Int.J.Curr.Microbiol.App.Sci (2017) *6*(7): 2594-2603

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 7 (2017) pp. 2594-2603**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.607.366

Effect of Biofertilizers and Inorganic Fertilizers on Yield Attributes, Yield and Quality of *Triticum aestivum* and *Zea mays* in an Acid Alfisol

Shilva Dhiman* and Y.P. Dubey

Department of Soil Science, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, 176062, Himachal Pradesh, India
**Corresponding author*

Keywords

Biofertilizer, Inoculation, Quality, Wheat-maize cropping sequence, Yield.

Article Info

Accepted:
26 June 2017
Available Online:
10 July 2017

A B S T R A C T

An experiment with wheat-maize cropping system was conducted during *rabi*, 2010 and *kharif*, 2011 at the soil microbiology section of Department of Soil Science CSKHPKV, Palampur. An increase in number of tillers per plant, number of grains per spike, number of cobs per plant, grains per cob, diameter of cob were recorded highest in the treatment (T_{12}) where inoculation with nitrogen fixer and phosphate solubilizers+125% of RDF of nitrogen+75% of RDF of phosphorus was done. Grain yield and straw yield were also increased in the treatment (T_{12}) where inoculation with nitrogen fixer and phosphate solubilizers+125% of RDF of nitrogen+75% of RDF of phosphorus sources were applied. Quality parameters (protein and carbohydrate content) were also highest in treatment (T_{12}).

Introduction

Wheat- Maize is main cropping sequence of food production. The major share of food grain production in the state is maize-wheat under rain fed conditions. The productivity of these crops is not commensurable to the consumption of fertilizers since last decades due to imbalance use of fertilizers and the poor availability of major nutrients.

The decline trend in yield under acid soils is seemed to be related accumulation of Al^{3+} and /or Fe^{3+} to toxic levels resulting from increased acidity (Nambiar, 2002). Food production is directly linked with nutrient supply. The production of more and more food for increasing population has lead to increased dependency on chemical fertilizers. The last three decades, however, observed decline in the growth of food production in spite of best use of high yielding varieties and increased amount of chemical fertilizers (Sharma *et al.*, 2006). The fertilizers have played a prominent role in increasing the productivity of crops in the country, the use of chemical fertilizers would remain the main stay of agricultural production in future too. However, continuous and imbalanced use of fertilizers caused deterioration of soil health and crop productivity that is not commensurable to consumption of fertilizers. On the other hand, organic manures improved soil physical, chemical and biological

properties and thus resulting in enhanced crop productivity along with maintaining soil health. Although, the organic manures contain plant nutrients in small quantities as compared to the chemical fertilizers, the presence of growth hormones and enzymes, besides plant nutrients make them essential for improving soil fertility, productivity and health (Bhuma, 2001). In addition to this, the organic manures help in improving the use efficiency of inorganic fertilizers (Singh and Biswas, 2000). In this scenario, no single source of nutrients, be mineral fertilizers, organic manures/crop residues or biofertilizers, can meet total nutrient requirement of crops taking care of increasing human population. Biofertilizers have emerged as an essential component of crop production. The major attraction of using biofertilizers in integrated nutrient supply system is their characteristic ability to convert unavailable or inert nutrients to a form which is readily available and easily accessible to the plants. The biofertilizers are environmental friendly and contain organisms that enrich the nutrient quality of soils. The major concerns in today's agricultural world are: Mining of nutrients, decreasing fertilizer use efficiency and the pollution and contamination of soils. Biofertilizers are defined as preparations containing live or latent cells of efficient strains of micro-organism used for applications to seed, soil or composting preparation. The populations of such beneficial micro-organisms accelerate certain microbial process to augment the extent of the availability of nutrients in a form which can be easily assimilated by plants. Keeping this in view the present study was taken to account the effect of biofertilizers and inorganic fertilizer on yield attributes, yield and quality of wheat- maize.

