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SHORT COMMUNICATION

INTERACTIVE EFFECT OF NITROGEN, PHOSPHORUS AND CUTTING MANAGEMENT ON MICRO-NUTRIENTS UPTAKE BY OAT (*AVENA SATIVA* L.)

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SUMMARY

Although, no micro nutrient has been applied to the crop but the effect of cutting management, nitrogen and phosphorus application on micro-nutrients uptake was studied in the field experiment on oat. Results indicated that the highest zinc uptake by oat fodder (19.6 g/ha) was recorded when oat was cut 70 days after sowing (DAS) followed by cut 60 DAS (17.6 g/ha) and then cut 50 DAS (15.7 g/ha). Whereas highest zinc uptake by oat grain (24.7 g/ha) was recorded when oat was cut 60 DAS followed by cut 50 DAS (22.5 g/ha) and least by cut 70 DAS (21.1 g/ha). Zinc uptake by oat straw was recorded highest when oat was cut 50 DAS (36.0 g/ha) followed by cut 70 DAS (30.5 g/ha) and then cut 60 DAS (35.0 g/ha). Similar trend was also observed in case of copper, manganese and iron uptake by oat fodder, grain and straw with different cutting managements. Zinc uptake by fodder, grain and straw increased significantly from 11.7, 19.3 and 31.4 to 23.4, 25.9 and 36.5 g/ha, respectively, with the treatment $N_{120}+P_{60}$ over control, $N_{40}+P_{20}$ and $N_{80}+P_{40}$ treatments. Application of nitrogen and phosphorus significantly increased the copper uptake in oat fodder, grain and straw from 7.2, 8.3 and 19.4 to 14.5, 11.1 and 22.6 g/ha, respectively, with $N_{120}+P_{60}$ over all other treatments. Manganese uptake by oat fodder, grain and straw also increased from 12.8, 15.6 and 34.2 to 25.5, 20.9 and 39.8 g/ha, respectively, with the application of $N_{120}+P_{60}$. Application of nitrogen and phosphorus significantly increased the iron uptake in oat fodder, grain and straw from 68.1, 144.7 and 182.4 to136.1, 193.8 and 212.5 g/ha, respectively, with $N_{120}+P_{60}$.

Key words : Zinc, copper, manganese, iron, micro-nutrients uptake, fertility levels, cutting management

Oat (*Avena sativa* L.), locally known as "jai", occupied a small area under cultivation but it is an important winter cereal crop, grown under irrigated conditions of northern and north-western regions of India because of its excellent growth characters, quick regrowth and economic source of dietary energy like other multi cut fodders. It provides succulent and highly palatable fodder in two to three cuttings extending from December to February. Oat fodder can also be converted into hay or silage for feeding the animals during lean period. This food is low in saturated fat, and very low in cholesterol and sodium. It is also a good source of dietary fiber, thiamin, magnesium and phosphorus, and a very good source of manganese. Main constraint in achieving proven crop potential is imbalanced use of fertilizers, particularly low use of P as compared to N. Deficiency of micro-nutrients such as zinc, copper, manganese and iron in grain and straw of the cereals as well as in fodder crops may cause severe disorder in animals and human beings. Application of nitrogen and phosphorus may affect the absorption of these micro-nutrients and ultimately their uptake by plants. Therefore, the present study was conducted to find out the effect of cutting management, nitrogen and phosphorus on micro-nutrients uptake by oat.

The field experiment was conducted to study the requirement of N and P in oat at the Forage Research Farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar during **rabi** 2012-13.

