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Effects of Phosphorous Solublizing Bacteria with Mineral Phosphorous on Wheat Yield in New Halfa Irrigated Scheme at East of Sudan

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ABSTRACT: Multi locations experiment was conducted or two consecutive winter seasons (2017/ 2018 and 2018/ 2019), at three regions (Southern, middle and Northern) of New Halfa scheme to study the effect of bio-fertilizers (namely Phosphorous solublizing Bacteria) with N fertilizer on grain yield of wheat. The experimental locations (sites) were Hajer (L1), Faculty of Agriculture (L2) and Shebaik (L3) which represented three types of soils and environments of New Halfa scheme Eastern Sudan. The experiment was arranged according to randomized complete block design (RCBD) with three replicates in each site. The bio fertilizers treatments were inoculation with P–solublizing **bacteria** (FB Bacillus mucilaginous) solely or with 43 kg, 86 kg P hectare in addition to control treatment. The yield attributes parameters include grains number and weight per plant, spike length, number of spikelets per spike, 100–grain weight and grain yield/ha. The results revealed that, inoculation seeds with Bacteria increased yield parameters particularly in first season at all sites. Addition of P to bio fertilizer(FB+86kg N\ha) relative to control treatment significantly increased all aforementioned yield traits particularly grain yield/ha by more than 54% at northern site (Shebaik) of New Halfa Scheme, which was associated with significant increased in related character 1000–grain weight. Inoculation, application of bio fertilizer with P, can greatly increased yield of wheat at all regions of New Halfa scheme.

KEYWORDS: bio-fertilizers, P–solublizing **bacteria**, P, wheat, grain yield

I. INTRODUCTION

Wheat (*Triticum aestivum* L.), is one of the major food crops in the world, it is a cool-season annual monocot C₃ plant which is representative of graminaceous species common to temperate and savannas zones (Wall et al., 2006). According to Hari and Perumal(2010) bio-fertilizer is most commonly referred to as selected strains of beneficial soil microorganisms cultured in the laboratory and packed in suitable carriers. Bio-fertilizers are products containing living cells of different types of microorganisms, which have an ability to convert nutritionally important elements from unavailable to available form through biological processes (Vessey, 2003).

Phosphorus in the soil occurs mostly as insoluble phosphate which cannot be absorbed by plants (Gupta., 2004). Phosphorus bio-fertilizer not only could increase the availability of accumulated phosphate by solubilization but also improve efficiency of biological nitrogen fixation and increase the availability of Fe, Zn and so on, through production

of plant growth promoting substances (Kucey et al, 1989). Also, Zahgloul et al. (2015) mentioned that the application of bio-stimulants (*Bacillus* and *Azospirillum*) significantly decreased the consumption of mineral fertilizers, and these biological applications were increased the growth, productivity and quality of orange fruits.

Other investigators (Baliah and Priya, 2017; Zhang et al,2018; Deng et al,2019; Prakash and Arora, 2019; Wang et al, 2020) reported that application of P – solubilizing Bacteria significantly increased available P in the soil and promote utilization of nutrients by plant thus increased wheat growth development.

The increased in spike length, number of spikelets per spike due to addition of bio fertilizer was reported by (Chauban et al., 2011; Amin and Kurosh., 2015). Kandil et al.,(2011) found that application of bio fertilizer had favorable effects on 1000-grain weight particularly with combination with chemical fertilizers. Many studies have been performed on different crops using bio fertilizer to increase grain yield.

The continuous use of higher levels of chemical fertilizers by the farmers has led to the problem of soil degradation, which is proving detrimental to crop production in our country. In this context, it is necessary to provide conditions for effective use of natural processes, such as bio fertilization, the process of fixing nutrients through microorganisms(Astarai and Koocheki.,1996). However, current trends in agriculture are focused on search for alternative to chemical fertilizer due to huge cost of procurement, contamination of environment, and couple with improper application leading to the degradation of soil quality.

