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EFFECT OF NITROGEN, BIO-FERTILIZER AND FARM YARD MANURE ON YIELD AND NUTRIENT UPTAKE IN OAT (*AVENA SATIVA* L.)

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ABSTRACT
An experiment with Four levels of nitrogen (0, 60, 120 and 180 kg/ha), two levels of bio-fertilizer (No bio-fertilizer (B_0) and bio-fertilizer inoculation (B_1)) and two levels FYM (0 and 10 tonnes/ha) was conducted to study the effect of nitrogen, bio-fertilizer and FYM on yield and nutrient uptake of oat (*Avena sativa* L.). Significantly highest seed (54.02 and 51.90 q/ha) and straw (111.17 and 108.82 q/ha) yields, N (85.42 kg/ha), P (24.58 kg/ha) and K (44.61 kg/ha) uptake by seed, N (132.94 kg/ha), P (27.07 kg/ha)and K (105.25 kg/ha) uptake by straw were recorded with application 180 (N_3) and 120 N/ha (N_2) over control (N_0) being remained at par with each other. *Azotobacter* inoculation (B_1) recorded significantly highest seed (48.05q/ha) and straw (105.24 q/ha) yields, highest N (78.69 kg/ha), P (22.66 kg/ha) and K (41.07 kg/ha) uptake by seed, N (127.35 kg/ha) uptake by straw were observed with *Azotobacter* inoculation (B_1) over no inoculation (B_0). FYM application at 10 tonnes/ha (F_1) significantly increased seed (49.97 q/ha) and straw (106.60 q/ha) yields, N (81.63 kg/ha), P (23.65 kg/ha) and K (42.91 kg/ha) uptake by seed and N (129.35 kg/ha), P (26.40 kg/ha)and K (102.98 kg/ha) uptake by straw over control (F_0).

INTRODUCTION

Oat (*Avena sativa* L.) is the most important fodder crop of winter season as it is having high tonnage, good palatability and high nutritive value. Oat is used as green fodder, straw, hay or silage. Oat grain makes a good balanced concentrate in the rations for poultry, cattle, sheep and other animals. Green fodder contains about 10-12 % protein and 30-35 % dry matter and supply abundant quantity of vitamin-A and important minerals like Ca and Fe in addition to energy for the animals. Oat has wider adaptability because of its excellent growth habits, quick regrowth, better yield potential and provides palatable, succulent and nutritious green fodder (Singh *et al*., 1989).

India ranks first among the major livestock holding countries having about 15% livestock population of the world, however, milk production of our country is about 17% (Anonymous 2012-2013). Total livestock population of India is 512 million (2012-13). The present availability of green fodder is about 400 million tonnes projecting a deficit of 63.50 % and that of dry fodder is around 466 million tonnes against the requirnment of 609 million tonnes (Anonymous 2014-15). Fodder and feed are the major inputs in animal production especially in milch animals, which accounts for about 60 to 70 % of total cost of milk production. The milk production can be easily increased by adequate supply of nutritious feed and fodder.

Oat (*Avena sativa* L.) is an important fodder crop and is fast growing and high yielding crop thus requires a large quantity of fertilizers N for enhancing production of quality of herbage (Singh and Dubey, 2007). It is an exhaustive crop considering its nutrient demand and puts heavy nutritional load on soil. Among the major nutrients, nitrogen plays a pivotal role in quantitative as well as qualitative improvement in productivity of fodders. It is an important constituent of protein and chlorophyll which imparts dark green colour to the plants and promotes early vegetative growth. It improves the quality by increasing the protein content of fodder crops and governs to a considerable utilization of potassium, phosphorus and other nutrients. Whereas, split application of nitrogen may further help to reduce its leaching and volatilization losses and improves the efficiency of nitrogenous fertilizers. *Azotobacter chroococcum* is free living heterotropic nitrogen-fixing bacteria which produces a variety of growth promoting substances (Rao, 1975) may play a significant role in integrated N management in fodder oats. FYM is known to play an important role in improving the fertility and productivity of soils through its positive effects on soil physical, chemical and biological properties and balanced plant nutrition (Kumar *et al*., 2011). Balanced fertilizer use along with organic manure like farm yard manure (FYM) is considered as promising agro-technique to sustain yield, increase fertilizer-use efficiency and restore soil fertility. Thus the integrated approach of nutrient supply in oat by chemical fertilizers, FYM along with biofertilizers are gaining importance because this system not

