficiently meet the nutritional requirement of the crop (Kumar and Singh 2013). The effect of FYM in increasing P uptake may be associated with improvement of the soil environment which encouraged proliferation of roots resulting in more absorption of water and nutrients from larger area and depth, The higher nutrient uptake with FYM might be attributed to solubilization of nutrients, chelation of complex intermediate organic molecules, produced during the decomposition of added FYM, their mobilization and accumulation of different

Table 1: Effect of FYM, potassium and zinc on growth, yield and quality of fodder oat

Treatment	Plant height (cm)	Yield (q ha^{-1})		Protein content (%)	Protein yield (kg ha^{-1})
		Green foliage	Dry matter		
FYM (t ha^{-1})					
0	46.5	302.1	65.5	10.4	681.2
5	65.5	362.8	78.8	11.3	890.4
SEm±	1.94	2.16	2.47	0.21	24.3
CD (P=0.5)	5.55	6.19	7.08	0.75	69.2
Potassium (kg ha^{-1})					
0	45.9	296.1	64.4	10.3	663.3
30	48.7	345.7	73.4	10.5	770.7
60	51.5	401.0	81.0	10.8	874.8
90	53.7	446.6	89.6	11.0	985.6
SEm±	0.53	3.73	1.30	0.04	7.8
CD (P=0.5)	1.54	10.70	3.80	0.12	22.3
Zinc (kg ha^{-1})					
0	45.9	301.4	64.3	10.1	649.4
1	47.3	345.8	72.4	10.3	745.7
2	50.2	397.5	79.8	10.8	861.8
4	51.8	449.2	88.8	10.9	968.0
SEm±	0.37	3.49	1.10	0.02	6.1
CD (P=0.5)	1.02	9.93	3.13	0.07	17.3

nutrients in different plant parts. Similar results were reported by Singh *et al.,* (2013).

Effect of potassium

Data (Table 1) show that application of potassium significantly increased the plant height in oat up to 90 kg K_2O ha^{-1}. This may be due to function of K in most of the physiological and metabolic processes resulting in increased growth and development of plants. Similar results were reported by Singh and Singh (2009).Application of 30, 60 and 90 kg K_2O ha^{-1} increased the green foliage yield by 10.0, 35.4 and 50.8 per cent over contro l, respectively. As potassium is essential for growth, the favorable effect of high doses of K on growth and yields of oat was mainly responsible for green foliage and dry matter yields. The results are in close conformity with those of Singh *et al.,* (2015). Each successive increase in K levels from 0 to 90 kg K_2O ha^{-1} increased the protein content and yield. The maximum value of protein yield (985.6 ha^{-1}) was obtained with 90 kg K_2O ha^{-1}. Since, protein yield is the resultant of dry matter yield and protein content, it also increased due to potassium application because of an increase in dry matter yield. Similar results were reported by Kumar *et al.,* (2015).A marked increase in N uptake (162.5 kg ha^{-1}), P (24.5 kg ha^{-1}), K (136.3 kg ha^{-1}), S (16.8 kg ha^{-1}) and Zn (130.0 g ha^{-1}) was recorded with the application of 90 kg K_2O ha^{-1} (Table 2). Since, the nutrient uptake is a function of their content in crop plant and yield of plant, increases in nutrients uptake by the crop are expected. These results are in conformity with those of Singh and Singh (2009) and Kumar *et al.,* (2015) who reported increased uptake of N, P, K, S and Zn by the crops.

Table 2: Effect of FYM, potassium and zinc on uptake of N, P, K, S (kg ha^{-1}) and Zn (g ha^{-1}) by oat crop

Treatment	Nitrogen	Phosphorus	Potassium	Sulphur	Zinc
FYM (t ha^{-1})					
0	113.5	13.5	97.6	8.1	90.0
5	151.4	22.4	126.0	14.1	130.0
SEm±	1.32	1.78	1.39	0.86	9.6
CD (P=0.5)	3.77	5.09	4.00	2.46	27.5
Potassium (kg ha^{-1})					
0	108.8	13.5	93.7	7.5	87.0
30	128.0	16.5	109.6	11.5	102.0
60	144.3	20.3	122.4	13.8	116.0
90	162.5	24.5	136.3	16.8	130.0
SEm±	0.91	0.91	0.93	0.81	4.6
CD (P=0.5)	2.59	2.30	2.65	2.33	13.2
Zinc (kg ha^{-1})					
0	107.3	13.1	93.2	7.5	87.0
1	129.9	16.2	106.5	10.3	101.0
2	140.3	20.2	119.7	13.8	115.0
4	158.0	24.3	135.4	18.5	132.0
SEm±	0.76	0.70	1.04	0.71	4.0
CD (P=0.5)	2.17	2.00	3.00	2.04	11.5

