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EFFECT OF UREA AND *AZOTOBACTER* ON GROWTH, YIELD AND BIOCHEMICAL PARAMETERS OF WHEAT (*TRITICUM AESTIVUM*) VARIETIES AAI-W14 & K-65 UNDER LATE SOWN CONDITION

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Abstract

The research was conducted to evaluate the best source and schedule of nitrogen fertilizer for growth, yield and biochemical parameters of wheat crop. A pot experiment was conducted to evaluating effects of urea and *Azotobacter* inoculants on the growth and yield of wheat under semi controlled environmental condition on the department of biological sciences, SHUATS. During December 2016 to March 2017. AAI W-14 and K-65 wheat genotype was used in the experiment. The experiment was conducted using CRD in three replications with six treatments of different concentrations (T_0-control, T_1-0.9g urea, T_2-1.2g urea T_3-2.5 ml *Azotobacter*, T_4-0.9g urea+ 2.5 ml *Azotobacter*, T_5-1.2g +2.5 ml *Azotobacter*). All the parameters of wheat *viz.* plant height, leaf length, chlorophyll content in leaf, days to 50% flowering, days to 50% heading, days to maturity, number of tillers, spike length, fertility ratio, number of grains per spike, gluten content, nitrate reductase in leaf, grains weight index, test weight, grain weight was influenced significantly by the treatments. Application of urea and *Azotobacter* was highly significant in T_5 then T_4 of all these varieties best result was observed in K-65 with the concentration of 1.2gm urea and 2.5 ml of *Azotobacter*.

Key words: *Azotobacter*, Nitrogen, Parameters, Urea, Wheat.

Introduction

Wheat (*Triticum* spp.) is one of the most important food crops in the world in terms of the area harvested, production and nutrition; as it supplies about 19% of the calories and 21% of the protein to the world's population (FAO, 2011). It is the most important rabi season crop in the country occupying about 50 % of the total area under food crops and accounting for more than 70 % of the total grain production in the rabi season. In India wheat is the second important staple food crop, next to rice. The nutritive value of wheat is it has high content of vitamin B complex. Wheat proteins significies especially in providing a characteristic substance called gluten which is used in bakeries. Wheat provides more protein than any other cereal crops (Iqtidar *et al.*, 2006). The objective of present study was to investigate effects of different dose of nitrogen application rates on yield and biochemical parameters of late sown variety of wheat in sub tropical region.

- Among the plant nutrients, nitrogen plays a very important role in crop productivity (Zapata & Cleenput, 1986; Ahmad, 1999; Miao *et al.*, 2006; Oikeh *et al.*, 2007; Worku *et al.*, 2007). Nitrogen (N) is an essential macronutrient and a major structural and physiological component of basically all processes related to plant development, growth and reproduction. For sustainable agriculture and food production, N is indispensable and it therefore has to be re-supplied to agricultural soils to prevent nutrient depletion and soil degradation. Globally, more than 100 million tons of N fertilizer are applied to crop lands each year – however, only about 40% of the fertilizer is effectively used by the crop plant and converted into harvested crop yield.
- Nitrogen deficiency can reduce evapo transpiration and water-use efficiency in wheat crops ficiency (Gallagher and Biscoe, 1978; Whitfield and Smith, 1989; Abbate *et al.*, 1995).

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- Urea's high analysis, 46% N, helps reduce handling, storage and transportation costs over other dry N forms. Urea, when properly applied, results in crop yield increases equal to other forms of nitrogen. Positive response of nitrogen fertilizers has been reported by Koul (1997), Omer (1998), Gasim (2001) and Sawi (1993). Sharma (1973) observed addition of nitrogen fertilizer increased plant height. Increase in plant height resulted in an increase in leaf number per plant as reported by (Akintoye 1996).
- *Azotobacter* is a free living bacterium. It can successfully grow in the rhizospheric zone of wheat, maize, rice, cotton and many others and fix 10-20kg N/ ha cropping season (Jadhav *et al.*, 1987). Besides N2 fixation, *Azotobacter* synthesizes and secretes considerable amounts of biologically active substances like vit B, nicotinic acid, pentothenic acid, biotin, heteroauxins, gibberellins etc. Which enhance root growth of plants (Rao, 1986).