Materials and Methods

The present study was conducted during 2010-11 in wheat-maize cropping system at Research farm of CSKHPKV, Palampur. The experimental farm is situated at $31^{0}6$ N latitude and $76\ ^{0}3$ E longitude at an altitude of about 1290 meters above mean sea level. The site lies in the Palam valley of Kangra district in the mid hill sub humid zone of Himachal Pradesh. The climate of the study area is wet temperate with an average rainfall of 2600 mm per annum, about 80% of which is received during June to September. Winter rains are received during December to February. Soil of the study area at the start of the experiment was silty clay loam in texture and classified as Typic Hapludalfs as per the taxonomic system of soil classification (Soil Survey Staff 1975).

The initial soil characteristics of the experiment site were: pH 5.0, organic C 9.7 g/kg and available N, P and K 186.9, 13.7, 133 Kg/ha, respectively. The experiment comprised of twelve treatments. The detail of the treatments are: T_1 : Control, T_2 : No inoculation+100% of RDF (recommended dose of fertilizer) of nitrogen+75% of RDF of phosphorus, T_3 : No inoculation+100% of RDF of nitrogen+100% of RDF of phosphorus, T_4 : No inoculation+125% of RDF of nitrogen+75% of RDF of phosphorus, T_5 : Inoculation with nitrogen fixer only and no fertilizer, T_6 : Inoculation with nitrogen fixer + 100% of RDF of nitrogen+75% of RDF of phosphorus, T_7 : Inoculation with nitrogen fixer+100% of RDF of nitrogen+100% of RDF of phosphorus, T_8 : Inoculation with nitrogen fixer+125% of RDF of nitrogen+75% of RDF of phosphorus, T_9 : Inoculation with nitrogen fixer and phosphate solubilizers and no fertilizer, T_{10} : Inoculation with nitrogen fixer and phosphate solubilizers + 100% of RDF of nitrogen+75% of RDF of phosphorus, T_{11} : Inoculation with nitrogen fixer and phosphate solubilizers + 100% of RDF of nitrogen+100% of RDF of phosphorus, T_{12} : Inoculation with nitrogen fixer and phosphate solubilizers+125% of RDF of nitrogen+75% of RDF of phosphorus.

Well decomposed FYM @ 10 t ha/ha (before sowing) was applied uniformly to all the plots in both crops. Inoculums were used as soil application *i.e. Azospirillum* and phosphate solubilizers were applied in both the crops @ 2.5 kg/ha in the furrows after sowing of seed. The wheat crop was sown on 2nd Dec, 2010 and harvested on, 19th May, 2011 and the maize crop was sown on 29th June, 2011 and harvested on 21st oct, 2011. 100% recommended doses of N, P and K used were 120, 60 and 30 kg/ha for wheat and 120, 60 and 40 kg/ha for maize, respectively. Half dose of N and full dose of P and K were applied at the time of sowing in both the crops. The remaining half of N was top dressed in two equal splits. The sources of N, P and K were urea, SSP and MOP, respectively. The data generated from the study was subjected to the statistical analysis through the requisite statistical computation following the procedure as outlined by (Gomez and Gomez 1984).

Results and Discussion

Yield attributes of wheat

Tillers per plant differed significantly under different treatments. The maximum number of tillers per plant was recorded in treatment T_{12} (inoculation with nitrogen fixer and phosphate solubilizers + 125% of RDF of nitrogen + 75% of phosphorus) and the minimum number of tillers per plant in T_1 (control). Amongst different treatments of biofertilizer inoculations, inoculation with nitrogen fixer and phosphate solubilizers found to be significantly better than no inoculation. Inoculation with nitrogen fixer and phosphate solubilizers proved to be significantly at par with inoculation with nitrogen fixer only and registered numerically more number of tillers per plant. These results are in conformity with the findings of Bharti *et al.,* (2010). Under inorganic fertilizer levels, 125% of RDF of nitrogen + 75% of RDF of phosphorus was found to be significantly at par with 100% of RDF of nitrogen + 100% of RDF of phosphorus albeit, 125% of RDF of nitrogen + 75% of RDF of phosphorus gave numerically more number of tillers per plant in comparison to 100% of RDF of nitrogen + 100% of RDF of phosphorus and 100% of RDF of nitrogen + 75% of RDF of phosphorus, respectively at same level of inoculation. Increase in number of tillers might be due to increase in vegetative growth. The results were corroborated with findings of Singh *et al.,* (2000). Biofertilizers and inorganic fertilizers effect on grains per spike was found to be significant in treatment T_{12} (inoculation with nitrogen fixer and phosphate solubilizers + 125% of RDF of nitrogen + 75% of phosphorus) which gave highest number of grains per spike in comparison to other treatments and T_1 (control) gave the lowest grains per spike. Amongst different treatments of biofertilizer inoculations, inoculation with nitrogen fixer and phosphate solubilizers found to be significantly better than no inoculation. Inoculation with nitrogen fixer and phosphate solubilizers proved to be significantly at par with inoculation with nitrogen fixer only and registered numerically more number of grains per spike. The results were similar with the findings of Ozturk *et al.,* (2003). Among different inorganic fertilizer levels, 125% of RDF of nitrogen+75% of RDF of phosphorus gave significantly higher number of grains per spike than 100% of RDF of nitrogen+100% of RDF of phosphorus followed by 100% of RDF of nitrogen+75% of RDF of phosphorus respectively. Similar results were reported by Singh *et al.,* (2000).

