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RESEARCH ARTICLE

IMPACT OF BIO-FERTILIZER AND ORGANIC FERTILIZER ON YIELD AND YIELD PARAMETERS OF BREAD WHEAT (*TRITICUM AESTIVUM L.*)

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ABSTRACT

The results of studies made on the impact of Biofertilizer (*Azotobacter sps*.) of bread wheat *Triticum aestivum* L. and its integrated effect in combination with organic fertilizer I,e Farmyard manure and and Jinong (a liquid humic acid containing organic fertilizer) that has been newly introduced, on yield and yield parameters of bread wheat *Triticum aestivum* L.variety k -9107. Globally wheat is a leading source of vegetable protein in human food and in terms of total production is currently second to rice as main food crop. Use of organic farming has emerged as an important priority over the chemical fertilizers in order to meet the growing demand of food in the world. Experimental studies were conducted at Christ Church College, Kanpur. Observations were recorded on the influence of biofertilizer (*Azotobacter sps.*) and its comparison with organic fertilizers. Summarizing the recorded data one can conclude that Bio-fertilizer alone induced yield and yield parameters. Humic acid containing Jinong (0.2%) was superior to Biofertilizer and Farmyard manure under study. Combination of Jinong + Farmyard induced better growth than Biofertilizer + Jinong or Biofertilizer + Farmyard manure. Addition of both Farmyard manure and Jinong to Biofertilizer was least effective in increasing growth. The overall picture of Biofertilizer enhancing yield and yield parameters and the more promoting effect with humic acid containing Jinong is encouraging.

INTRODUCTION

Wheat is the main staple food crop of India. It finds place in both the meals of a common citizen. Amongst the cultivated food cereal, wheat occupied second place in production at global level. It contributes towards food front to the tune of 36 per cent of the world population and provides 20 per cent of total global calorie supply. An increasing realization in human population all over the world, the need of consumption of wheat after rice has importance. To meet out the requirement effort is being made of how to increase crop productivity. This is really not an easy task as wheat yield is a complex attribute, consisting of number of direct or indirect components, which is polygenically controlled. Therefore, yield is very susceptible to environmental fluctuations. A real breakthrough in yield potential of wheat got tremendous jump only after introduction of Norin-10 dwarfing genes during the seventies. This spurt in wheat production after 1965 may be attributed to short statured Mexican wheat varieties developed by Noble Laurate Norman E. Borlaug and appropriate technology of wheat culture. Consequently, the yield rose from 16.5 million tons in 1966-67 to 78.4 million tons during 2007-08. Work done on improvement of yield potential from last 4-5 decades, has revealed that even the best existing combinations of wheat varieties along with best agronomic practices, are unable to give more yield beyond its limit. Now the question arises what are yield barrier and how it can be broken, so that yield potential may be pushed beyond its limit. Among many factors, increasing plant population, harvesting of more solar radiation per unit area, per unit time, production of greater dry matter and its proper allocation to developing grain site and potential sink capacity are major traits that limit the yield potential to greater extent. Thus, yield potential may be improved by increasing biomass production or through improvement of harvest index. In order to suggest the possible line of attack for improving the yield potential of wheat, scientists have been trying to understand the yield formation process which seemed to be of immense practical significance. The use of chemical fertilizers has been realized to increase the yield but potential of soil decreased due to loss of organics. The present investigation entitled “impact of bio-fertilizer and organic fertilizer on yield and yield parameters of bread wheat (*Triticum aestivum* L.)” was, therefore, undertaken to identify the yield parameters associated with grain yield with emphasis for further improvement in wheat yield production using Biofertilizer under the following objectives:

1. To estimate the variability effects of Bio-fertilzer on wheat plant variety.

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2. To compare the effect of Biofertilizer used (*Azotobacter sps.*) with organic fertilizers including the newly marketed humic acid containing liquid organic fertilizer – Jinong.