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The soil of the field is sandy loam in texture having pH 7.9, EC 0.13 dS/m and OC 0.34 per cent. Available N, P and K were 96.68, 6.09 and 124.83 mg/kg, respectively. Four representative soil samples were drawn from different places in the experimental field from 0-15 cm depth before sowing of experimental crop. Composite samples, prepared by passing through 2 mm mesh sieve, were analyzed. In all, 12 treatments consisting of four fertility levels (control, $N_{40}+P_{20}$, $N_{80}+P_{40}$ and $N_{120}+P_{60}$) and three cuttings (first cut for fodder at 50 DAS+second cut for seed, first cut for fodder at 60 DAS+second cut for seed and first cut for fodder at 70 DAS+second cut for seed) were maintained. After cutting, crop was left for grain production. The green fodder was harvested 8-10 cm above the ground level as per treatment. Then the crop was managed for grain production. Gross plot size was 5 x 3 m = 15 m^2 and net plot size was 4 x 2.5 m=10 m^2. Experiment was laid out in factorial randomized block design (FRBD). Each of 12 treatment combinations was randomly allotted to individual plot in block of equal size. The treatments were replicated thrice. The details of the treatments are given in Table 2. Nitrogen and phosphorus were applied through urea and single super phosphate as per the treatments. All the field operations such as hoeing, irrigation, etc. were done as and when required. The harvested green fodder from each plot was weighed *in situ* on salter balance in kg/plot and then green fodder yield (q/ha) was calculated. A random sample of 500 g was taken from each plot at the time of green fodder harvest, chopped well and put into the paper bag. These paper bags were aerated by making small holes all over. The samples were first dried in the sun for several days and then transferred in an electric hot air oven for drying at a temperature of 60±50°C till constant weight. On the basis of these samples, the green fodder yields were converted into dry fodder yields (q/ha). After recording the sun-dried weight of biological yield obtained from each net plot, the grains were separated and weighted. The grain yield was subtracted from the total biological yield to obtain straw yield. Later on grain and straw yields per hectare were calculated. The data presented in Tables 1 and 2 were statistically analyzed by the method as described by Panse and Sukhatme (1995). Plant samples (grain and straw) were analysed for total Zn, Cu, Mn and Fe with the help of atomic absorption spectrophotometer.

TABLE 1
Effect of cutting management and fertility levels on zinc and copper uptake (g/ha) in fodder, grain and straw of oat

Cutting management	Nutrients uptake (kg/ha)					
	Zinc			Copper		
	Fodder	Grain	Straw	Fodder	Grain	Straw
First cut	15.7	22.5	36.0	9.7	9.7	22.3
Second cut	17.6	24.7	35.0	10.9	10.7	21.7
Third cut	19.6	21.1	30.5	12.1	9.1	18.8
C. D. (P=0.05)	1.6	2.1	2.5	1.1	0.8	2.0
Fertility levels						
F_0	11.7	19.3	31.4	7.2	8.3	19.4
F_1	15.7	21.9	32.8	9.3	9.4	20.3
F_2	20.3	24.0	34.7	12.5	10.4	21.4
F_3	23.4	25.9	36.5	14.5	11.1	22.6
C. D. (P=0.05)	1.8	1.9	2.2	1.4	0.7	1.5

TABLE 2
Effect of cutting management and fertility levels on manganese and iron uptake (g/ha) in fodder, grain and straw of oat

Cutting management	Nutrients uptake (kg/ha)					
	Manganese			Iron		
	Fodder	Grain	Straw	Fodder	Grain	Straw
First cut	17.1	18.2	39.3	91.2	168.8	209.5
Second cut	19.1	19.9	38.2	102.8	185.2	203.8
Third cut	21.4	17.0	33.2	114.2	157.9	177.3
C. D. (P=0.05)	1.7	1.6	2.3	6.6	7.2	5.1
Fertility levels						
F_0	12.8	15.6	34.2	68.1	144.7	182.4
F_1	16.5	17.6	35.8	87.9	163.9	190.9
F_2	22.1	19.4	37.8	118.0	180.2	201.6
F_3	25.5	20.9	39.8	136.1	193.8	212.5
C. D. (P=0.05)	2.3	1.7	1.9	6.1	8.4	9.6

Zinc Uptake

A perusal of data (Table 1) indicated that Zn uptake in oat fodder recorded highest when oat was cut at 70 DAS (19.6 g/ha) followed by cut at 60 DAS (17.6 g/ha) and then cut at 50 DAS (15.7 g/ha). The highest Zn uptake (24.7 g/ha) in grain was obtained cut at 60 DAS which was significantly higher than first cut at 50 DAS (22.5 g/ha) and third cut at 70 DAS (21.1 g/ha).