Yield attributes of maize

Cobs per plant under different sources of nutrients were found to be non-significant.

Grains per cob under different sources of nutrients differed significantly. The highest grains per cob (342.4) were recorded in the treatment T_{12} (Inoculation with nitrogen fixer and phosphate solubilizers+125% of RDF of nitrogen+75% of RDF of phosphorus) and the lowest grains per cob (308.4) were observed in treatment T_1 (control) as shown in table 1. Amongst different treatments of biofertilizer inoculations, inoculation with nitrogen fixer and phosphate solubilizers was significantly higher grains per cob than no inoculation and statistically at par with inoculation with nitrogen fixers alone. Under different inorganic fertilizers levels 125% of RDF of nitrogen+75% of RDF of phosphorus gave significantly higher grains per cob than 100% of RDF of nitrogen+100% of RDF of phosphorus and 100% of RDF of nitrogen+75% of RDF of phosphorus. Similar results were reported by Ebrahimpour (2011).

Yield of wheat and maize

The maximum grain yield was recorded in the treatment T_{12} (Inoculation with nitrogen fixer and phosphate solubilizers+125% of RDF of nitrogen+75% of RDF of phosphorus) and the lowest grain yield was recorded in the treatment T_1 (control) as shown in table 2. Amongst different treatments of biofertilizer inoculations, inoculation with nitrogen fixer and phosphate solubilizers gave significantly higher grain yield than no inoculation but was significantly at par and numerically higher to inoculation with nitrogen fixer only. It might be due to synergetic effect of dual and single inoculation. Under different inorganic fertilizers levels, 125% of RDF of nitrogen+ 75% of RDF of phosphorus gave higher grain yield than 100% of RDF of nitrogen+75% of RDF of phosphorus at all inoculation levels but was at par with 100% of RDF of nitrogen+100% of RDF of phosphorus. In all the treatment combinations, the treatment T_{12} (Inoculation with nitrogen fixer and phosphate solubilizers+125% of RDF of nitrogen+75% of RDF of phosphorus) gave numerically higher yield than treatment T_{11} (Inoculation with nitrogen fixer and phosphate solubilizers + 100% of RDF of nitrogen+100% of RDF of phosphorus). The treatment T_{11} was significantly at par with the treatment T_8 (Inoculation with nitrogen fixer+125% of RDF of nitrogen+75% of RDF of phosphorus). Irrespective of inoculation, recommended dose of nitrogen and phosphorus registered significantly at par grain yield to 125% of RDF of nitrogen and 75% of RDF of phosphorus. 100% of recommended nitrogen+75% of RDF of phosphorus at each inoculation level gave significantly less grain yield than 100% of RDF of nitrogen and 100% of RDF of phosphorus and 125% of recommended nitrogen and 75% of recommended phosphorus, respectively. Increasing doses of nitrogen might have found more pronounced than the impact of inoculations and phosphorus levels because the experimental soil was medium in phosphorus and low in nitrogen. Results were corroborated with the findings of Sonbol *et al.,* (2000). The higher straw yield was observed in the treatment T_{12} (Inoculation with nitrogen fixer and phosphate solubilizers+125% of RDF of nitrogen+75% of RDF of phosphorus) and the lowest was observed in the treatment T_1 (control) in table 2. The treatment T_{12} registered significantly higher straw yield than rest of the treatments. Amongst different treatments of biofertilizer inoculations, inoculation with nitrogen fixer and phosphate solubilizers gave significantly higher straw yield than inoculation with nitrogen fixer only and no inoculation. Results were corroborated with findings of Ozturk *et al.,* (2003).Under different inorganic fertilizer levels, 125% of RDF of nitrogen+ 75% of RDF of phosphorus gave higher straw yield than 100% of RDF of nitrogen+100% of RDF of phosphorus followed by 100% of RDF of nitrogen+75%

