Impact of Bio-fertilizer with NP Application on yield and yield components of wheat variety Tijaban-10

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Abstract*— *It was noted from the present study that the maximum grain yield and fresh biomass yield 2799 kg ha^{-1} and 10373 kg ha^{-1} respectively was recorded in treatment-3 with application of Bio-fertilizer (AzospirillumA1-Q) + N 45kgha^{-1} and P_2O_5 30kgha^{-1}.Whereas, minimum grain yield and fresh biomass yield 1340 Kg ha^{1} and 6783 kg ha^{-1} respectively was noted in treatment-1 (control). Both grain and biomass yield increased due to increase in number of tillers, grain weight and suitable Nitrogen fixation, showing positive effect of mineral fertilizer (Biomass yield= Clipping of crop before heading stage for fodder purposes). The results proved that application of bio fertilizer in combination with N 45 kg ha^{-1} and P_2O_5 30 kg ha^{-1} increased 100% grain yield and 52% fresh biomass yield as compared to the treatment-1 (control).

Keywords*— *Wheat, Bio-fertilizer, nitrogen, phosphorous, yield components.

I. INTRODUCTION

Bio fertilizer is defined as a substance which contains living organisms when applied to seed, plant surface or soil, colonize the rhizosphere or the interior of plant and promotes growth by increasing supply or availability of primary nutrients to the host plant (Vessey, 2003). Bio-fertilizers are well recognized as an important component of integrated plant nutrient management for sustainable agriculture and hold a great promise to improve crop yield (Narula*et al*., 2005). Microbial inoculants or bio fertilizer is an important component of organic farming which helps the crops through required nutrients. These microbes help to fix atmospheric nitrogen, soluble and mobilize phosphorous, translocate minor elements like zinc, copper to the plants, produce plant growth promoting hormones, vitamins, amino acid and control plant pathogenic fungi. It improves the soil health and increase crop production. Bio-fertilizer like *rhizobium,azotobacter, azospirillum* and blue green algae are in use since long. *Azospirillum* inoculants are recommended mainly for wheat, sorghum, millets, maize, sugar cane and vegetable crops. Plant growth promoting *rhizobacteria* are free living microorganisms having beneficial effects on plants by colonizing their roots. They include such effects as the production of phytohormones, auxin, cytokines and gibberellins (Garcia, 2001) and enhanced the release of the nutrients to plantsBalochistan Agricultural Research & Development Centre western bypass Brewerey Quetta, Pakistan (Nautical et al., 2000). The microorganisms involved in P volatilization can enhance plant growthby increasing the efficiency of biological nitrogen fixation, enhancing the availability of other trace elements and by production of plants growth promoting substances (Gyaneshwaret al., 2002). Azotobacter and azospirillum significantly increased wheat and barley yield in irrigated land as well as in rain fed. Although, the inoculation treatment increased irrigated wheat yield on an average by 24%, the obtained difference depends on the farmers' location with increasing environmental index (Pauwet al,. 2008). In 2005 -06 the Biofertilizer treatment increased irrigated grain yields by 11% in Honam, while the yield of rain fed barley increased by 36% .In the follow year, grain yield of irrigated wheat increased by 24%.These differences in response are suggested to be an effect of the fertility level of the soil and the fertilizer application .Wheat and in particular irrigated wheat, is grown on the most fertile soil and receives the highest amount of mineral fertilizers. On the contrary, rain fed barley is grown on the most marginal soil with low inherent fertility and no mineral fertilizer. This is supported by other researches (Ali et al., 2005). After the introduction of chemical fertilizers in the last century, farmers were happy of getting increased yield in agriculture in the beginning. But slowly chemical fertilizers started displaying their ill- effects such as leaching out and polluting water basins, destroying micro-organisms and friendly insects, making the crop more susceptible to the attack of diseases, reducing the soil fertility and thus causing irreparable damage to the overall system (Wu et al., 2005). The aim of the present study was to determine the impact of bio fertilizer with NP application on yield and yield components of wheat variety 'Tijaban-10 in agro climatic zone of Quetta Balochistan.