Zinc uptake in straw was statistically at par under first and second cuts (36.0 and 35.0 g/ha, respectively) but significantly higher over third cut (30.5 g/ha). The lowest (11.7, 19.3 and 31.4 g/ha) Zn uptake was recorded in fodder, grain and straw under control and it increased significantly with increasing fertility levels up to the highest level $N_{120}+P_{60}$. Application of $N_{40}+P_{20}$ increased the Zn uptake by fodder, grain and straw from 11.7, 19.3 and 31.4 to 15.7, 21.9 and 32.8 g/ha, respectively, over control. Application of $N_{80}+P_{40}$ further increased the Zn uptake to 20.27, 24.02 and 36.52 g/ha, respectively. Application of $N_{120}+P_{60}$ recorded the significant and highest (23.70, 25.85 and 36.52 g/ha) Zn uptake by oat fodder, grain and straw. Since nutrients uptake is a product of nutrients concentration in crop (grain and straw) and yield of the crop and application of N and P increases the vegetative growth as well as grain yield. This may be the reason of increase in micro-nutrient uptake in oat with the application of N and P. Moreover, it is also applicable for all crops and nutrients. Duhan *et al.* (2011) also reported the increase in Zn uptake with the increasing N rate in wheat crop. Chandel *et al.* (2014) also reported increase in Zn uptake with the application of N, P and K in wheat and maize.

Copper Uptake

Data (Table 2) indicated that Cu uptake in oat fodder also followed the similar trend as in case of zinc uptake, highest Cu uptake was recorded when oat was cut at 70 DAS (12.1 g/ha) followed by cut at 60 DAS (10.9 g/ha) and then cut at 50 DAS (9.7 g/ha). Whereas highest Cu uptake (10.7 g/ha) by oat grain was recorded when oat was cut at 60 DAS followed by 50 DAS (9.7 g/ha) and least at 70 DAS (9.1 g/ha). Data (Table 1) further indicated that application of nitrogen and phosphorus significantly increased the Cu uptake in oat fodder, grain and straw with increasing dose of nitrogen and phosphorus up to the level of $N_{120}+P_{60}$ and increase was from 7.2, 8.3 and 19.4 to 14.5, 11.1 and 22.6 g/ha, respectively, over control, $N_{40}+P_{20}$ and $N_{80}+P_{40}$, respectively. Duhan and Singh (2002) reported the increase in Cu uptake with increasing dose of N up to 120 kg N/ha in rice.

Manganese Uptake

Data (Table 2) indicated that highest Mn uptake (21.4 g/ha) by oat fodder was recorded with the cut at 70 DAS followed by cut at 60 DAS (19.1 g/ha) and least by cut at 50 DAS (17.1 g/ha). In case of Mn uptake by oat grain, the highest uptake (19.9 g/ha) was recorded by cut at 60 DAS followed by cut at 50 DAS (18.1 g/ha) and then cut at 70 DAS (17.0 g/ha). Highest Mn uptake by oat straw was recorded at 50 DAS (39.3 g/ha) followed by cut at 60 DAS (38.2 g/ha) and least by cut at 70 DAS (33.2 g/ha). Application of nitrogen and phosphorus significantly increased the Mn uptake by oat fodder, grain and straw with each succeeding dose up to the level of $N_{120}+P_{60}$ and increase was from 12.8 to 25.5, 15.6 to 20.9 and 34.2 to 39.8 g/ha, respectively, over all other treatments. Lasztity (1987) reported the increase in Mn content in wheat with increase in fertilizer N. Tiwana and Narang (1997) also reported increase in Mn uptake with N and P application in rice.

Iron Uptake

Data (Table 2) indicated that Fe uptake by oat fodder was highest (114.2 g/ha) when cut at 70 DAS, then cut at 60 DAS (102.8 g/ha) and least by cut at 50 DAS (91.2 g/ha). Highest Fe uptake by grain (185.2 g/ha) was recorded cut at 60 DAS followed by cut at 50 DAS (168.8 g/ha) and then cut at 70 DAS (157.9 g/ha). Whereas highest Fe uptake by straw (209.5 g/ha) was recorded by cut at 60 DAS followed by cut at 50 DAS (203.8 g/ha) and then cut at 70 DAS (177.3 g/ha). Application of nitrogen and phosphorus at a rate of $N_{120}+P_{60}$ significantly increased the Fe uptake by oat fodder, grain and straw from 68.1, 144.7 and 182.4 to 136.1, 193.8 and 212.5 g/ha, respectively, overall other treatments. Koteva and Videva (1997) also reported that application of N increased the iron content in wheat and barley.

CONCLUSION

Uptake of all the four micro-nutrients (Zn, Cu, Mn and Fe) followed almost similar trend. The highest uptake by oat green fodder was recorded when oat was cut for fodder 70 DAS and by oat grain when cut 60 DAS, whereas by straw when cut 50 DAS. Application of N and P significantly increased the Zn, Cu, Mn and Fe uptake by oat fodder, grain and straw, respectively.

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