of RDF of phosphorus. The maximum straw yield was recorded with 125% of recommended nitrogen+75% of RDF of phosphorus gave higher straw yield followed by 100% of RDF of nitrogen and 100% of RDF of phosphorus and 100% of RDF of nitrogen+ 75% of RDF of phosphorus respectively. It might be due to the fact that nitrogenous fertilizers enhanced the vegetative growth of crop which resulted in the high production of straw yield. Results were corroborated with the findings of Sonbol *et al.,* (2000).

The effect of biofertilizers and inorganic fertilizers on grain yield of maize was found to be significant. The maximum grain yield was recorded in the treatment T_{12} (Inoculation with nitrogen fixer and phosphate solubilizers+125% of RDF of nitrogen+75% of RDF of phosphorus) and lowest was observed in the treatment T_1 (control). Amongst different treatments of biofertilizer inoculations, inoculation with nitrogen fixer and phosphate solubilizers gave the maximum grain yield (16.9 q/ha) followed by nitrogen fixer alone (15.6 q/ha) and no inoculation (13.8 q/ha), respectively. The grain yield obtained at different inoculation levels differed significantly with each other. It might be due to the fact that inoculation with nitrogen fixer and phosphate solubilizers enhance growth and yield of maize crop and inoculation with only nitrogen fixer also showed impact on growth and yield of maize crop than no inoculation. Under different inorganic fertilizer levels, 125% of RDF of nitrogen+75% of RDF of phosphorus gave higher grain yield than 100% of RDF of nitrogen+100% of RDF of phosphorus and 100% of RDF of nitrogen+75% of RDF of phosphorus at each inoculation levels. Irrespective of inoculation, 125% of nitrogen and 75% 0f phosphorus registered significantly higher grain yield than 100% of RDF of nitrogen and 100% of RDF of phosphorus and 100% RDF of nitrogen +75% of RDF of phosphorus, respectively. The treatment combination *i.e.* inoculation with nitrogen fixer and phosphate solubilizers along with different inorganic chemical fertilizer found to be significantly superior to the different fertilizer combinations with inoculation of nitrogen fixer and no inoculations. Treatment combination with no inoculation with chemical fertilizers gave significantly less grain yield of maize than the different fertilizer treatment in combination with nitrogen fixer alone. Similar were the findings of Kumar *et al.,* (2008). The highest stover yield was recorded in the treatment T_{12} (Inoculation with nitrogen fixer and phosphate solubilizers+125% of RDF of nitrogen+75% of RDF of phosphorus) and the lowest stover yield was recorded in the treatment T_1 (control) (Table 2). Under different treatments of biofertilizers inoculation, inoculation with nitrogen fixer and phosphate solubilizers gave significantly higher stover yield than inoculation with nitrogen fixer only and no inoculation. In inorganic fertilizer levels, 125% of RDF of nitrogen+75% of RDF of phosphorus gave significantly higher stover yield than 100% of RDF of nitrogen+100 % of RDF of phosphorus and 100% of RDF of nitrogen+75% of RDF of phosphorus at each inoculation level except at the 100% of nitrogen + 100% of phosphorus and 100% of nitrogen + 75% of phosphorus in nitrogen fixer inoculated treatment. It might be due to the fact that nitrogenous fertilizers enhanced the vegetative growth of crop which resulted in the higher production of stover yield. Results were corroborated with the findings of Jat and Ahlawat (2004).

