BIOFERTILIZER- A POSSIBLE SUBSITUTE OF FERTILIZERS IN PRODUCTION OF WHEAT VARIETY ZARDANA IN BALOCHISTAN

Amanullah, Ahmed Aziz Kurd, Saifullah Khan,Munir Ahmed and Jahangir Khan*

ABSTRACT: -The study was conducted to investigate the effect of biofertilizer on wheat variety Zardana production at four locations of Balochistan. Biofertilizer (Azospirillum A1-Q + N 45 kg ha^{-1}, P_2O_5 30 kg ha^{-1}) was used to substitute for half of the Nitrogen (N) and phosphorus (P) fertilizer application rates as compared to a high fertilizer treatment (N 90 kgha$^{-1,}$ P_2O_5 60 kgha^{-1}). The high mineral fertilizer and biofertilizer + half mineral fertilizer treatments were compared with a control treatment (no fertilizer). Significant grain yield were measured at all sites, although, at all sites both fertilizer treatments apparently out yielded the control and the biofertilizer + half mineral fertilizer treatment out yielded the high fertilizer treatment by 220-1180 kgha^{-1}. Fresh yields differed significantly at all sites. At Mastung field, both fertilizer treatments out yielded the control by 3000 kgha^{-1} and at Quetta (Aghbarg field-2) the biofertilizer + half mineral fertilizer treatment out yielded the others by over 3000 kgha^{-1}. The results proved that the application of biofertilizer in combination with N 45kgha^{-1} and P_2O_5 30 kgha^{-1} increased fresh yield from11% to 59% and suggested increases in grain yield of 20-46% as compared with control treatment.

Key Words: Wheat; Biofertilizer; Nitrogen; Phosphorus; Yield; Yield Component; Pakistan.

INTRODUCTION

Biofertilizer is defined as a substance which contains living organisms that when applied to seed, plant surface, or soil, colonize the rhizosphere or the interior of plant and promote growth by increasing supply or availability of primary nutrients to the host plant (Vessey, 2003). Biofertilizers 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 inoculation or biofertilizer is an important component of organic farming as the microbes help to fix atmospheric nitrogen, solublize and mobilize phosphorous, translocate minor elements like zinc and copper to the plants, produce plant growth promoting hormones, vitamins and amino acids and control plant pathogenic fungi. It improves soil health and increases crop production. Biofertilizer like *Rhizobium, Azotobacter, Azospirillum* and blue green algae have been used for many years. *Azospirillum* inoculants are recommended mainly for wheat, sorghum, millets, maize, sugarcane and vegetable crops. Plant growth promoting rhizobacteria are free living microorganisms having beneficial effects on plants by colonizing their roots. They include

**PARC-Arid Zone Research Centre, Brewery Road, Quetta, Pakistan.*
Corresponding author:aman_azrc@yahoo.com

such effects as the production of phytohormones; auxin, cytokinins and gibberellins (Garcia et al., 2001), enhancing release of the nutrients (Nautiyal et al., 2000). The microorganisms involved in P solubilization can enhance plant growth by increasing the efficiency of biological nitrogen fixation, enhancing the availability of other trace elements and by production of plant growth promoting substances (Gyaneshwar et al., 2002). In the last century after the introduction of chemical fertilizer farmers were initially happy with the increased yield in agriculture. 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. Much of the attention has focused on seed inoculation by different types of bacteria for increasing agricultural production, to limit the use of chemical fertilizer and environmental pollution through seed inoculation by different types of bacteria (Abd El Humid and Amal, 1994; Abd El- Ghany and Bouthaina, 1994).