Zahgloul, A.E., El-Din, M.N. and Ghazi, A.A., 2015. Combination Effects of Biofertilization and Biostimulants Foliar Application on Yield, Quality and Marketability of Washington Navel Orange Fruits. *Journal of Agricultural Chemistry and Biotechnology*, 6(12), pp.627-655.

Integrated application of P – solubilizing Bacteria with chemical fertilizer may increase the availability of P in the soil, which led to higher crop production. Poor soil nutrients concentration especially, low availability of P coupled with unscientific method of cultivation are major constraints to wheat production in Sudan. This may play a vital role in enhancing crop productivity and sustaining soil fertility, which lead to prove great promise for increasing farmer's income. These factors interrelate providing an important insight to the study of the effects of amended chemical fertilizers (phosphorous) on wheat in New Halfa scheme. Accordingly, the objective of this study was:- investigate the interactive effects of bio fertilizer amended with mineral P on yield of wheat at three different sites (Hajer, Faculty of Agriculture and Shebaik) represent Southern, Central and Northern regions of New Halfa scheme.

II. MATREIALS AND METHODS

Multi locations field experiment was conducted for two consecutive seasons (2017/018 and 2018/019) in New Halfa Agricultural scheme on Kassala State in Eastern Sudan between latitudes 13° 21'-14° 1' North, longitude 36° 11'- 36° 46' East, over the three proposed soil series of, Khashm el Girba, Asupri and Sabaat which were represented production areas of South, Central and North of New Halfa scheme.

Experimental treatments and layout:

A wheat cultivar; Bohain was used in this study and the seeds for the two seasons were obtained from Agricultural Research Station in New Halfa. The experimental locations (sites) were Hajer (L1), Faculty of Agriculture (L2) and Shebaik (L3) which represented three types of soils and environments of New Halfa scheme Eastern Sudan. The experiment was arranged according to randomized complete block design (RCBD) with three replicates in each site. The bio fertilizers treatments were inoculation with P–solubilizing Bacteria (*Bacillus mucilaginosus*) solely or with 43 kg, 86 kg N hectare (in the form of triple Phosphate because it was a common fertilizer material and can be applied uniformly in research plot) in addition to control treatment(without fertilization). The treatments were control without any fertilizer PsB = only P–solubilizing bacteria; PsB + 43kg P/ha= P–solubilizing with 43kgP/ha; PsB +86kg N/ha = P–solubilizing bacteria with 86kg P/ha. The land was prepared by disc ploughing, harrowing, leveling, and ridging at 80 cm apart as. The plot size was 6× 3.75 meters consisting of four ridges 5-meter in length. Seeds were sown manually at a rate of 120 kg/ha, in three lines 15 cm apart, on the second week of November in both seasons. Weeding was done manually and with herbicides many times per season.

At harvest, the two inner rows in each plot were used for the determination of the following yield components:-

Spike length (cm): Ten spikes from each subplot were randomly selected and the average length of spike was measured.

Number of spikelets spike⁻¹: From the ten selected spikes the average number of spikelets per spike was determined.

Number of grains spike⁻¹: The previous spikelets were threshed manually after drying and the average number of grains per spike was determined.

Grains weight (g plant⁻¹)

Grains obtained from the 10 randomly selected plants were weighed using sensitive balance to determine the average grain weight per plant.

100-grain weight (g): From each plot, 1000 grains were randomly selected and weighed using sensitive balance to determine the average 1000-grain weight.

Grains yield (kg ha⁻¹)

In each plot, all plants grown in an area of 1.7 m² in the two central ridges were harvested, air-dried, weighed to determine the average yield per unit area.

Statistical analysis

Data was statistically analyzed using Statistix 10 software package, version 10 for RCBD according to Gomez and Gomez (1972). Means comparison was worked out by Duncan's Multiple Range Test (DMRT) at 5% level of probability.