Materials and Methods:

A pot experiment was carried out during rabi season of 2016-17 at the Department of Biological Sciences, SHUATS, Allahabad (UP). The experiment was laid out in CRD design with six treatments with two replications for present investigation two varieties of wheat are taken. Two plants are randomly tagged for morphological, physiological/biochemical studies. Treatments are denoted as $\mathbf{T_0}$, $\mathbf{T_1}$, $\mathbf{T_2}$, $\mathbf{T_3}$, $\mathbf{T_4}$ and $\mathbf{T_5}$ and varieties are AAI W-14 and K-65. All plants were irrigated weekly with nutrient solutions.

Treatment code	Chemical	Concentration
$\mathbf{T_0}$	Control	0.6gm
$\mathbf{T_1}$	Urea	0.9gm
$\mathbf{T_2}$	Urea	1.2gm
$\mathbf{T_3}$	*Azotobater* (1×10^8 cfu/ml.)	2.5ml
$\mathbf{T_4}$	Urea + *Azotobacter*	0.9gm+2.5ml
$\mathbf{T_5}$	Urea + *Azotobacter*	1.2gm+2.5ml

Result and discussion

1. Plant height:

Plant height (cm) was taken on the interval of 30 days

Fig 1 show a significant positive response of urea and *Azotobacter* on plant height (cm) in different varieties of Wheat (*Triticum aestivum)* at different concentration of urea and *Azotobacter* revealed that the plant height (cm) ranged from 43.33 to 65.17 (cm). Minimum value was exhibited by variety AAI W-14 (43.33) whereas

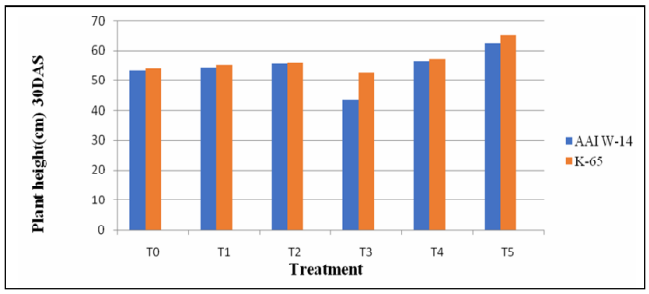

Fig 1: Effect of urea and *Azotobacter* on plant height (cm) of different varieties of wheat at 30 days

maximum value was exhibited by K-65 (65.17) in $\mathbf{T_5}$ (1.2g urea+ 2.5ml *Azotobacter*). The height of wheat mainly affected by the application of urea and *Azotobacter* as a fertilizer. Nitrogen increased PLH through elongation of internodes. Kumar & Agarwal, 1990; Lorzadeh, 1993; Swarup & Sharma, 1993; Ayoub *et al.*, 1994; Khaliq *et al.*, 1999 have reported direct relation between nitrogen application and PLH.

2. Number of tillers:

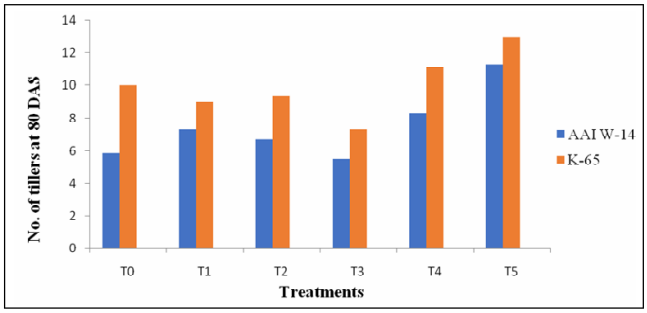

Fig 2: Effect of Urea and *Azotobacter* on number of tillers of different varieties of wheat at 80 days

