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SHORT COMMUNICATION

EFFECT OF FERTLIZER APPLICATION AND CUTTING SCHEDULE ON GROWTH AND YIELD PARAMETERS IN OAT (*AVENA SATIVA* L.)

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SUMMARY

Field experiment was conducted to study the effect of nitrogen, phosphorus and cutting management on the yield and nutrient uptake by oat. Results obtained from this experiment indicated that cutting management had non-significant effect on tillering. However, application of N and P significantly increased the number of tillers from 97.2 to 118.3 per metre length. Maximum plant height was recorded when oat was cut at 70 DAS (65.9) followed by cut at 60 DAS (53.8) and then cut at 50 DAS (45.9). Plant height increased significantly from 49.8 to 60.1 with the increase in each successive dose of N and P up to the level of N_{120}+P_{60}. Highest green fodder and dry matter accumulation were recorded when oat was cut at 70 DAS (172.6 and 34.4q/ha) and least when oat was cut at 50 DAS (140.2 and 22.8q/ha). The lowest (106.0 and 20.8q/ha) green fodder and dry matter accumulation were found under control and the highest (518.32 and 93.80 g/m) green fodder and dry matter accumulation were found under treatment 120 kg N+60 kg P_2O_5/ha. Number of panicles/m and spikelets/panicle were found to be non-significant under various cutting treatments. Lowest number of panicles/m row length (61.79) was recorded under control and it increased significantly to 75.00 with (F_3) N_{120}+ P_{60} over all other treatments. Seeds per panicle were found highest (66.0) under first cut and lowest at third cut for fodder 62.20 grains/panicle. Application of N and P significantly increased the grains per panicle from 60.60 to 66.90 with (F_3) N_{120}+P_{60}/ha. The test weight of oat was found highest (39.23) with the 60 DAS and it was significantly higher over 50 and 70 DAS. However, 50 and 70 DAS were found at par. The highest test weight (39.83) was recorded with the treatment (F_3) N_{120}+P_{60}/ha followed by N_{80}+ P_{40} (38.59), then N_{40}+ $P_{20,}$ (35.16) and least by control (30.88).

Key words : Cutting management, fertility levels, tillers, plant height, panicles, spikelets, test weight

India is having the largest livestock population of 512.1 million heads, which is about 15 per cent of the world's livestock population. But, the country is having only 4.4 per cent of the cultivated area under fodder crops with an annual total forage production of 833 m t (390 mt green and 443 mt dry forage). Whereas the annual forage requirement is 1594 mt (1025 mt green and 569 mt dry) to support the existing livestock population. Oat (*Avena sativa* L.), locally known as " jai ", is an important non-legume, 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. Like barley oat grain is also used in processed food like biscuit etc. 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. Nitrogen and phosphorus are the major essential nutrients which may be able to play a major role in improving the quality and yield of fodder crop like oat. Main constraint in achieving proven crop potential is imbalanced use of fertilizers, particularly low use of P as compared to N (Rashid *et al.*, 2007). The optimum rates of P application play a vital role in improving yields of most crops. Therefore, present investigation was carried out to find out the nutritional requirement of oat crop under different cutting schedules.

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The field experiment was conducted at the Forage Research Farm of CCSHAU, Hisar during **rabi** 2012-13. Oat variety HJ 8 was taken as test crop. Hisar is situated in the semi-arid, sub-tropics at $29^0$17' N latitude and $75^0$77' E longitude at an altitude of 215.2 metres above mean sea level. The soil of the field is derived from Indo-Gangetic alluvium and is sandy loam in texture. Four fertilizer levels (Control, $N_{40}+P_{20}$, $N_{80}+P_{40}$ and $N_{120}+P_{60}$) and three cuttings (50, 60 and 70 DAS) 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. 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 ± 5^0C 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.

Growth Attributes

Data regarding number of tillers per metre row length of oat crop are given in Table 1. It revealed that number of tillers per metre row length were non-significant under cutting management treatments. However, application of fertlizers significantly increased the number of tillers per metre length. The lowest number of tillers per metre row length (97.2) was recorded in control and it increased significantly to 103.7 with $N_{40}+P_{20}$, 110.50 with $N_{80}+P_{40}$ and 118.34 with $N_{120}+P_{60}$. Since N is integral part of chlorophyll molecule and its application increases vegetative growth of the plants this may be the reason for increasing the number of tillers per meter row length. Application of P increases the root growth of the plants and thereby may help in increasing the number of tillers per meter length. Patel and Rajagopal (1998) observed that application of nitrogen increased the number of shoots and leaves per metre row length.