III. RESULTS AND DISCUSSION

Inoculated seeds with P-solubilizing bacteria when combined with chemical fertilizer (P) at high level significantly increased the mean length of spikes and number of spikelets/spike at all locations (Tables 1, 2). The longest spikes (8.10) recorded in first season at Faculty of Agriculture site (L2) due to application of PsB followed by (7.30cm) in second season at Hagir location (L1) due to application of PsB+43kg P/ha. While the highest number of spikelets/spike (18.82) was recorded at Faculty location (L2) in the second season due to application of PsB+43kg P/ha (Table 2). Increasing P level with PsB significantly increased the mean grain number and weight per plant (Tables 3, 4). In this regard, application of PsB+43kg P/ha as compared to other treatments, gave the highest number of grains/plant (208.0) was recorded at (L2) in the first season (Table 3) while the heaviest grains weight per plant (5.9 and 6.0 g) were recorded at (L1 and L2) in the second seasons due to application of PsB+43kg P/ha (Table 4). Generally, application of chemical fertilizer with inoculation with Bacteria gave the highest values of 1000-grain weight at all sites (Table 5). Superiority of PsB+86kg N/ha treatment was observed in increasing the mean 1000-grain weight particularly in the first season as compared with other fertilization treatments (Table 5). The heaviest 1000-grain weight (43.7 and 46.5 g) were recorded at L1 in second season and at L3 in the first season, respectively (Table 5).

Inoculation wheat grains with P-solubilizing bacteria (PsB, Psb+43 and PsV+86kgP/ha) significantly increased the grain yield by more than (21.92%, 19.55% and 26.42%) relative to control treatment as average of the two seasons at L2 respectively (Table 6). While at L3 application of (PsB, PsB+43 and PsB+86kgP/ha) relative to control were significantly increased the grain yield by more than (36.05%, 91.57% and 93.20%) respectively (Table 6). Superiority of PsB+86kg P/ha treatment was observed in increasing the mean grain yield/ha relative to PsB solely at the three locations (Table 6).

The positive effects of bio fertilizer on grain yield and yield components measured in this study could be attributed to the positive effects of these fertilizers on improving growth characters and consequently enhanced crop to produce more number of spikes, spikelets grains per spike and increasing individual grain weight which, in turn, positively increased grain yield. The increased in spike number, spike length, number of tillers, grain weight per plant, spikelets per plant due to application of solely Bacteria (solubilizing) observed in this study were agreed of these results reported by (Chauhan et al., 2011). Also, Kandil et al., (2011) found that application of bio fertilizer had favorable effects on 1000-grain weight, grain weight per plant, spikelets per plant due to application of solely Bacteria (fixing or solubilizing) particularly with combination with chemical fertilizers; such results were agreed with these reported in

this study. The increased in HI observed in this study due to all treatments may be attributed to increased in 1000 – grain yield and grain weight per plants in these treatments. The increase in aforementioned yield components might explain the increased in grain yield obtained in this study.

The significant increases in yield attributes at Shebaik and Hajer sites compare to Faculty site might e due to the differences in soil types because the later site (Faculty) located in area which covered with Khashm el Girba soil series it is a clay soil which riches with CaCO₃ might interact, with phosphate and become in unavailable form for wheat plant while the other two sites did not affect P availability to plant and as a result increased plant growth and yield of grains. The results indicated that P–solublizing bacteria can significantly increased P in the soil which increased yield of wheat.