Fig 2 show a significant positive response of effect of urea and *Azotobacter* on number of tillers per plant of different varieties of Wheat (*Triticum aestivum)* at different dose of urea and *Azotobacter* revealed that the number of tillers ranged from 5.50 to 13.00. Minimum value was exhibited by variety AAI W-14 (5.50) in $\mathbf{T_3}$ (2.5ml *Azotobacter*). Whereas, maximum value was exhibited by variety K-65 (13.00) in $\mathbf{T_5}$ (1.2g urea + 2.5ml *Azotobacter*). Optimum nitrogen availability plays an essential role in plant growth. Increased number of tillers of wheat in plant is due to N application and it was also reported by Rajput *et al.,* (1993) and Ahmad (1999).

3. Days to 50% heading:

Fig 3 show a significant positive response of effect of urea and *Azotobacter* on days to 50% hiding per plant of different varieties of Wheat (*Triticum aestivum)* at different concentration of urea and *Azotobacter* revealed that the days to 50% hiding ranged from 71 to 80 days.

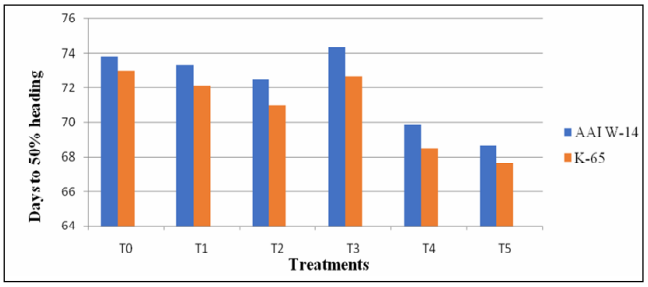

Fig 3: Effect of Urea and *Azotobacter* on days to 50% heading of different varieties of wheat

Minimum value was exhibited by variety K-65 (71) in $\mathbf{T_5}$ (1.2g urea + 2.5ml *Azotobacter*), whereas, maximum value was exhibited by variety AAI W-14 (80 days). Cock and Ellis (1992) reported that sufficient nitrogen at right time results in rapid growth and heading.

4. Days to 50% flowering:

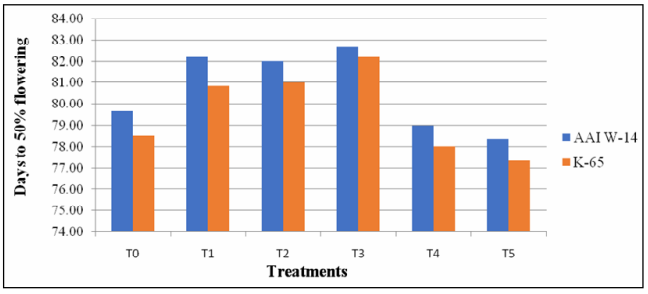

Fig 4: Effect of urea and *Azotobacter* on days to 50% flowering of different varieties of wheat

Fig 4 shows a significant positive response of effect of urea and *Azotobacter* on days to 50% flowering of different varieties of Wheat (*Triticum aestivum)*. Minimum value was exhibited by variety K-65(77) in $\mathbf{T_5}$ (1.2g urea + 2.5ml *Azotobacter*) whereas; maximum value was exhibited by variety AAI W-14 (82 days). In this study it was shown that increasing N availability diminished the amount of floret primordia degenerating. Kirby, 1988 reported that number of grains per spike is mainly the consequence of the dynamics of floret initiation and degeneration to produce fertile florets at flowering.