Grain yield seemed to be determined by combination of different characters rather single traits. The increased yield potential of semi-dwarf bearing wheat genotypes is related to the enhancement of harvest index was first pointed out by **McVetty and Evans (1980)**. Consequently experimental results showed that significant improvement in yield potential can be achieved only by enhancing harvest index (**Fischer and Kohan, 1966; Jain *et al.*, 1974; Bhatt, 1977**). Various plant parts have diverse contribution for spike development during grain filling (**Blade and Baker, 1991**) and grain number/ear bear significant positive correlationship with grain yield. **Mehrotra, (1984) and Villegas *et al.* (2001)** reported positive and significant relationship between grain yield and biomass production. Saini and Nanda (1974) observed significant positive correlationship of grain yield with ear number and grain weight per year. Grain yield differences in wheat were found to be a function of better tiller survival and dry matter production. Increasing plant density through higher seed rate has been recognized as one of the ways to increase crop yield (**Yoshida, 1972**). Final ear number is largely attributed to per cent survival of primary tillers (**Ishaq and Taha, 1974, Saini and Nanda, 1974; Hill and Watkins, 1975**). **Saini and Nanda (1974)** observed that profuseness of tillering is positively associated with ear production in wheat genotypes. **Verma and Mathur (1988)** revealed that grain yield was positively associated with number of ears per meter square and 1000-grain weight, but number of ear per m^2 was negatively associated with number of grain per year. A review of literature, thus, revealed that grain yield in wheat is governed by number of direct and indirect characters and each of them is polygenically controlled, therefore, yield is very susceptible to changing environment. It is, therefore, concluded that there is no point to suppose that yield potential in wheat is near to limit.

The flag leaf is the primary source of assimilates for grain filling and grain yield (**Briggs and Aytenfish, 1980; Khaliq *et al.*, 2008**). Awns have also been observed as important photosynthetic organs which act as source of assimilates for grain formation as they are nearest plant parts to developing grains in spikelets (**Birsin, 2005**). Biofertilizers are better source for protection and production (**Mithal, 2001**). Biofertilizer stimulate barley growth and yield of maize (**Wu *et al.*, 2005**), wheat and barley (**Canbelat *et al.*, 2006**) depending on environmental conditions, bacterial strains, plant and soil conditions (**Ozturk *et al.*, 2003**) and fungicides used (**Mubeen *et al.*, 2006**). Biofertilizers recorded higher N uptakes and net returns over no biofertilizers in wheat-maize cropping system (**Kumar and Ahlawat, 2006**). The microorganisms in Biofertilizers restore the soils natural nutrient cycle and build soil organic matter. Experiencing the adverse effects of synthetic input dependent agriculture the concept of organic agriculture is gaining momentum. Almost 31 million hectares of land are currently managed organically and constitute 0.7% of agricultural land. Of the total cultivable area in India 70% of the land which is mainly rainfed, a very negligible amount of chemical fertilizer is being used. Farmers in these areas often use organic manures. India has tremendous potential to grow crops organically (**Maity *et al.*, 2004**). Application of organic manures or biofertilizers is the only option to improve soil organic carbon for sustenance of soil quality and future agricultural productivity (**Ramesh, 2008**). Jinong, recommended by China Green Food Development Center, Under the Agricultural Ministry, Govt. of China (www. cfcl_india.com /jinong-haolf.html) is an organic liquid fertilizer, whose main constituent is humic acid its effect on increasing crop yield is more significant than chemical fertilizer and manure.

Jinong is a new product and has just been introduced in the market. Jinong organic liquid fertilizer contains – 65.54 g/l humic acid; 20.58 g/l of N; 23.69 g/l of P; 21.67 g/l of K; 2.03 g/l of Cu + Fe + Zn + Mo + Mn + B; 2.8% of water and pH is 4.3. Consequently the use of humic substance has often been proposed as a method to improve crop food (**Adani *et al.* 1998**). **Singer *et al.* (1998)** found that application of Delta mix (a fertilizer containing humic acid substance with micronutrients B, Zn, S, Mn, Fe and Cu) enhanced the growth with food quality of common bean. **Sharif *et al.* (2002)** found the addition of 0.5 – 1.0 kg/ha humic acid resulted in increased wheat grain yield by 25-69% over control. They further suggested that addition of humic acid with half dose of NPK produced significant and economical wheat yield with increased crop productivity by increased nutrient uptake. The micronutrients thus, made available to plants play an important role in increasing crop yield and straw yield in wheat (**Asad and Rafique 2000; Hussain *et al.*, 2002**). Several reports indicate that either soil or foliar application of micronutrients have positive correlation with wheat yield (**Rashid and Rafique 1988; Wisal *et al.*, 1990; Habib, 2009; Wroble, 2009**). For yield parameters time taken for booting, for anthesis, flag leaf area, tiller number, number of spikes / plant, spikelets on main axis, spikelets number / plant, peduncle, awn and spike length, grain number on main shoot, grain number / plant, dry weight of 100 seeds, dry grain weight / plant, straw weight and harvest index can be studied. The present investigation will be of applied significance to growers of commercial crop of *Triticum aestivum* L.