REFERENCES

1. Al- Freeh, L. M.S; sundus, A. and Huthily, K.H (2019).contribution of combinations of mineral and bio fertilizers and organic fertilizer in the concentration of NPK on some physiological characters istics and yield of oats.plant Archives, 19(2) : 3767-3776.
2. Amin Farnia and Kurosh 2015. Comparison between Effect of Chemical and Biological Fertilizers on Yield and Yield Components Wheat (Triticum aestivum L.)Pishtaz Cultivar.Department of Agriculture, Boroujerd branch, Islamic Azad University, Boroujerd, Iran. ISSN: 0976 – 0997.
3. Astarai A, koocheki, A(1996) Application OF bio fertilizer in sustainable agriculture, mashed Jahad Danesshgah; publications Iran.
4. Chauhan, D. S.; Sharma, R. K.; Tripathe, S.C and Chhokar, R. S (2011)- News paradigmin tillage technology for wheat production. Research Bulletin,NO. 8. DWR, Karnal. Pp.16-17.
5. Choudhury MA, Kennedy IR. Prospect and potentials for system of biological nitrogen fixation in sustainable rice production. Biological Fertilizer and Soil.2004;(39):219-27.
6. Esmailpour, A., Hassanzadehdelouei, M., Madani, A. (2013) Impact of livestock manure, nitrogen and biofertilizer (Azotobacter) on yield and yield components of wheat (Triticum aestivum L.). Cercetări Agronomice în Moldova, 46 (2), 5-15.
7. Gomez, K.A., (1972). Techniques for Experiment with Rice. International Rice Research Institute, Manila, Philippines.
8. Hari M, Perumal K. (2010).Booklet on Bio-fertilizer (phosphabacteria). Shri Annm Murugapa Chettiar Research Centre Taramani Cheninai.;1-6.
9. Kandil, A.A., Attia, A.N., Badawi, M.A., Shari ef, A.E. and Abido, W.A.H. (2011). Effect of Water stress and fertilization with inorganic nit rogen and organic chicken manure on yield and yield components of potato. Australian Journal of Basic and Applied Sciences, 5: 997–1005
10. Khosro M, Yousef S.(2012;). Bacterial bio-fertilizers for sustainable crop production: A review APRN Journal of Agricultural and Biological Science. 7(5):237-308.
11. Kloepper,J,W.;Zabloto;WICZ,R.M.;Tipping, E.M.; Lfshitz,R.(1991).Plant growth promoting mediated by bactenal rhziosphere colonizers. In.keister,D.I. Gregan, P.B(cds). The Rhizosphere and plant growth. Kluwer Academic pblisling, Dordrecht, P.P.315-326
12. Soleimanzadeh, H. And Gooshchi, F.(2013). Effects of azotobacter and nitrogen chemical fertilizer on yield and yield components of wheat (Triticum aestivum L. World Applied Sciences Journa;21(8):27-34.
13. Wall, G.W.; Garcia, R.L.; Kimball, B.A.; Hunsaker, D.J.; Printer, P.J.; Long, P.; Osborne, C.P.; Hendrix, D.L.; Wechsung, F.; Wechsung, G.; Leavitt, S.W.; LaMorte, R.L. and Idso, B.(2006). Interactive Effects of Elevated Carbon Dioxide and Drought on Wheat. Agron. J., 98:354-38.

Table(1): Effects of Phosphorous solubilizing Bacteria (PsB)on mean of wheat Spike length (cm)during 2017/2018 and 2018/2019 seasons

Sites	Treatment	control	PsB	PsB +43kgP/ha	PsB +86kgP/ha	mean
L1	2017/2018	5.20	6.50	7.12	7.10	
	2018/2019	5.10	6.22	7.30	6.70	
	Mean	5.142	6.40	7.20	6.90	
	LSD _{0.05} =	0.24				

L2	2017/2018	6.30	8.10	6.20	5.60	
	2018/2019	6.30	6.42	6.30	6.22	
	Mean	6.30	7.30	6.23	5.91	
	LSD _{0.05} = 0.26					
L3	2017/2018	6.14	5.73	6.10	5.10	
	2018/2019	5.60	6.50	6.33	6.23	
	Mean	5.84	6.11	6.20	6.10	
	LSD _{0.05} = 0.30					

Table(2): Effects of Phosphorous solubilizing Bacteria (PsB) on mean of wheat Number of Spikelets/ spike during 2017/2018 and 2018/2019 seasons