Quality parameters in wheat and maize

Protein content differed significantly under different treatments, highest protein content (8.00 %) in grain was recorded in treatment T_{12} (Inoculation with nitrogen fixer and phosphate solubilizers+ 125% of RDF of

nitrogen+75% of RDF of phosphorus) and lowest (6.7%) in treatment T_1 (control) in grain. Amongst different treatments of biofertilizer inoculations, inoculation with nitrogen fixer and phosphate solubilizers gave significantly higher protein content than no inoculation and statistically at par and numerically higher protein content than inoculation with nitrogen fixer only. It might be due to the fact that dual inoculation (nitrogen fixer and phosphate solubilizers) improved the nutritional value of the crop which resulted in higher protein content in the grain of wheat. Similar results were also reported by Randhe *et al.,* (2009). Under inorganic treatments highest protein content was observed in 125% of RDF of nitrogen+75% of RDF of phosphorus followed by 100% of RDF of nitrogen+100% of RDF of phosphorus and 100% of RDF of nitrogen+75% of RDF of phosphorus, respectively. The treatment combinations *i.e.* inoculation with nitrogen fixer and phosphate solubilizers along with different chemical fertilizers gave numerically higher protein content than the inoculation of nitrogen fixer with different fertilizer combination and no inoculation with different combination of fertilizer. It might be due to the fact that higher nitrogen dose and dual inoculation of biofertilizers improved the nutritional quality of wheat grain. Similar were the findings of Suke *et al.,* (2011).The highest protein content in straw (5.0%) was observed in treatment T_{12} (Inoculation with nitrogen fixer and phosphate solubilizers+125% of RDF of nitrogen+75% of RDF of phosphorus) and lowest (4.3%) was recorded in the treatment T_1 (control) in table 3.

Amongst different treatments of biofertilizer inoculations, Inoculation with nitrogen fixer and phosphate solubilizers gave significantly higher protein content than and no inoculation and statistically at par and numerically higher than inoculation with nitrogen fixer only. Under different inorganic fertilizers levels, highest protein content in straw was observed in 125% of RDF of nitrogen+75% of RDF of phosphorus followed by 100% of RDF of nitrogen+100% of RDF of phosphorus and 100% of RDF of nitrogen+75% of RDF of phosphorus, respectively.

Table.1 Effect of biofertilizers and inorganic fertilizers on yield Attributing characters of wheat and maize

	Wheat		Maize	
Treatments	No. of tillers/ plant	No. of grains/spike	No. of cobs/plant	No. of grains/cob
T_1	2.5	30.5	1.1	308.4
T_2	3.4	36.0	1.2	315.4
T_3	3.9	37.9	1.2	322.2
T_4	4.0	38.7	1.2	342.3
T_5	2.7	34.1	1.2	310.5
T_6	3.5	36.8	1.2	316.1
T_7	3.9	38.1	1.2	323.3
T_8	4.1	39.0	1.2	324.5
T_9	2.8	34.3	1.1	311.0
T_{10}	3.7	37.8	1.2	317.6
T_{11}	4.1	38.3	1.2	324.3
T_{12}	4.3	39.4	1.3	342.4
CD (P = 0.05)	0.22	2.32	NS	1.01

Table.2 Effect of biofertilizers and inorganic fertilizers on yield of wheat and maize

Treatments	Wheat		Maize	
	Grain yield wheat (q/ha)	Straw yield wheat (q/ha)	Grain yield maize (q/ha)	Stover yield maize (q/ha)
T1	12.5	36.9	13.8	40.6
T2	26.9	66.1	28.5	72.3
T3	30.5	76.1	30.7	75.9
T4	31.1	77.4	32.6	79.3
T5	13.3	39.3	15.6	46.8
T6	27.2	68.2	31.9	79.6
T7	31.5	76.7	32.1	80.5
T8	32.3	80.6	34.1	83.7
T9	13.9	41.5	16.9	50.8
T10	29.1	72.4	33.0	81.3
T11	33.0	82.3	35.8	86.5
T12	34.0	85.1	36.5	89.7
CD (P = 0.05)	1.39	1.83	1.14	1.37

Table.3 Effect of biofertilizers and inorganic fertilizers on protein and Carbohydrate content in wheat and maize