5. Spike length (cm):

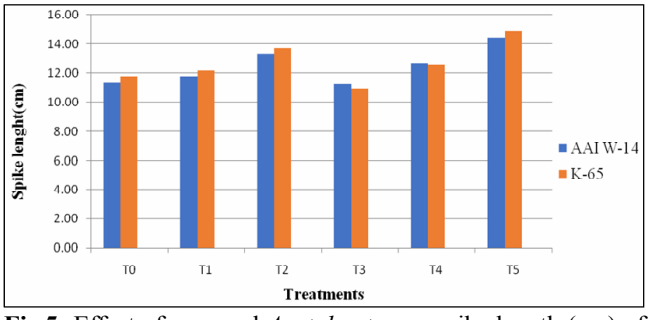

Fig 5: Effect of urea and *Azotobacter* on spike length (cm) of different varieties of wheat (*Triticum aestivum)*

Fig 5 show a significant positive response of effect of urea and *Azotobacter* on Spike length(cm) of Wheat (*Triticum aestivum)* at different concentration of urea and *Azotobacter* revealed that the Spike length(cm) ranged from 10.95 to 14.87 (cm). Minimum value was exhibited by variety AAI W-14 (10.95), whereas, maximum value was exhibited by variety K-65 (14.87cm). Cereals are mainly grown for grain yield. Optimum amount of nitrogen fertilizer at right time has significant effect on growth of spike length and it was also reported by Alcoz *et al.,* 1993. Danaei (1993), Swarup and Sharma (1993) reported that the effect of nitrogen application on spike length was significant.

6. Number of grains per spike:

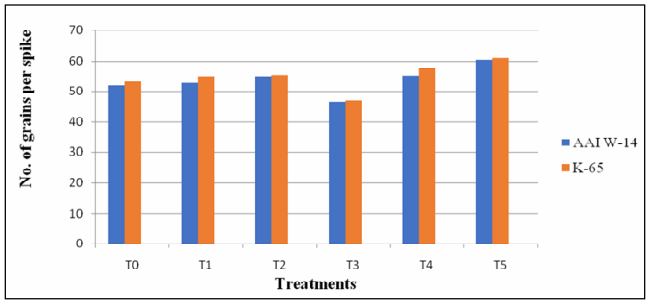

Fig: 6: Effect of urea and *Azotobacter* on number of grain per spike of different varieties of wheat.

Fig 6 show a significant positive response of effect of urea and *Azotobacter* on numbers of grain per spike of wheat (*Triticum aestivum)* plant of different varieties at different concentration of urea and *Azotobacter* revealed that the numbers of grain per spike ranged from 46.67 to 61. Minimum value was exhibited by variety AAI W-14 (46.67) in $\mathbf{T_3}$ (2.5 ml *Azotobacter*), whereas; maximum value was exhibited by variety K-65 (61.00) in $\mathbf{T_5}$ (1.2g urea + 2.5ml *Azotobacter*). Ayoub *et al.* (1994), Khaliq *et al.* (1999) reported that grains per spike increased with increasing nitrogen levels. The higher yield in different doses was mainly given because nitrogen is a readily available nutrient and not retained in the soil for long time. It was reported that nitrogen fertilizer should be incorporated for achieving target grain yield. Such results was also reported by Yousef *et al.* (1977), Rathore and Singh (1980).

7. Days to maturity:

Fig 7 shows a significant positive response of effect of urea and *Azotobacter* days to maturity of wheat (*Tritium aestival)* plant of different varieties at different concentration of fertilizers revealed that the Days to maturity ranged from 100 to 107 days. Minimum value was exhibited by variety K-65 (100) in $\mathbf{T_5}$ (1.2g urea + 2.5ml *Azotobacter*) whereas; maximum value was