II. MATERIALS AND METHODS

Study was carried out at Arid Zone Research Centre Quetta, Balochistan, under irrigated conditions during rabbi season 2009-2010. The location falls in cold highlands with minimum temperature up to -12^{0}C or below. Each treatment was replicated three times in randomized complete block design .The plot size was 9m x 10m = 90 m^2 in each treatment. Row to row distance was 25cm. An improved wheat variety "Tijaban-10" was used as test crop. Seed was applied @ 125Kgha^{-1}. The land was thoroughly prepared and seeds were treated with calculated quantities of bio fertilizer. Bio fertilizer (A1-Q) *azotobacter* and *azospirillum* was provided by national agricultural research centre, Islamabad. Three treatments including treatment:1 un inoculated as well as un fertilized , treatment:2 N 90 kgha^{-1} and P_2O_5 60 kgha^{-1}, treatment:3 bio fertilizer + N 45kgha^{-1} and P_2O_5 30 kgha^{-1} (Urea and TSP form) were kept. Yield components were recorded on plant height (cm), (Fresh Biomass yield kgha^{-1}=Clipping of crop before heading stage for fodder purposes), (number of tillers/m^2, total dry matter kgha^{-1}, 1000 grain weight (g) and grain yield kgha^{-1}. All the observations were analyzed by using the Fisher's analysis of variance techniques and difference among treatments means were compared by using the LSD test at $p< 0.05$ (Steel *et al*., 1997).

III. RESULTS AND DISCUSSION

The data presented in Table-1 reveals that bio fertilizer application on plant height was significant. Maximum plant height (68 cm) was observed in treatment-3 bio fertilizer + N45kgha^{-1} and P_2O_5 30 kgha^{-1} while the minimum plant height (49 cm) was recorded in treatment-1 (Control). The same type of study was carried out by (Mohammad 2002). He reported that a treatment receiving P+ *Azotobacter* improved plant height, number of tillers and spikes per plant and significantly increased grain, shoot and biomass yield of a wheat crop. Such increase in plant height may be occurred due to the stimulation of cell division and internodes elongation resulted from nitrogen application (Sabah *et al*, 2006). It is also evident from (Table -1) that effect of bio fertilizer application on biomass yield kgha^{-1} was significant. Maximum biomass yield (10373kgha^{-1}) was recorded in treatment-3 bio fertilizer + N 45kgha^{-1} and P_2O_5 30kgha^{-1} while minimum biomass yield (6783kgha^{-1}) was recorded in the treatment-1 (Control). These results are consistent with the findings of (Plensicar&Kustori 2005) who reported that maximum biological yield was found at higher planting density. Good soil fertility management ensures adequate nutrient availability to plants and increases yields. High above-ground biomass yield is obviously accompanied by an active root system, which releases an array of organic compounds into the rhizosphere (Mandal *et al*., 2007). Positive effect of bacteria in providing nitrogen causes to increase cell division in plant and distance between nodes in stem and finally plant length. (Sharifi and Haghniya, 2007) reported increased biomass and vegetative growth with use of nitroxin biological fertilizer. In a study on the effect of *azotobacter* and *azospirillum* + chemical fertilizer on biological yield in wheat, (Hajibolan*et al*., 2005) reported that this treatment significantly increased biological yield as compared with control. (Rajaei*et al* 2008) concluded that *Azotobacter* not only affected the increase in growth and chlorophyll content of wheat, but also had a positive effect on uptake and transfer of elements and consequently, caused the increase in biological yield.

Table-1 showed that effect of bio fertilizer application on plant density was significant. Maximum plant density (195) was recorded in treatment-3 bio fertilizer + N 45kgha^{-1} and P_2O_5 30kgha^{-1} while minimum plant density (150) was recorded in treatment-1 (Control). Several other studies reported that plant population is a key factor for attaining maximum grain yield (Akbar *et al*., 2002).