only reduces the use of inorganic fertilizers but is also an environment friendly approach. The demand of green forage is increasing day by day with the introduction of high yielding milch animal. The non availability of quality seeds of improved varieties is a crucial factor in popularization of fodder at vegetative stage, eliminates the opportunity for producing seed which result scarcity of fodder seeds. Therefore, it is essential to develop strategies for high production potential of fodder crop seeds. The paper deals with the effect of nitrogen, bio-fertilizer and FYM and interaction effect of different treatment on growth, yield and quality of oat and nutrient status of soil after harvest of oat.

MATERIALS AND METHODS

The present study was conducted throughout *rabi* season of 2013-14 at the college farm N. M. college of agriculture, Navsari Agricultural University, Navsari, India to study the effect of nitrogen, bio-fertilizer and FYM on yield and nutrient uptake of oat (*Avena sativa* L.). The experiment site was situated at 20°57′ N latitude, 72°54′ E longitude and has an altitude of about 10 metre above the mean sea level. The soil of the experimental field was clayey in texture, low in available nitrogen (216.5 kg/ha), medium in available phosphorus (34.22 kg/ha) and high in available potassium (361.0 kg/ha). The soil was slightly alkaline (pH 7.7) in reaction with normal electrical conductivity (0.34 dS/m) and organic carbon (0.46 %). The experiment was laid out in factorial randomized block design with three replications and 16 treatment combinations *viz.,* Four levels of nitrogen (0, 60, 120 and 180 kg/ha), two levels of bio-fertilizer (No bio-fertilizer (B_0) and bio-fertilizer inoculation (B_1)) (*Azotobacter* as seed treatment) and two levels FYM (0 (F_0) and 10 tonnes/ha (F_1)). The required quantity of seed for experimental area @ 100 kg/ha was worked out.

RESULTS AND DISCUSSION

Effect on yield

Seed and straw yields of oat progressively enhanced due to increasing levels of nitrogen significantly. Application of 120 kg/ha (N_2) and 180 kg N/ha (N_3) recorded significantly highest seed yield (51.90 and 54.02 q/ha, respectively) and straw yield (108.82 and 111.17 q/ha, respectively) (Table 1) over other treatments being remained at par with each other. The better effect of nitrogen levels might be attributed to rapid expansion of dark green foliage, which could intercept and utilize more incident light energy in the production of carbohydrates through the process of photosynthesis. Increased seed and straw yields may be attributed to the improvement in growth attributes due to N application. The results were in agreement with those of Chouhan *et al*. (2015), Joon *et al*. (1993), Sharma *et al*. (2001), Patel and Rajagopal (2002) as well as Devi *et al*. (2014) in oat. Inoculation of seed with *Azotobacter chrococcum* (B_1) registered significantly highest seed (48.06 q/ha) and straw (105.24 q/ha) over control (B_0). The highest yield under bacterial strain inoculation might be due to build up of their higher population in soil at different growth stages *viz*., sowing, tillering and flowering which in turn helped in fixation of more atmospheric nitrogen over non-inoculated treatments. The increase in seed and straw yields was attributed remarkable improvement in almost all parameters of yield under bio-fertilizers treatments. These findings are in conformity with the results of Agarwal *et al*. (2002), Deva, S. (2015), Sheoran *et al*. (2002), Singh and Dubey (2007), Sharma (2009), Patel *et al*. (2010) as well as Devi *et al*. (2014) in oat. Plants under the influence of 10 tonnes/ha farm yard manure (F_1) significantly attained highest seed (48.72 q/ha) and straw (105.21 q/ha) yields over control (F_0). This might be due to significant and progressive effect of FYM application on yield attributes *viz.,* number of grains per panicle, panicle length, seed weight per plant and test weight. The marked increase in seed and straw yields due to beneficial effect of FYM on various yield attributes. The results are in consonance with those reported by Devi *et al*. (2014) in oat.