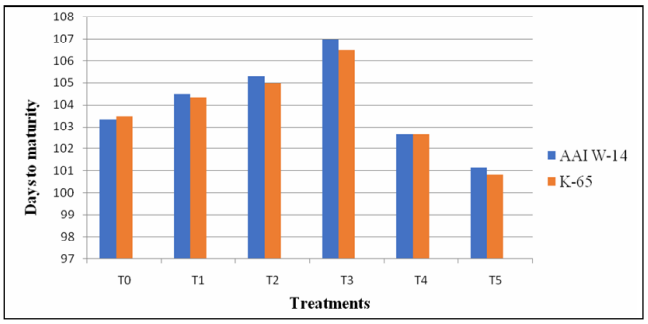

Fig 7: Effect of urea and *Azotobacter* on days to maturity of different varieties of wheat.

exhibited by variety AAI W-14 (107 days) in T3 (2.5 ml *Azotobacter*). Hailu Geberemariam, 2003 reported that growth and maturity of wheat directly influenced by availability of nitrogen.

8. Test weight:

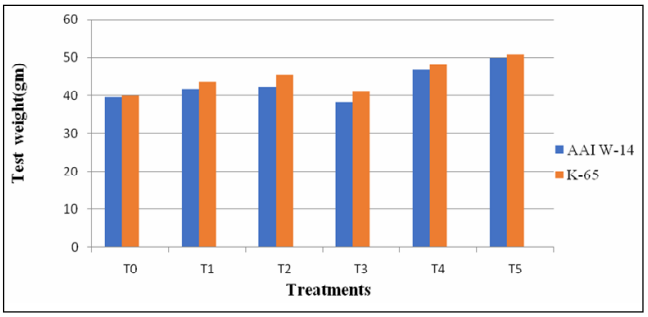

Fig 8: Effect of urea and *Azotobacter* on the test weight (g) of different varieties of wheat.

Fig 8 shows a significant positive response of effect of urea and *Azotobacter* on test weight of different varieties of Wheat (*Triticum aestivum)* at different concentration of urea and *Azotobacter* revealed the grain yield ranged from 39.27 to 50.60. Minimum value was exhibited by variety AAI W-14 (39.27) in $\mathbf{T_3}$ (2.5ml *Azotobacter*), whereas, maximum value was exhibited by variety K-65 (50.50) in $\mathbf{T_5}$ (1.2g urea + 2.5ml *Azotobacter*. Samiram, J.S. *et al.*, 1993 reported that the increasing levels of nitrogen increased the 1000 seed weight. Thousand seed weight is an important yield determining component and reported by (Ashraf *et al*, 1999).

9. Grain yield:

Fig 9 shows a significant positive response of Effect of urea and *Azotobacter* on grain yield of different varieties of Wheat (*Triticum aestivum)* at different concentration of urea and *Azotobacter* revealed the grain yield ranged from 28.92 to 34.71. Minimum value was exhibited by variety AAI W-14 (28.92g) in $\mathbf{T_3}$ (2.5ml *Azotobacter*), whereas, maximum value was exhibited by variety K-65 (34.71g) in $\mathbf{T_5}$ (1.2g urea + 2.5ml

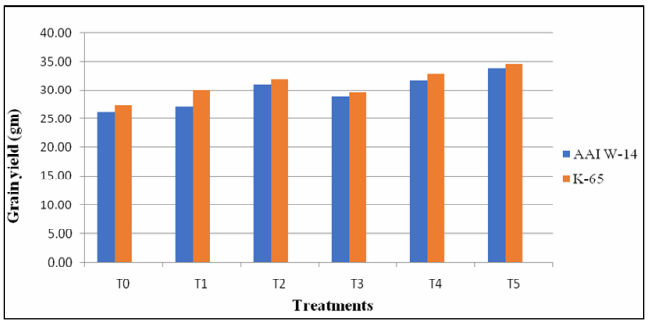

Fig 9: Effect of urea and *Azotobacter* on grain yield of different varieties of wheat.

Azotobacter). Spiertz and De Vos, 1983; Borghi *et al.*, 1997 reported that nitrogenous fertilizers influence yield and grain protein percentage. Weston *et al.* (1993) and Khaliq *et al.* (1999) also reported that nitrogen caused an increase in grain yield.