Effect of zinc

Application of zinc increased the plant height over control. The maximum value of this character was noted at 4 kg Zn ha^{-1} followed 2, 1 kg Zn ha^{-1} and control. Similar findings were reported by Chauhan *et al.,* (2014). Application of Zn also increased the green foliage and dry matter yield significantly up to 4 kg Zn ha^{-1} (Table 1). The magnitude of increase was 49.0 and 38.1 per cent in green foliage and dry matter yield, respectively over control. The increase in plant height and yields might be due to role of Zn in biosynthesis of indole acetic acid (IAA) and especially due to its role in initiation of primordial for partitioning of photosynthates towards them which resulted in better yield (Singh *et al.,* 2015). Increasing levels of Zn from 0 to4 Zn ha^{-1} increased the content and yield of protein from 10.1 to 10.9 % and from 649.4 to 968.0 kg ha^{-1}, respectively in oat crop. This was mainly owing to higher dry matter yield and protein per centage in oat plants. The results corroborate with the findings of Chauhan *et al.,* (2014). A perusal of data (Table 2) revealed that N, P, K, S, and Zn uptake increased significantly with Zn application over control. The highest uptake of N (158.0 kg ha^{-1}) was associated with 4 kg Zn ha^{-1}. Significant increase in P uptake by plants (24.3 kg ha^{-1}) was also found with 4 kg Zn ha^{-1} as observed by (Pandey and Chauhan, 2016). The maximum uptake of K by the crop (135.4 kg ha^{-1}) was recorded with 4 kg Zn ha^{-1}. Plant uptake of S and Zn increased along with rise in levels of Zn up to 4 kg ha^{-1}. The increase in nutrient uptake may be due to increase in nutrient content and dry matter yield. Zinc plays structural and regulatory role in large numbers of enzymes and protein synthesis, which directly affects the nutrients absorption from the soil (Marschner, 1986, Chauhan *et al.,*,2014). Zinc uptake by oat crop increased significantly with increasing levels of applied Zn. Highest Zn uptake was found with 4 kg Zn ha^{-1} and lowest in control. The higher Zn uptake due to its application could be attributed to the priming effect caused by higher crop growth and consequently higher removal of zinc due to its application.Chauhan *et al.,* (2014) reported similar results.

Interaction effect:

The significant interaction between FYM and zinc levels (Table 3) indicated that the highest green foliage yield of oat was recorded at 5t FYM X 4kg Zn ha^{-1}. Similary the uptake of nitrogen by oat plants was recorded significantly higher under 5t FYM X 4kg Zn ha^{-1}. The control (no FYM and no zinc) produced the lowest (284.0 q ha^{-1}) green foliage that remained non-significant with no FYM X 1kg Zn ha^{-1}. Similarly, the minimum uptake of nitrogen by oat crop was recorded under no FYM and no zinc treatment.

Table 3: Interaction effect of FYM and zinc on green foliage yield and nitrogen uptake in oat

FYM (t ha^{-1})	Zinc (kg ha^{-1})			
	0	1	2	4
Green Foliage yield (q ha^{-1})				
0	284.0	289.5	301.5	313.4
5	340.3	365.2	408.2	447.5
Sem $\pm$	3.24			
CD (P=0.05)	9.31			
Nitrogen uptake (kg ha^{-1})				
0	104.1	120.3	136.0	144.1
5	118.1	133.2	145.7	157.7
SEm $\pm$	1.56			
CD (P=0.05)	4.50			

From the present investigation, it may be concluded that the application of FYM, K and Zn increased the green foliage and dry matter yields and protein content in fodder oat, Application of 5 t FYM, 90 kg K_2O and 4 kg Zn ha^{-1} gave the maximum values of yields and protein content in oat under agro climate condition of Agra region.

REFERENCES

Behera, S. K., Singh, M. V. and Lakaria B. L. (2009) Micronutrient deficiency in India and their amelio-ration through fertilizers. *Indian Farming* **59**: 28-31.

Chauhan, T.M., Ali, J., Singh, S.P. and Singh, S.B. (2014) Effect of nitrogen and zinc nutrition on yield, quality and uptake of nutrients by wheat. *Annals of Plant and Soil Research* **16** (2): 98-101.

Chesnin, L. and Yien, C. H. (1951) Turbidimetric determination of available sulphate. Soil Science Society of America Proceedings **15:** 149-151**.**

Jackson, M. L. (1973) *Soil Chemical Analysis.* Prentice Hall of India Private Limited, New Delhi.

Kumar, D. and Singh, J.P. (2013) Integrated effect of copper and farmyard manure on yield, quality and uptake of nutrients in wheat. *Annals of Plant and Soil Research* **15** (2): 156-159.

Kumar, Y., Singh, S.P. and Singh, V.P. (2015) Effect of FYM and potassium on yield, nutrient uptake and economics of wheat in alluvial soil. *Annals of Plant and Soil Research* **17** (1): 100-103.

Marschner, H. (1986) *Mineral nutrition* of higher plants. Academic Press Inc. USA, pp. 269-369.

Pandey, M. and Chauhan, M. (2016) Effect of sulphur and zinc on yield, quality and uptake of nutrients in barley. *Annals of Plant and Soil Research* **18** (1): 74-78.

Singh, J.P. and Singh, V. (2009) Response of rabi crops to potassium. Better crops **3**: 16-17.

Singh, V., Singh, S.P. Singh, Sandeep and Shivay, Y.S. (2013) Growth, yield and nutrient uptake by wheat (Triticum aestivum) as affected by bio-fertilizers, FYM and nitrogen. *Indian Journal of Agricultural Sciences* **83** (3): 331-334.

Singh, V., Ali, J., Seema, Kumar, A. and Chauhan, T. M. (2015) Productivity, nutrient uptake and economics of wheat (Triticum aestivum) under potassium and zinc nutrition. *Indian Journal of Agronomy* **60** (3): 426-430.