Treatments	Protein Wheat		Carbohydrate		Protein Maize		Carbohydrate	
	Grain (%)	Straw (%)	Grain (%)	Straw (%)	Grain (%)	Straw (%)	Grain (%)	Straw (%)
T_1	6.7	4.3	35.6	25.5	6.9	4.4	42.1	29.6
T_2	7.2	4.7	45.2	28.9	7.3	4.7	47.3	30.9
T_3	7.6	4.9	46.9	30.2	7.7	4.8	48.2	31.3
T_4	7.8	4.9	47.7	30.4	7.9	4.9	48.3	31.9
T_5	6.8	4.5	42.1	26.6	7.0	4.5	42.3	30.3
T_6	7.4	4.8	46.2	29.1	7.4	4.8	48.2	32.2
T_7	7.7	4.9	47.6	30.2	7.8	4.9	48.5	32.3
T_8	7.9	5.0	49.2	30.8	8.0	5.0	49.3	32.5
T_9	7.9	4.6	43.2	27.3	7.1	4.6	42.5	30.5
T_{10}	7.6	4.8	48.4	30.7	7.5	4.8	49.3	32.5
T_{11}	7.9	4.9	51.6	31.2	7.9	5.0	52.0	32.7
T_{12}	8.0	5.0	51.9	31.8	8.2	5.0	52.1	32.8
CD (P = 0.05)	0.90	0.29	4.60	1.47	0.14	0.04	4.23	2.06

The protein content in the straw was significantly at par with different inorganic fertilizer combinations at same inoculation level. It might be due to the fact that the higher nitrogen doses increased nitrogen content in straw which is resulted in higher protein content. Similar results were also reported by Pandagre *et al.,* (1992).

The maximum carbohydrate content (51.9%) in grain was found in treatment T_{12} (Inoculation with nitrogen fixer and phosphate solubilizers + 125% of RDF of nitrogen+75% of RDF of phosphorus) and minimum (35.6%) in the treatment T_1 (control) in the table 3. Amongst different treatments of biofertilizer inoculations,

inoculation with nitrogen fixer and phosphate solubilizers gave significantly higher carbohydrate content than no inoculation but was statistically at par and numerically higher than inoculation with nitrogen fixer only. The carbohydrate content under no inoculation was significantly less than inoculation with nitrogen fixer and inoculation with nitrogen fixer and phosphate solubilizers. Under inorganic fertilizer levels, the maximum carbohydrate content was observed in treatment 125% of RDF of nitrogen+75% of RDF of phosphorus followed by 100% of RDF of nitrogen+100% of RDF of phosphorus and 100% of RDF of nitrogen+75% of RDF of phosphorus, respectively. The carbohydrate content obtained at 125% of RDF of nitrogen+75% of RDF of phosphorus and 100% of RDF of nitrogen+100% of RDF of phosphorus was statistically at par in the inoculation level of nitrogen fixer and phosphate solubilizers and no inoculation whereas it was significantly inferior at only nitrogen fixer inoculation. The carbohydrate content in straw was significantly higher (31.8%) in treatment T_{12} (Inoculation with nitrogen fixer and phosphate solubilizers + 125% of RDF of nitrogen+75% of RDF of phosphorus) and lowest (25.5%) in treatment T_1 (control). Amongst different treatment of biofertilizer inoculation, inoculation with nitrogen fixer and phosphate solubilizers gave higher carbohydrate content in straw than no inoculation but was at par with inoculation with nitrogen fixer only. Under different inorganic fertilizers levels, the significantly higher carbohydrate content was observed in 125% of RDF of nitrogen+75% of RDF of phosphorus than 100% of RDF of nitrogen+75% of RDF of phosphorus but was at par with 100% of RDF of nitrogen+100% of RDF of phosphorus at each inoculation level. It might be due to the fact that increasing dose of nitrogen and inoculation might have resulted in higher rate of photosynthesis which resulted in an increase in the carbohydrate content in straw. Similar results were reported by Ramadan *et al.,* (2002).