10. Total chlorophyll content:

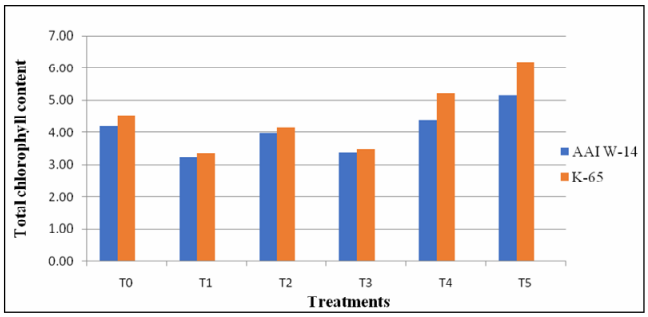

Fig.10: Effect of urea and *Azotobacter* on chlorophyll content (mg/g) of different varieties of wheat at 45 days.

Figure 10 show a significant positive response of Effect of urea and *Azotobacter* on chlorophyll content of different varieties of Wheat (*Triticum aestivum)* by applying different concentration urea and *Azotobacter* revealed that chlorophyll content ranged from 3.23 to 6.20(mg/g). Minimum value was exhibited by variety AAI W-14(3.23mg/m), whereas, maximum value was exhibited by variety K-65 (6.20mg/g) in $\mathbf{T_5}$ (1.2g urea+ 2.5ml *Azotobacter*). Leaves exhibit a structural and functional acclimation of the photosynthetic apparatus to the light intensity experienced during their growth (PRIOUL *et al.*, 1980). Nitrogen supply has large effect on leaf growth because it increases the leaf area of plants and it influences on photosynthesis. Nitrogen is a one the main constituent of chlorophyll (Mengel and Kirkby, 1987).

11. Nitrate reductase in leaf:

Fig 11 show a significant positive response of effect of urea and *Azotobacter* grain of different varieties of Wheat (*Triticum aestivum)* at different concentration of urea and *Azotobacter* revealed the nitrate reductase in leaf. Minimum value was exhibited by variety AAI W-14

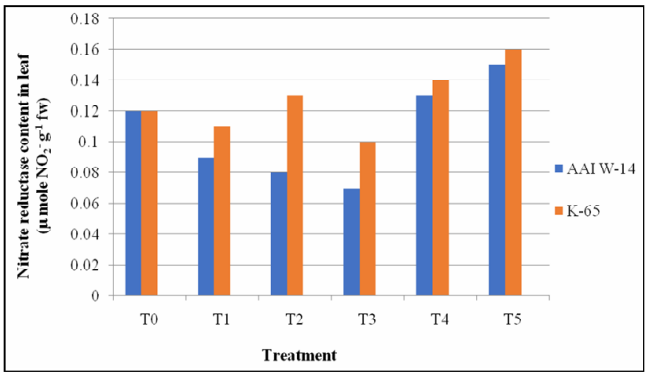

Fig.11: Effect of urea and *Azotobacter* on nitrate reductase content in leaf (µ mole NO_2^- g^{-1} fw) of different varieties of wheat.

(0.07%) in $\mathbf{T_3}$ (2.5ml *Azotobacter*) whereas, maximum value was exhibited by variety K-65 (0.16%) in T5 (0.9g urea + 2.5ml *Azotobacter*).

Conclusion

In conclusion, the results from this study demonstrated that in plants grown at high N obtained higher grain yields. The results revealed that nitrogen sources affected growth parameters at all sampling occasions. The combination of urea and *Azotobacter* enhanced growth and decreased the number of days to 50% heading and flowering. Also increase the grain yield and its quality. Based on the present investigation it is considered that genotype K-65 showed best result in $\mathbf{T_5}$ (1.2gm urea and 2.5ml *Azotobacter*) and after that $\mathbf{T_4}$ shows good response.

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