Azotobacter and *Azospirillum* have previously significantly increased wheat and barley yield in irrigated as well as in rainfed crops (Pauw De et al., 2008). Biofertilizer treatment increased irrigated grain yield by 11% in Honam, while the yield of rainfed barley increased by 36% grain yield of irrigated wheat increased by 24% while rainfed barley yield doubled (Ali et al., 2005). These differences in response are suggested to be an effect of the fertility level of the soil and fertilizer application. Wheat, and in particular irrigated wheat, is grown on the most fertile soils and receives mineral fertilizers. On the contrary, rainfed barley is grown on the most marginal soils with low inherent fertility; this observation is supported by other researchers (Raj and Gaur, 1988; Ali et al., 2005). The study was conducted to investigate the effect of *Azospirillum* biofertilizer on wheat variety Zardana production under irrigation at four different locations of Balochistan.

MATERIALS AND METHOD

This study was conducted at four locations i.e. Aghbarg-1, Aghbarg-2, Umer Dhor and Mastung in Balochistan under irrigated conditions during *rabi* 2009-2010. All the sites are in the cold highlands with minimum temperature of -12°C or below. The soil differences were also recorded for different sites. Randomized soil samples were collected at the depths of 0-5 cm, 15-30 cm and 30-45 cm from each location. These samples were analyzed at the soil chemistry laboratory of Arid Zone Research Centre, Quetta. An improved wheat variety, 'Zardana' was used as test crop. Seed @ 125 $kgha^{-1}$ were applied during the second week of November. The sowing was carried out on November 8, 2009 at Aghbarg-1 and 2; November 9, 2009 at Umer Dhor and November 11, 2009 at Mastung. Three treatments were uninoculated and unfertilized (control), high mineral fertilizer, N 90 $kgha^{-1}$ and P_2O_5 60 $kgha^{-1}$, Biofertilizer + half mineral fertilizer, N 45 $kgha^{-1}$ and P_2O_5 30 $kgha^{-1}$. Nitrogen and phosphorus were applied at the time of sowing in the form of urea and triple super phosphate were applied at the sowing time. Treatment was replicated thrice in a randomized complete block design. Each treatment plot size was kept 1333m^2 and total plot size was one acre in each experimental location with a row to row distance of 25cm. Seeds were treated with calculated quantities of biofertilizer (A1-Q) provided by National Agricultural Research Centre, Islamabad. The crop was harvested during the third week of May. Three samples of 1m^2 from each treatment were randomly collected in terms of fresh yield at the vegetative growth stage. At Aghbarg-1 and 2 sample was collected after 145days of sowing while at Umer Dhor and Mastung collection was made after 151 and 147 days, respectively. However, plant height (cm), No. of tillers m^{-2}, total dry matter $kgha^{-1}$ were recorded at maturity stage. After threshing and cleaning grain yield and 1000 grain weight were recorded. All observations were analyzed by using Fisher's analysis of variance techniques and differences among treatment means were compared by using the LSD test at $P< 0.05$(Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Soil Analysis

Soil samples from Mastung field was silty clay loam, low in organic matter, with pH 8.3 and $CaCO_3$ was present. Soil from Aghbarg was slightly saline, clay loam with low organic matter it showed moderate alkalinity with pH 7.9, $CaCO_3$ was comparatively less than other sites. Soil Soil samples of Umer Dhor field revealed a saline clay loam, high in alkalinity and low in organic matter.

The data revealed that, although biofertilizer application appeared to increase plant height at all locations, the effects were non significant.(Table 1) The same type of study was carried out by Mohammad (2002) who 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.

The effect of biofertilizer application on fresh biomass yield at Mastung and Aghbarg-2 (Quetta) was significant whereas at Aghbarg-1 (Quetta) and Umer Dhor Dasht field it was non-significant. At Mastung field, both fertilizer treatments out-yielded the control by 3000 $kgha^{-1}$ and at Aghbarg field-2 the biofertilizer + half mineral fertilizer treatment out yielded the others by over 3000 $kgha^{-1}$. Biofertilizer application significantly increased number of tillers m^{-2} at Mastung but not at the other locations although, again, the biofertilizer treatment tended to produce more tillers at all locations (Table 1).