It is obvious from the data (Table- 1) that the bio fertilizer application on spike length was not significant. Maximum spike length (13cm) was recorded in treatment-3 bio fertilizer + N 45 kgha^{-1} andP_2O_5 30kgha^{-1} and minimum spike length (11 cm) was recorded from the treatment-1(control). Highest plant population had a negative impact on ear length. They observed that ear length decreased with increase in plant population. Ear length was more in planting density when compared with other treatments. This may be due to the fact that available nutrients, moisture, space and light become limited in high plant population due to high competition of soil resources between plants. Ultimately plants produced relatively small ears reported by (Hassan 2000).

It is apparent from (Table-1) that bio fertilizer application on number of tillers/m^2 was significant. The maximum (491) numbers of tillers/m^2 were observed in treatment-3 bio fertilizer + N 45kgha^{-1} and P_2O_5 30kgha^{-1} while the minimum (307) number of tillers/ m^2 were recorded in treatment-1 (control). Same type of study was also carried out by (Mohammad, 2002). He reported that the effect of treatment receiving P + *azotobacter* in improving number of tillers increased significantly the grain, shoots and biomass yield of wheat crop.

The presented in (Table-1) showed that use of bio fertilizer application on dry matter yield kgha^{-1} was significant. Maximum dry matter yield (8750 kgha^{-1}) was observed in treatment-3 bio fertilizer + N 45kgha^{-1} and P_2O_5 30kgha^{-1} while the minimum dry matter yield (4900 kgha^{-1}) was recorded from the treatment-1 (control). With respect to response of yield and its components to bio fertilizer, table-1 showed that bio fertilization either with *azotobacter* or yeast single or combined had a significant positive effect on grain and straw yields. This increment of yield and its components may be due to the positive effect of bio fertilization which play important role in assimilation processes of wheat plants which reflected on enhancing these characters (Mahdi *et al*., 2010). (Idris *et al*, 2001) reported increase in dry matter yield with the integration of organic manure with mineral fertilizer. These results are in agreement with (Singh, Agarwal, Zeidan and Kramany 2001), and similar results were obtained by (Shaaban, 2006) who reported that higher grain yield were recorded with (80kg organic (chicken) N+40kg inorganic N).

The data also reveals (Table-1) that the results of bio fertilizer application on grain yield kgha^{-1} was significant. The maximum grain yield (2799 kgha^{-1}) was observed in treatment-3 bio fertilizer + N 45kgha^{-1} and P_2O_5 30kgha^{-1} while minimum grain yield (1340 kgha^{-1}) was recorded from the treatment-1 (Control). Keeping all these facts in view, phosphorus and *azotobacterization* applied alone and in combination with on the yield, yield components and nitrogen and phosphorus uptake by wheat (*Tritium aestivum*), had a beneficial effect in wheat production. Phosphorus alone and in combinations with inoculations and dual inoculation all significantly increased the grain yield over control as well as single inoculations. These results confirmed the previous findings. (Biswas *et al*., 2000; Ragaei*et al*., 2008; and Hajibolan*et al*. 2005) reported that treatment of *azotobacter* and *azospirillum* + chemical fertilizer significantly increased grain yield as compared with control (chemical fertilizer). They stated that nitrogenous compounds, that are built up following the interaction between root and *azotobacter*, might be transferred more quickly and efficiently (e.g. at loading stage) to shoots than normal nitrogen transfer (in un-inoculated plants).