Effect on nutrient uptake

There was significant improvement in uptake of N, P and K

Table 1: Effect of nitrogen, biofertilizers and FYM on yield and nutrient uptake in oat (*Avena sativa* L.)

Treatment	Seed yield (q/ha)	Straw yield (q/ha)	Uptake by seed			Uptake by straw		
			N	P	K	N	P	K
Nitrogen levels (kg/ha)								
0	34.95	88.62	1.54	0.46	0.82	1.13	0.24	0.93
60	42.07	98.52	1.55	0.46	0.83	1.16	0.24	0.93
120	51.90	108.82	1.64	0.47	0.86	1.22	0.25	0.97
180	54.02	111.17	1.65	0.47	0.86	1.23	0.25	0.97
S.Em. ±	1.27	3.38	0.02	0.01	0.01	0.02	0.00	0.01
C. D. at 5 %	3.66	9.77	0.06	NS	NS	0.05	NS	NS
Bio-fertilizer								
B_0	43.41	98.32	1.57	0.46	0.84	1.16	0.24	0.94
B_1	48.06	105.24	1.62	0.47	0.85	1.20	0.25	0.96
S.Em. ±	0.90	2.39	0.01	0.00	0.01	0.01	0.00	0.01
C. D. at 5 %	2.59	6.91	0.04	NS	NS	0.03	NS	NS
FYM (t/ha)								
0	41.50	96.96	1.57	0.46	0.83	1.16	0.24	0.94
10	49.97	106.60	1.62	0.47	0.85	1.21	0.25	0.96
S.Em. ±	0.90	2.39	0.01	0.00	0.01	0.01	0.00	0.01
C. D. at 5 %	2.59	6.91	0.04	NS	NS	0.03	NS	NS
Interaction effect	NS	NS	NS	NS	NS	NS	NS	NS
CV %	9.60	11.52	4.55	3.96	4.50	4.57	4.81	4.55

due to nitrogen application. Each increase in nitrogen application significantly influenced N, P and K uptake up to the highest nitrogen levels of 180 kg/ha. Application of 120 kg/ha (N_2) and 180 kg N/ha (N_3) resulted in significantly highest uptake of N, P and K in seed and straw over other treatments being remained at par with each other. Highest N, P and K uptake may be attributed to the beneficial effect of nitrogen sufficiency in the soil solution and higher dry matter yields leading to improved uptake to a sufficiency level. These findings corroborated the result of Sharma (2009) as well as Sarkar and Mallick (2010) in oat. The present study reflected that N, P and K uptake by seed and N uptake by straw (Table 1) were significantly influenced due to bio-fertilizer (*Azotobacter*). The highest N (78.69 kg/ha), P (22.66 kg/ha) and K (41.07 kg/ha) uptake by seed and N (127.35 kg/ha) uptake by straw were recorded under *Azotobacter* inoculation over control. Increased uptake of nutrients with *Azotobacter* inoculation may be combined effect of higher dry matter production and creation of proper environment by bacteria for uptake of various plant nutrients. Moreover, this might be due to favourable effect of *Azotobacter* on growth and yield parameters which accumulated more water along with nutrients and produced more photosynthates leading to increased content in seed and straw. These findings were in accordance with those reported by Sharma and Verma (2005), Patel *et al*. (2008), Devi *et al*. (2010), Patel *et al*. (2010) as well as Jat *et al*. (2013) in oat. P and K content uptake by seed and straw showed non significant results by various bio-fertilizer treatments. Application of farm yard manure 10 tonnes/ha (F_1) markedly influenced nutrient uptake in oat crop. The present study reflected that N, P and K uptake by seed and straw (Table 1) were significantly influenced due to FYM application.The highest N, P and uptake by seed and straw were recorded under FYM application @ 10 tonnes/ha over control treatment (F_0). Moreover, this might be due to addition of FYM improved physical, chemical and biological properties of soil and this leads to improve the root growth and development and thereby uptake of nutrients and water from soil volume resulting in increase content in seed and straw. These findings were in accordance with those reported by Jat *et al*. (2013) in oat.

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