The significant and maximum plant height was recorded when oat was cut at 70 DAS (65.9cm) than cut at 60 DAS (53.8cm) and then cut at 50 DAS (45.9cm). Data further indicated that the plant height of oat crop increased significantly with the increase in each successive combination of N and P up to the highest level of $N_{120}+P_{60}$. The increase in plant height (60.11) was recorded with $N_{120}+P_{60}$ over control, $N_{40}+P_{20}$ and $N_{80}+P_{40}$. This increase in plant height with the application of N and P may be the reason that application of both N and P increases the growth of the plants. Patel and Rajagopal (1998) observed that application of nitrogen up to 75 kg/ha increased the plant height, number of shoots and leaves per metre row length but significant response was registered only up to 50 kg N/ha.

Green and Dry Matter Accumulation

A significant and linear increase in green and dry matter accumulation was recorded with increase in age of plant from 50 to 70 DAS. Significant and highest green fodder and dry matter accumulation were recorded when oat was cut at 70 DAS (172.6 and 34.4 q/ha) followed by cut at 60 DAS (155.0 and 30.6 q/ha) and least when oat was cut at 50 DAS (140.2 and 22.4 q/ha). Singh (1992) recorded that dry matter accumulation and its distribution pattern increased with the advancement of the crop age. The lowest (265.03 and 52.07 g/m) GMA and DMA/m were found under treatment F_0 (control) and it increased significantly with each increase in fertility level up to the highest dose i. e. 120 kg N+ 60 kg P_2O_5/ha. The extent of increase in green and dry matter accumulation was 233.8and 25.5q/ha respectively, with the application of $N_{40}+P_{20}$ over control (without N and P). Application of $N_{80}+P_{40}$ further improved green and dry matter accumulation to 176.7 and 22.7 q/ha, respectively. The highest (207.3 and 37.5 q/ha) green and dry matter accumulation were found under treatment 120 kg N+60 kg P_2O_5/ha. This increase in green fodder and dry matter accumulation may be

TABLE 1
Effect of cutting management and fertility levels on plant height and tillers at fodder harvest

Cutting management	Tillers/m row length	Plant height (cm)	GMA (g/m)	DMA (g/m)	No. of panicles	Spikelets/ panicle	Grains/ panicle	Test weight
Cut at 50 DAS	105.9	45.9	140.2	22.4	70.5	45.0	66.0	34.9
Cut at 60 DAS	108.6	53.8	155.0	30.6	69.8	43.8	63.3	39.2
Cut at 70 DAS	107.8	65.9	172.6	34.4	66.6	43.8	62.2	34.2
C. D. (P=0.05)	NS	3.6	20.9	3.6	NS	NS	2.5	2.1
Fertility levels								
Control	97.2	49.8	106.0	20.8	61.8	41.7	60.6	30.9
40 kg N+20 kg P_2O_5	103.7	55.9	133.8	25.5	66.9	42.9	62.8	35.2
80 kg N+40 kg P_2O_5	110.5	56.3	176.7	32.7	72.1	45.6	65.0	38.6
120 kg N+60 kg P_2O_5	118.3	60.1	207.5	37.5	75.0	46.5	66.9	39.8
C. D. (P=0.05)	6.1	4.1	24.2	4.2	3.9	2.7	2.8	2.5

due the reason that application of nitrogen and phosphorus both considered to increase the vegetative growth of the plants. Suhrawardy and Kalita (2001) reported that application of phosphorus increased the green and dry fodder yield. Singh *et al*. (2005) observed that application of nitrogen 75 kg/ha and phosphorus 40 kg/ha+inoculation of seed with *Azotobacter* produced highest seed and stover yield. Singh and Dubey (2008) also revealed that an application of nitrogen up to 80 kg/ha significantly increased the growth and produced 493 and 98.75 q/ha green and dry fodder yields, respectively.