The protein content in maize grain was significantly highest (8.2%) in treatment T_{12} (Inoculation with nitrogen fixer and phosphate solubilizers+125% of RDF of nitrogen+75% of RDF of phosphorus) and the lowest (6.9%) protein content was recorded in the treatment T_1 (control). Amongst different treatments of biofertilizer inoculations, inoculation with nitrogen fixer and phosphate solubilizers gave the highest protein content and the lowest in no inoculation. The protein content in inoculation with nitrogen fixer and phosphate solubilizers was at par with nitrogen fixer only and significantly higher than no inoculation. It might be due to the fact that dual inoculation (nitrogen fixer and phosphate solubilizers) improved the nutritional value of the crop which resulted in higher protein content in the grain of maize. The results were corroborated with the findings of El-Nagar (2003). Under inorganic treatments the highest protein content was observed in 125% of RDF of nitrogen+75% of RDF of phosphorus followed by 100% of RDF of nitrogen+100% of RDF of phosphorus and 100% of RDF of nitrogen+75% of RDF of phosphorus, respectively. Increasing doses of nitrogenous fertilizer and inoculation has resulted in higher nitrogen content in the grain which resulted to increase the protein content in the grain. Results were corroborated with the findings of Ramadan (2002) and Duraisami *et al.,* (2002). The highest protein content (5.0%) in stover was observed in treatment T_{12} (Inoculation with nitrogen fixer and phosphate solubilizers+100% of RDF of nitrogen+75% of RDF of phosphorus) and the lowest (4.4%) was observed in the treatment T_1 (control). Amongst different treatment of biofertilizer inoculation, inoculation with

nitrogen fixer and phosphate solubilizers gave significantly higher protein content in stover than inoculation with nitrogen fixer only and no inoculation. Under different inorganic fertilizer levels, highest protein content was observed in 125% of RDF of nitrogen+75% of RDF of phosphorus followed by 100% of RDF of nitrogen+100% of RDF of phosphorus and100% of RDF of nitrogen+75% of RDF of phosphorus. Increasing doses of nitrogenous fertilizer and inoculation has resulted in higher nitrogen content in the stover which resulted to increase the protein content in the stover. Results were corroborated with the findings of Ramadan *et al.,* (2002).

Carbohydrate content in grain was the highest (52.1%) in treatment T_{12} (Inoculation with nitrogen fixer and phosphate solubilizers + 125% of RDF of nitrogen+75% of RDF of phosphorus) and the lowest (42.1%) was observed in treatment T_1 (control). Amongst different treatments of biofertilizer inoculations, inoculation with nitrogen fixer and phosphate solubilizers was numerically higher than no inoculation and statistically at par with inoculation nitrogen fixer alone. It might be due to the fact that inoculation caused a better vegetative growth of a plant which resulted in high rate of photosynthesis than single or no inoculation.

Under inorganic fertilizers levels, numerically highest carbohydrate content was observed in 125% of RDF of nitrogen+75% of RDF of phosphorus than 100% of RDF of nitrogen+75% of RDF of phosphorus but was at par with 100% of RDF of nitrogen+100% of RDF of phosphorus.

It might be due to the fact that increasing dose of nitrogen might have resulted in higher rate of photosynthesis which increased the carbohydrate content in grains. Results were corroborated with the findings of Ramadan *et al.,* (2002). The carbohydrate content in stover was significantly higher (32.8%) in treatment T_{12} (Inoculation with nitrogen fixer and phosphate solubilizers + 125% of RDF of nitrogen+75% of RDF of phosphorus) and lowest (29.6%) in the treatment T_1 (control). Amongst different treatments of biofertilizer inoculations, inoculation with nitrogen fixer and phosphate solubilizers gave higher carbohydrate content in stover than no inoculation but was at par with inoculation with nitrogen fixer only. It might be due to the fact that inoculation caused a better vegetative growth of a plant which resulted high rate of photosynthesis than single or no inoculation. Under different inorganic fertilizer levels, the higher carbohydrate content was observed in 125% of RDF of nitrogen+75% of RDF of phosphorus than 100% of RDF of nitrogen+75% of RDF of phosphorus but was at par with 100% of RDF of nitrogen+100% of RDF of phosphorus. It might be due to the fact that increasing dose of nitrogen might have resulted in higher rate of photosynthesis which increased carbohydrate content in stover.

From the study conducted, it can be concluded that inoculation with nitrogen fixers and P solubilizers in combination with nitrogen fertilizers improved the yield attributes, yield and crop quality. From the yield data of both wheat and maize, it is concluded that we can save 25% of recommended N and P when applied in combination with N fixers and P solubilizers.