Use of fertilizer increased total dry matter yield at all locations (Table 1), although at Mastung field this was non-significant. At Aghbarg-2 the biofertilizer treatment significantly out yielded both the high mineral fertilizer treatment and the control, while at Aghbarg -1 and Umer Dhor Dasht the biofertilizer treatment out yielded only the control.

Both fertilizer treatments significantly increased 1000 grain weight (g) over the control at Aghbarg-1, Aghbarg-2 and Umer

Dhor Dasht and, although grains tended to be larger with biofertilizer treatment than mineral fertilizer alone, these differences were not significant.

The data also revealed that, at all sites, the highest grain yields were obtained with the biofertilizer treatment, followed by the mineral fertilizer alone and then the control (Table 1). However, none of these effects were statistically significant, despite the yields with biofertilizer being almost double than the control at both Quetta sites. *Azotobacter* has also been reported to improve not only yield, but also N and P utilization by the crop (SAIC, 1996). Bhandhari and Somani (1990) reported that the beneficial effect of P and Azotobacterization applied alone and in combination on the yield, yield components and N P uptake by wheat (*Triticum aestivum*), were quite significant. They also reviewed the work of many workers who reported a 30% improved germination by increases in the yield, higher population of Azotobacter in the rhizosphere of wheat as result of Azotobacter inoculation of wheat.

At Umer Dhor Dasht, the fertilizer treatment reduced harvest index percentage whereas at the other sites, the reduction in harvest index also occurred but was non-

Table 1. Effect of different fertilizers on some morphological characteristic of wheat at four sites

Location	Treatment (kg ha^{-1})	Plant height (cm)	Fresh yield (kg ha^{-1})	No: Tillers m^2	TDM (kg ha^{-1})	Grain yield (kg ha^{-1})	1000 grain wt.(g)	H. I
Mastung	Control	65	6900 b	242 b	6030 c	2900 b	36.0	48.0
field	N-90+P-60	70	9937 a	252 b	9400 ab	3620 ab	37.0	38.5
	Biofertilizer+N-45+ P 30	75	10187 a	333 a	9870 a	3920 a	38.0	40.0
		NS	*	*	*	*	NS	NS
Aghbarg field-1 Quetta	Control	73	12420	320	5150 b	2110 c	30.5 b	41.0
	N-90+P-60	82	13150	360	10390 a	3550 b	33.0 a	34.0
	Biofertilizer+N-45+ P 30	83	14020	379	10800 a	3910 a	34.0 a	36.0
		NS	NS	NS	*	*	*	NS
Aghbarg field-2	Control	63	5700 b	205	3903 b	1870 c	28.0 b	48.0
	N-90+P-60	69	7580 b	307	6920 b	2480 b	30.0 ab	36.0
Quetta	Biofertilizer+N-45+ P 30	70	10798 a	324	8570 a	3660 a	34.0a	43.0
		NS	*	NS	*	*	*	NS
Umer Dhor Dasht Mastung	Control	57	6420	304	5010 b	1720 b	28.0 a	34.0 a
	N-90+P-60	70	8103	309	7000 ab	1930 ab	30.5 a	27.5 ab
	Biofertilizer+N-45+ P 30	74	9950	325	9060 a	2150 a	33.0 a	24.0 b
		NS	NS	NS	*	*	*	*

Means followed by same letters do not differ significantly significant. The highest harvest index (48.0%) was observed in the control at Mastung field while the lowest (24.0%) was recorded from biofertilizer +N 45kgP_2O_5 30 $kgha^{-1}$ at Umer Dhor Dasht.

It is therefore concluded that application of biofertilizer with ½ N+P dose is a potential alternative for full dose N+P fertilizers in irrigated conditions. Therefore, the use of biofertilizer in this way will reduce costs of mineral fertilizers and reduce environmental impacts while maintaining yields.

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