MATERIALS AND METHODS

The seeds of *Triticum aestivum* L. (var. K-9107 (Deva)) were obtained from Chandra Shekhar Azad University of Agriculture and Technology, Kanpur.

Preparation of Biofertilizer

The Biofertilizer (*Azotobacter sp*) in packets of 200 g each were bought from the Microbiology Dept. of C.S.A. University, Kanpur.

Preparation of farmyard manure

Farmyard manure was bought from the local market.

Preparation of solutions of Jinong

Jinong also called Zinong is an organic liquid fertilizer, manufactured by Yangling Techteam Jinong Humic Acid

Products Co., Ltd. China was obtained from dealers of Elegant Fashion Fiber Chemicals Ltd. For preparation of the experimental chemicals 0.5, 1.0, 2.0, 3.0, 4.0 and 5.0 c.c. Jinong was taken and made to 100 c.c. with distilled water in clean measuring flask and continued to 1000 ml for 0.5%, 0.1%, 0.2%, 0.3%, 0.4% and 0.5% solutions. In order to find the most suitable concentration of Jinong i,e 0.05%, 0.1%, 0.2%, 0.3%, 0.4%, and 0.5% preliminary experiments were conducted under controlled laboratory conditions in the Department of Botany, Christ Chruch College.

The experiments on seed germination and seedling growth were conducted by Garrad's Technique (1954) in test tube. For Garrad's technique seeds were placed in test tubes between blotting paper and wall of the tubes. The level of water and experimental solutions of 0.05%, 0.1%, 0.2%, 0.3%, 0.4%, 0.5% Jinong were made upto the marked level every alternate day.

Treatment of Biofertilizer

The Biofertilizer *Azotobacter* was applied as soil treatment. For this soil was mixed with *Azotobacter* powder as 50 mg for 10 kg soil as recommended. In preliminary experiments soils treatment and seed treatment were compared. For seed treatment two kg wheat grains were treated in a mixture of 40 g *Azotobacter* + 10 g Jaggery. However, soil treatment being more effective this was chosen as mode of application in the present study

Treatment of Farmyard manure

Two handful of manure was added per pot wherever it was considered as application.

Treatment of Jinong

Based on preliminary experiments and experiments on seedling growth 0.2% Jinong and 0.3% Jinong were applied alone or in combinations at soaking seed stage and three sprays at intervals of 14 days, the first spray being 20 DAS (days after sowing). (since 0.2% Jinong gave better result it was used for combined treatments with Biofertilizer / farmyard manure

Spraying of Experimental Jinong Solutions

Solutions were prepared as mentioned earlier. A few drops of teepol were added as wetting agent in each solution, followed by vigorous shaking. The solutions thus prepared were throughly sprayed on the plants with the help of a 600 ml hand sprayer. The spraying machine was thoroughly cleaned, rinsed several times with the solution intended to be sprayed next to avoid any admixture of the experimental solution. The first treatment was done by seed soaking in the respective solutions. This was followed by the first spray 20 DAS.

Two more sprays of the respective solutions were made at intervals of 14 days. Control plants were sprayed with distilled water having few drops of teepol. Plants in each pot (5 sample) were drenched with approx. 100 c.c. of solution, remaining falling to the soil.

Ten treatments were applied as follows

1.Control	6.FYM
2.Biofertilizer	7.Biofertilizer + FYM
3.0.2% Jinong	8.0.2% Jinong + FYM
4.0.3% Jinong	9.0.3% Jinong + FYM
5.Biofertilizer + 0.2% Jinong	10. Biofertilizer + 0.2% J + FYM

Experimental Layout

For all experiments, earthenware pots (9") were arranged in randomized block design, having three blocks of two rows each. Two pots were randomly selected in each block for each treatment. Each pot had 5 plants growing in them. Two plants in each pot were tagged for regular observations.