Yield Attributes

The data revealed that number of panicles per metre and spikelets per panicle were found to be non-significant under various cutting treatments. However, application of nitrogen and phosphorus significantly increased the number of panicles per metre row length. The lowest number of panicles per metre row length (61.8) was recorded under control and it increased significantly to 66.9 with N_{40}+P_{20} over control. The treatment N_{80}+P_{40} further increased it to 72.12 over control. The highest and significant numbers of panicles (75.0) were obtained with N_{120}+ P_{60} over all other treatments.

Application of nitrogen and phosphorus also increased the number of spikelets per panicle and the increase was from 41.7 to 42.9, 45.6 and 46.5 with the application of N_{40}+ $P_{20,}$ N_{80}+ P_{40} and N_{120}+P_{60}/ha, respectively, over control. Rao and Patil (1979) found that spikelet number increased with increase in nitrogen levels. Ghosh (1985) observed that application of 80 kg N/ha improved the panicles/m^2 and grains per panicle. Browne *et al*. (2006) observed that the nitrogen application increased both number of panicles/m^2 and grains per panicle.

The data revealed that seeds per panicle were found highest (66.0) under 50 DAS cut and it decreased with delay in cut up to 70 DAS cut for fodder. The decrease was from 66.0 to 63.3 and 62.20 seeds/panicle, respectively, at 60 DAS and 70 DAS cut. This may be due the reason early cutting of fodder give more time for the reproductive phase. Application of nitrogen and phosphorus also increased the number of seeds/panicle and the increase was from 60.6 to 62.8, 65.0 and 66.9 with N_{40}+ $P_{20,}$ N_{80}+ P_{40} and N_{120}+P_{60}/ha respectively, over control. The application of phosphorus considered to improve the seed setting in crops by counteract the over effect of nitrogen application.

The test weight of oat was found significantly highest (39.2) with 60 DAS cut over 50 and 70 DAS. However, 50 and 70 DAS cut were found at par. The test weight of oat increased with the increasing level of nitrogen and phosphorus. The highest test weight (39.8) was recorded with the treatment N_{120}+P_{60}/ha followed by N_{80}+P_{40} (38.59), then N_{40}+ $P_{20,}$ (35.16) and least by control (30.88). Ghosh (1985) observed that application of 80 kg N/ha improved the grains per panicle. Browne *et al*. (2006) observed that at the higher rates of nitrogen both number of panicles/m^2 and grains per panicle increased.

Economics

The data on economics of oat are presented in Table 2. The data revealed that net returns were found

TABLE 2
Effect of cutting management and fertility levels on economics of oats

Cutting management	Cost of cultivation (Rs/ha)	Gross returns) (Rs/ha)	Net returns (Rs/ha)
Cut at 50 DAS	28790	48,565	19,775
Cut at 60 DAS	29040	52,764	23,724
Cut at 70 DAS	29290	48,280	18,990
Fertility levels			
Control	26940	40,490	13,550
$N_{40}+P_{20}$	28340	46,596	18,256
$N_{80}+P_{40}$	29740	53,547	23,807
$N_{120}+P_{60}$	31140	58,853	27,713

to be maximum fodder at 60 DAS (Rs. 23724/ha) followed by C_{50} (Rs. 19775/ha) and least by cut at 70 DAS (Rs. 18990/ha) treatment. Similarly the highest net returns (Rs./ha) was obtained under 120 kg N+60 kg P_2O_5/ha (Rs. 27713/ha) and these decreased with decrease in fertility levels and lowest net returns (Rs. 13550/ha) were recorded under control. Sharma and Verma (2005) observed that marginal rate of return analysis on mean yield basis revealed that application of 100 kg N/ha, 20 kg P_2O_5/ha and combined inoculation of *Azotobacter chroococcum* and *Pseudomonas striata (PSB)* to oats recorded the highest net returns.

CONCLUSION

Maximum plant height, green fodder and dry matter accumulation, was recorded when oat was cut at 70 DAS. Whereas. Maximum seed per panicle recorded when first cut fodder was done at 50 DAS and highest test weight was recorded at cut at 60 DAS. Application of nitrogen and phosohorus significantly increased all the yield parameters, green fodder and dry matter accumulation, seed per panicle and test weight.

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