The data presented in (Table -1) indicated that efficiency of bio fertilizer application on 1000 grain weight (g) was significant. The maximum 1000 grain weight (34.0 grams) was recorded from the treatment-3 bio fertilizer + N 45kgha^{-1} and P^2O^5 30 kgha^{-1} which showed positive effect of grain weight on total grain yield kgha^{-1} while minimum 1000 grain weight (30.5 grams) was recorded from the treatment-1 (control) which reveals decreased yield . (Ragaei*et al*., 2008) reported that inoculation of wheat with *azotobacter* significantly increased grain number per spike and 1000 grain weight as compared with control (no-fertilization). Similar results have also been reported by (Zeidan and Kramany 2001) who observed higher 1000 grain weight with the use of organic manure and mineral nitrogen. The large accumulation of proteins and other reserved food in the seed due to which 1000 grain weight was increased may be due to the ease availability of nitrogen and other soil nutrients from fertilizers.

The data in (table -1) reveals that the results of bio fertilizer application on harvest index % were not significant. The maximum harvest index (32.0 %) was observed in treatment-3 bio fertilizer + N 45kgha^{-1} and P_2O_5 30 kgha^{-1} while minimum harvest index (27.0%) was recorded in treatment-1 (Control) respectively. The non-significant differences in Harvest Index may relate to instability of Harvest Index due to different environments, positive effect of biofertilizer may resulted from its ability to increase the availability of Phosphorus and other nutrients especially under the specialty of the calcareous nature of the soil of the region which cause decreasing on the nutrients availability, results agree with (Afzal *et al*., 2005)

TABLE 1

SOME MORPHOLOGICAL CHARACTERS OF WHEAT VARIETY TIJABAN-10 USED FOR STUDY

Treatments	Plant height (cm)	Biomass Yield kg ha^{-1}	Plant density	Spike length (cm)	Number of tillers/m^2	TDM kg-ha^{-1}	Grain yield kgha^{-1}	1000 grain wt: (g)	H.I
T1	49 b	6783 b	150b	11	307b	4900 b	1340 b	30.5 b	27.0
T2	62 a	10057 a	180a	12	401a	6590 a	2070 ab	33.0 a	31.0
T3	68 a*	10373 a*	195a*	13 ns	491a*	8750 a*	2799 a*	34.0 a*	32.0 ns

Values followed by different letters within same column are significant at alpha =0.050

T1-Control

T2- Nitrogen applied @ 90 kgha^{-1} + Phosphorous 60 kgha^{-1}

T3- Bio-fertilizer applied@ 1/2kg/60kg seed + Nitrogen 45kg ha^{-1} + Phosphorous 30 kg/ha^{-1}

REFERENCES

[1] Akbar, H., M.T. Miftahullah, A., Jan and Ihsanullah. 2002. Yield potential of sweet corn asinfluenced by different levels of nitrogen and plant population. *Asian J. Plant Sci.*, 1:631-633.

[2] Ali, S., M. G. Amin, M. Fayaz, M. El-Tahan, M. Monib and N. Hegazi. 2005. Production ofbiofertilizers using baker's yeast effluent and their application to wheat and barley growth in northSinal deserts. Achieves of Agron. Soil Sc., 51(6):589-604.

[3] Biswas, J.C., J.K. Ladha and F.B. Dazzo. 2000. Rhizobia inoculation improves nutrient uptake and growth of lowland rice. Soil Sci. Soc. America J., l 64: 1644–50.

[4] Garcia, De., I.E. Salamone, R.K., Hynes and L.M. Nelson. 2001. Cytokines Production by plantgrowth promoting *rhizobacteria* and selected mutants. Canadian Journal of Microbiology47: 404-411.

[5] Gyaneshwar, P., G.K.Naresh and L.J. Parekh. 2002. Effect of buffering on the phosphatesolubilizing ability of microorganism's .World J. Microbial.Biotechnology.14, 66-673.

[6] Hajibolan, R.N., azgharzade and Z. Mehrfar. 2005. The ecological study *azotobacter* in tworegions Azarbayjan, Iran and the effect it inoculation on growth and nutrient of wheat.Journal of Science and Technology of Agriculture and Natural Resources, 8(2): 75-89.

[7] Hassan, A.A. 2000. Effect of plant population density on yield and yield components of 8Egyptian maize hybrids. Bull. Faculty Agric. Uni. Cairo., 51: 1-16.