Sites	Treatment	control	PsB	PsB +43kgP/ha	PsB +86kgP/ha	mean
L1	2017/2018	116	122.8	124.2	115.5	
	2018/2019	77.1	149.1	120.6	134.0	
	Mean	96.6	135.9	122.4	124.8	
	LSD _{0.05}					
L2	2017/2018	133.9	182.8	208.0	164.5	
	2018/2019	164.4	181.9	174.8	144.0	
	Mean	149.2	182.4	191.4	154.2	
	LSD _{0.05}					
L3	2017/2018	133.5	62.83	115.5	152.00	
	2018/2019	118.0	151.3	129.0	149.5	
	Mean	125.8	107.1	122.2	150.73	
	LSD _{0.05}					

Table(3): Effects of Phosphorous solubilizing Bacteria (PsB) on mean of wheat Number of grains/ plant during 2017/2018 and 2018/2019 seasons

Sites	Treatment	control	PsB	PsB +43kgP/ha	PsB +86kgP/ha	mean
L1	2017/2018	10.32	14.49	11.57	14.72	
	2018/2019	11.76	13.22	16.20	13.88	
	Mean	11.04	12.96	13.89	14.30	
	LSD _{0.05}					
L2	2017/2018	9.51	11.70	14.50	11.70	
	2018/2019	10.62	8.42	18.82	16.74	
	Mean	10.57	10.06	16.66	14.22	
	LSD _{0.05}					
L3	2017/2018	9.53	16.64	10.70	14.94	
	2018/2019	10.90	10.36	10.30	12.96	
	Mean	10.22	10.50	10.50	13.95	
	LSD _{0.05}					

Table(4): Effects of Phosphorous solubilizing Bacteria (PsB) on mean of wheat grain weigh/plant (g) during 2017/2018 and 2018/2019 seasons

Sites	Treatment	control	PsB	PsB +43kgP/ha	PsB +86kgP/ha	mean
L1	2017/2018	4.2	5.5	4.2	4.1	
	2018/2019	4.7	5.9	5.9	4.6	
	Mean	4.5	5.7	5.1	4.3	

						LSD _{0.05}
L2	2017/2018	4.2	5.5	4.2	4.10	
	2018/2019	4.8	4.9	6.00	5.5	
	Mean	4.5	5.2	5.1	4.8	
						LSD _{0.05}
L3	2017/2018	4.82	2.30	3.64	4.01	
	2018/2019	3.43	4.34	4.70	3.92	
	Mean	4.12	3.33	4.20	3.10	
						LSD _{0.05}

Table(5): Effects of Phosphorous solublizing Bacteria (PsB)on mean of wheat 1000-grain weight (g)during 2017/2018 and 2018/2019 seasons

Sites	Treatment	control	PsB	PsB +43kgP/ha	PsB +86kgP/ha	mean
L1	2017/2018	41.20	40.10	40.10	39.03	
	2018/2019	39.70	41.90	41.94	43.70	
	Mean	40.43	41.43	41.01	41.34	
						LSD _{0.05}
L2	2017/2018	32.93	31.1	30.8	34.92	
	2018/2019	28.10	31.5	28.44	35.54	
	Mean	30.52	31.3	29.60	35.23	
						LSD _{0.05}
L3	2017/2018	42.06	40.82	44.1	46.5	
	2018/2019	35.10	38.2	43.5	36.63	
	Mean	39.02	39.5	43.8	41.7	
						LSD _{0.05}

Table(6): Effects of Phosphorous solublizing Bacteria (PsB)on mean of wheat yield(kg/ha) (g)during 2017/2018 and 2018/2019 seasons

Sites	Treatment	control	PsB	PsB +43kgP/ha	PsB +86kgP/ha	mean
L1	2017/2018	1663	1811	1296	1391	
	2018/2019	1652	2020	1595	1925	
	Mean	1657	1915	1446	1658	
						LSD _{0.05}
L2	2017/2018	985	1225	1620	1619.5	
	2018/2019	1558	1871	1420	1595.5	
	Mean	1271	1548	1520	1607.5	
						LSD _{0.05}
L3	2017/2018	1229	1355	2023	1990.5	
	2018/2019	1134	1860	2504	2575.7	
	Mean	1182	1607	2264	2283.1	
						LSD _{0.05}



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