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Effect of Azotobacter and Nitrogen on Yield and Nutrient Uptake by Wheat

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Abstract

An integrated approach for use of biofertilizers with chemical fertilizers is considered as the need of hour, as biofertilizers are not replacement of fertilizers but can supplement their requirement. Therefore, its use in wheat, which is heavy feeder of nitrogen, is much more relevant. The increase in eco-friendly production of wheat can be made possible by nitrogen management through biofertilizers. Hence, present investigation was carried out to study the effect of use of biofertilizer and inorganic nitrogen on wheat production.

The experiment was carried out at research farm Amar Singh (P.G.) College Lakhaoti Bulandshahr U.P. during the rabi season 2018-19 and 2019-20 in sandy loam soil. The available nitrogen, Phosphorus and Potassium contents in soil were 180, 10, 100 kg ha^{-1} respectively with pH 7.8. The experiment was laid out in randomized block design with three replications comprising three nitrogen (60, 80 and 120 kg ha^{-1}) levels and two levels of Azotobacter (uninoculated and inoculated). The wheat grains were inoculated with the culture solution then dried under shade before sowing. Wheat variety PBW- 343 was sown on 20 and 28 November of 2018-19 and 2019-20, respectively, 120 kg ha^{-1} between 22 cm apart rows at a depth of 3.0 cm from the top of the soil in lines. The full dose of recommended phosphorus (60 kg P_2O_5 ha^{-1}), potassium (40 kg K_2O ha^{-1}) and half of nitrogen was applied as per treatments at the time of sowing as basal dose and rest of nitrogen at two equal splits, at crown root initiation and ear initiation stage. Adopting standard agronomic practices raised the crop. The crop was harvested at maturity and grain and straw yields were recorded. The grain and straw were analysed for their nitrogen and Phosphorus content by adopting standard procedures. Soil samples collected after harvest were analysed for available nitrogen and Phosphorus content (Jackson 1973).

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Table: Effect of Azotobacter and nitrogen on yield, uptake of nitrogen and phosphorus in Wheat and status in soil (mean of two years)

Treatment (Kg ha^{-1})	Yield (t ha^{-1})		Nitrogen (Kg ha^{-1})		Phosphorus (Kg ha^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw
	Avail. N (Kg ha-1)		Avail. P (Kg ha-1)			
Azotobacter						
Uninoculated	4.44	12.53	101.6	70.3	9.3	12.7
	175.9		8.6			
Inoculated	5.08	14.32	118.3	86.1	11.3	15.8
	183.8		8.7			
CD at 5 %	0.13	0.32	3.58	2.68	0.87	1.84
	4.23		NS			
Nitrogen (Kg ha-1)						
60	3.98	11.18	87.8	58.0	7.8	9.8
	172.8		8.5			
80	5.03	14.22	115.9	81.8	10.9	15.4
	177.8		8.7			
120	5.29	14.90	126.1	94.8	12.5	17.8
	188.9		8.9			

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CD at 5 %	**0.17**	**0.40**	**4.40**	**3.30**	**1.08**
2.26	**5.97**	**NS**			

The grain and straw yield of wheat increased significantly with inoculation of Azotobacter over no inoculation. The mean increase in grain and straw yield was 14.1 and 14.0 percent over uninoculated one, respectively. The increase in yield might have resulted from the growth resulting substances produced by application of Azotobacter besides fixation of additional nitrogen from atmosphere, thereby, increasing the nitrogen availability in the soil throughout the crop growth. Similar results were reported by Singh et al. (2013), Pandey et al. (2014), Nishant *et al.* (2016) and Bishnupriya *et al*. (2018). Increasing levels of nitrogen applied in wheat increased grain and straw yield significantly over 60 kg nitrogen ha^{-1}. Application of 180 kg nitrogen ha^{-1} significantly increased the grain and straw yields by 32.3 and 33.9 % compared with the 60 kg nitrogen ha^{-1}. Such spectacular responses to nitrogen application are obviously attributable to low available nitrogen status of the soil and relatively high nitrogen requirement of the crop. Similar results were obtained by Kachroo and Razdan (2006), Pandey et al. (2014) and Nirolia et al. (2016) and Nishant et al. (2016). Inoculation of Azotobacter increased the nitrogen uptake by grain and straw significantly over no uninoculation. The increase was owing to enhanced nitrogen content in the soil due to inoculation of Azotobacter. Maximum nitrogen uptake was associated with the highest (180 kg ha^{-1}) dose of nitrogen applied to wheat. The nitrogen uptake by wheat noted at 180 kg nitrogen ha^{-1} was significantly superior to reduced levels of nitrogen. This was mainly due to the fact that better nitrogen utilization by more healthy and vigorous plants under 180 kg nitrogen ha^{-1} level and resulting in more dry matter accumulation, which ultimately increased the uptake of nitrogen. Cumulative effect of increase in Phosphorus content and grain and straw yield might have resulted in increase in Phosphorus uptake with increasing nitrogen level up to 180 kg nitrogen ha-1.

Available nitrogen content in soil increased significantly with Azotobacter inoculation as compared to uninoculation. The increase was owing to enhanced nitrogen content in the soil due to inoculation of Azotobacter. Available nitrogen status was higher at higher dose of nitrogen than lower doses of nitrogen and no nitrogen (control), which may be

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due to considerable gain of nitrogen content in the soil than control plots. The available phosphorus content in soil did not show any significant variation due to Azotobacter inoculation. Application of nitrogen did not affect the status of available phosphorus in soil after crop harvest significantly. However, a slight increase in available phosphorus status was noted with 180 kg N ha^{-1}.

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