[8] Idris, M., S.M. Shah, W. Muhammad and M.M. Iqbal. 2001. Integrated use of Organic andMineral Nitrogen and Phosphorus on the yield, yield components, N and P uptake by wheat. Pak. J. Soil Sci., 20:77-80.

[9] Mahdi, S., G.I. Hassan, S.A. Samoon, H.A. Rather and A.D. Showkat. 2010. Bio-fertilizer inorganic agriculture. J. Phytol., 2(10): 42-54.

[10] Mandal, A., A.K. Patra, D. Singh, A. Swarup and R. EbhinMasto. 2007. Effect of long-term application of manure and fertilizer on biological and biochemical activities in soil during crop development stages. Biores. Technol. 98: 3585-3592.

[11] Mohammad, I. 2002. The effect of fertilizer P and *Azotobacterization* applied alone and in combination on the yield, yield components, N and P accumulation by wheat. PAK. J. Soil Sci., Vol.21 pp 45-50.

[12] Narula, N., V. Kumar, B. singh, R. Bhatia and K lakshminarayana. 2005. Impact of Biofertilizer on grain yield in spring wheat under varying fertility condition and wheat –cotton rotation.Arcives of agronomy and soil science 51, 79-89.

[13] Nautiyal, C.S., S.Bhadauria, P. L.Kumar, R.Momdal and D. Verma. 2000. Stress inducedphosphate solubilization in bacteria isolated from alkaline soils. FEMSMicrobiology letters 182:291-296.

[14] Pauw, De.,E.A.Mirghasemi, A.Ghaffari and B. Nseir. 2008. Agro ecological zones of Karkheh River, Basin .Research Report, ICARDA, Aleppo, Syria.

[15] Plensicar, M. and R. Kustori. 2005. Corn yield and water use as influenced by irrigation level, N-rate and planting populations. Trans. Kansan Acad. Sci., 53(4): 121-127.

[16] Ragaei, S., H. Alikani and F. Raeci. 2008. The effect of plant growth promoting *rchrococom* on yield and nutrient uptake in wheat. Journal of Science and Technology of Agriculture and Natural Resources, 11(41): 285-296.

[17] Sabah, H. Abo-El-Ela. 2006. Influence of mineral and bio-nitrogen fertilization on three newbread wheat genotypes. Egypt. J. Agric. Res., 84(6): 1833-1841.

[18] Shaaban, S.M. 2006. Effect of Organic and Inorganic Nitrogen Fertilizer on Wheat Plant underWater Regime. Journal of Applied Sciences Research, 2(10): 650-656.

[19] Sharifi, z. and gh. Haghnia.2007. The effect of nitroxin biological fertilizer of performance andwheat yields. SabalanRagham. Second national conference of Iran's ecological agriculture. Gorgan. Page 123.

[20] Singh, R., S.K. Agarwal. 2001. Growth and yield of wheat (*Triticumaestivum* L.) as influencedby levels of farmyard manure and nitrogen. Indian J. Agron. 462-467.

[21] Steel, R.G.D., J.H.Torrie and D.A. Dickey. 1997. Principles and procedures of Statistics,Biometrical Approach. 3rd Ed. McGraw Hill Book Co., New York, U.S.A.

[22] Vessey, J.K. 2003. Plant growth promoting *rhizobacteria* as biofertilizer. Plant and soil 255, 571-586.

[23] Wu, S.C., Z.H. Cao, Z.G. Li., K.C. Cheung and M.H. Wong. 2005. Effects of Biofertilizer containing N-fixer, P and K solubilizers and AM fungi on maize growth: a greenhouse trial.Geoderma. 125:155–166.

[24] Zeidan, M.S., and M.F.E. Kramany.2001. Effect of organic manure and slow-release N-fertilizers on the productivity of wheat (*Triticumaestivum* L.) in sandy soil. AgronomicaHungarica. 49(4): 379-385.