References

Bharti, V., Azad, B.S., Bali, A.S. and Saha A. 2010. Effect of phosphorus levels and biofertilizers on yield, P uptake and economics of wheat (*Triticum aestivum*). *Environment and Ecology* 28(1): 534-537.

Bhuma, M. 2001. Studies on the impact of humic acid on sustenance of soil fertility

and productivity of Green gram. *M. Sc. (Agri) Thesis, TNAU, Coimbatore*

Ebrahimpour, F., Eidizadeh, K.H. and Damghani, A.M. 2011. Sustainable nutrient management in maize with integrated application of biological and chemical fertilizers. *International Journal of Agri Science* 1(7): 423-426

El-Nagar, G.R., 2003. Integrating of mineral and bio-fixed nitrogen fertilization in maize production under different irrigation regimes. *Assiut-Journal-of-Agricultural-Sciences* 34(5): 53-76

Gomez, K.A. and Gomez, A.A. 1984. *Statistical Procedure for Agricultural Research.* 2nd edn. Wiley Inter Science, New York, USA. pp 680

Jat, R.S. and Ahlawat, I.P.S. 2004. Effect of vermicompost, biofertilizer and phosphorus on growth, yield and nutrient uptake by gram (*Cicer arientinum*) and their residual effect on fodder maize (*Zea mays*). *Indian Journal of Agricultural Sciences* 74(7): 359-361

Kumar, R.B.P., Ravi, S. and Balayan, J.S. 2008. Influence of integrated nitrogen management and intercropping on growth, yield attributes, yield and nitrogen uptake of maize. *International Journal of Plant Sciences* 3(1): 154-157

Nambiar, K.K.M. 2002. Soil fertility and crop productivity under long term fertilizer use in India. Indian Council of Agricultural Research, New Delhi Published by Director (DIPA) Indian Council of Agricultural Research, Krishi Anusandhan Bhavan, Pusa, New Delhi

Ozturk, A., Caglar, O. and Sahin F. 2003. Yield response of wheat and barley to inoculation of plant growth promoting rhizobacteria at various levels of nitrogen fertilization. *Journal of Plant Nutrition Soil Science* 166: 262-266

Ramadan, H.M., Koreish E.A., Gaber H.M. and El-Fayoumy, M.E. 2002. Assessment and comparison of bio and mineral fertilization on farm profitability in different newly-reclaimed soils. *Alexandria Journal of Agricultural Research* 47(1): 133-146

Sharma, S.K., Verma, K.S. and Kumar, M. 2006. Response of different levels, methods and source of potassium on green pea production. *Himachal Journal of Agricultural Research* 32(2): 146-150

Singh, G, Somani, L.L and Totawat, K.L. 2000. Effect of integrated nitrogen management on yield attributing characters and yield of wheat. *Research on Crops* 1(2): 123-127

Singh, G.B. and Biswas, P.P. 2000. Balanced and integrated nutrient management for sustainable crop production. *Fertilizer News* 45(5): 55-60

Sonbol, H.A., Taha A.A., El-Sirafy, Z.M. and El-Naggar, E.M. 2000. Efficiency use of biological and chemical nitrogen fertilizers on wheat. *Annals of Agricultural Sciences Cairo* 3(special): 949-975

Suke, S.N., Deotale, R.D., Hiradeve, P., Mital, D. and Sorte, N.V. 2011. Effect of nutrients and biofertilizers on chemical and biochemical parameters of maize (*Zea mays*). *Journal of Soils and Crops* 21(1): 107-112

Zende, N.B., Chavan, S.A., Bhagat S.B., Dahiphale A.V. and Pawa,r P.P. 2007. Dry matter and nutrient partitioning in sweet corn as influenced by integrated nutrient management. *Annals of Plant Physiology* 21(1): 99-102

How to cite this article:

Shilva Dhiman and Dubey, Y.P. 2017. Effect of Biofertilizers and Inorganic Fertilizers on Yield Attributes, Yield and Quality of *Triticum aestivum* and *Zea mays* in an Acid Alfisol. *Int.J.Curr.Microbiol.App.Sci.* 6(7): 2594-2603. doi: https://doi.org/10.20546/ijcmas.2017.607.366