RESULTS AND DISCUSSION

The effect of Biofertilizer and Jinong on yield, and yield parameters have been summarized in chart C + D. There was a promoting effect with Biofertilizer and the percentage increase over control (Chart C) in early booting was by 2.51%, early anthesis by 1.32%, flag leaf area was 3.34%, tiller number / plant was 30.00%, spike number / plant was 13.73%, spikelet number on main axis was 25.28%, spikelet number / plant was 17.94% peduncle length was 25.48%, awn length was 3.77% and spikelength was 12.09%. Addition of Jinong to Biofertilizer further promoted the effect in flag leaf area, tiller number / plant, spike number / plant, spikelet number / plant, peduncle length, awn length, spikelength and increase over control was 8.22%, 80.71%, 45.60%, 43.59%, 64.01%, 6.13%, 13.16% respectively. When FYM was combined with Biofertilizer the percentage decrease over control indicated early booting (-4.17%), early anthesis (-4.22%) (Fig.1). Values were lesser than Bf + 0.2% J in flag leaf area (2.44), tiller number /plant (58.57%), spike number /plant (27.47%), spikelet number on main axis (22.63%), spikelet number/plant (4.33%), peduncle length (26.53%), awn length (3.06%) and spike length (4.92%). Astonishingly the new humic acid containing organic fertilizer Jinong was far more effective than Biofertilizer applied alone or with Farmyard manure. Among all applications 0.2% Jinong + Farmyard induced the best effects and percentage increase over control was 34.19% for flag leaf area, 147.85% for tiller number / plant, 89.56% for spike number / plant, 40.47% for spikelet number on main axis, 102.44% for spikelet number / plant, 85.00% for peduncle length, 23.58% for awn length and 24.62% for spikelength. However, 0.2% Jinong applied alone was best for booting (-9.29% increase over control) and for anthesis ((-11.95%) (Fig. 1) increase over control). When Biofertilizer was combined with

Jinong + Farmyard manure the increasing effect was reduced to the least as compared to the increasing effects of all other treatments. Enhancement of grain number (Chart D) on main shoot, grain number / plant, grain weight of 100 seeds, grain weight / plant, straw weight / plant and harvest index was also increased with the use of biofertilizer. The increase over control was 7.48%, 49.55%, 11.30%, 25.79%, 19.57% and 3.97%, respectively. Addition of Jinong to Biofertilizer improved the values and were 11.90%, 78.34%, 12.65%, 42.02%, 23.62% and 11.12%, respectively.

Chart C: Doses which showed maximum promoting effect on yield and yield parameters as compared to control

Parameters	Control	Treatments								
		BF	0.2% J	0.3%J	BF + 0.2% J	FYM	BF + F	0.2% J + F	0.3% J + F	BF + J + F
Booting (DAS)	74.24	-2.51	-9.29	-3.15	0.08	-0.53	-4.17	-5.17	-4.94	2.15
Anthesis (DAS)	83.07	-1.32	-11.95	-1.92	-0.60	-1.60	-4.22	-6.41	-5.09	1.19
Flag leaf area (cm^2)	22.14	3.34	18.92	7.77	8.22	1.17	2.44	34.19	19.42	-1.71
Tiller no. /plant	2.80	30.00	105.00	98.92	80.71	7.14	58.57	147.85	92.85	21.42
Spike no./plant	3.64	13.73	62.08	61.26	45.60	0.82	27.47	89.56	62.08	9.06
Spikelet No. on main axis	13.17	25.28	35.45	29.08	25.28	16.47	22.63	40.47	31.05	10.09
Spikelet No. / plant	44.57	17.94	66.03	59.68	43.59	8.81	4.33	102.44	67.53	-4.26
Peduncle length (cm)	6.67	25.48	44.97	37.03	64.01	16.49	26.53	85.00	79.91	6.44
Awn length (cm)	4.24	3.77	12.50	10.14	6.13	7.78	3.06	23.58	19.33	0.00
Spike length (cm)	9.34	12.09	20.98	14.98	13.16	7.06	4.92	24.62	17.77	0.32

Data shows % increase over control

Chart D. Comparative effect of Biofertilizer with organic fertilizers on yield parameters as compared to control

Parameters	Control	Treatments								
		BF	0.2% J	0.3%J	BF + 0.2% J	FYM	BF + F	0.2% J + F	0.3% J + F	BF + J + F
Grain no. on main shoot	27.67	7.48	14.70	10.22	11.90	7.48	9.50	18.97	12.03	6.14
Grain no. / plant	78.30	49.55	87.40	68.25	78.34	24.06	54.66	150.06	103.57	24.39
Grain weight of 100 seeds (g)	1.58	11.30	18.99	12.66	12.65	8.86	13.92	22.78	15.19	7.59
Grain weight / plant (g)	3.45	25.79	54.78	41.15	42.02	38.26	35.36	101.15	46.67	9.27
Straw weight (g)	11.60	19.57	25.86	31.38	23.62	27.07	12.93	35.69	42.24	14.91
Harvest index	22.92	3.97	16.84	5.67	11.12	6.63	14.66	33.51	2.40	-3.79

Data shows % increase over control

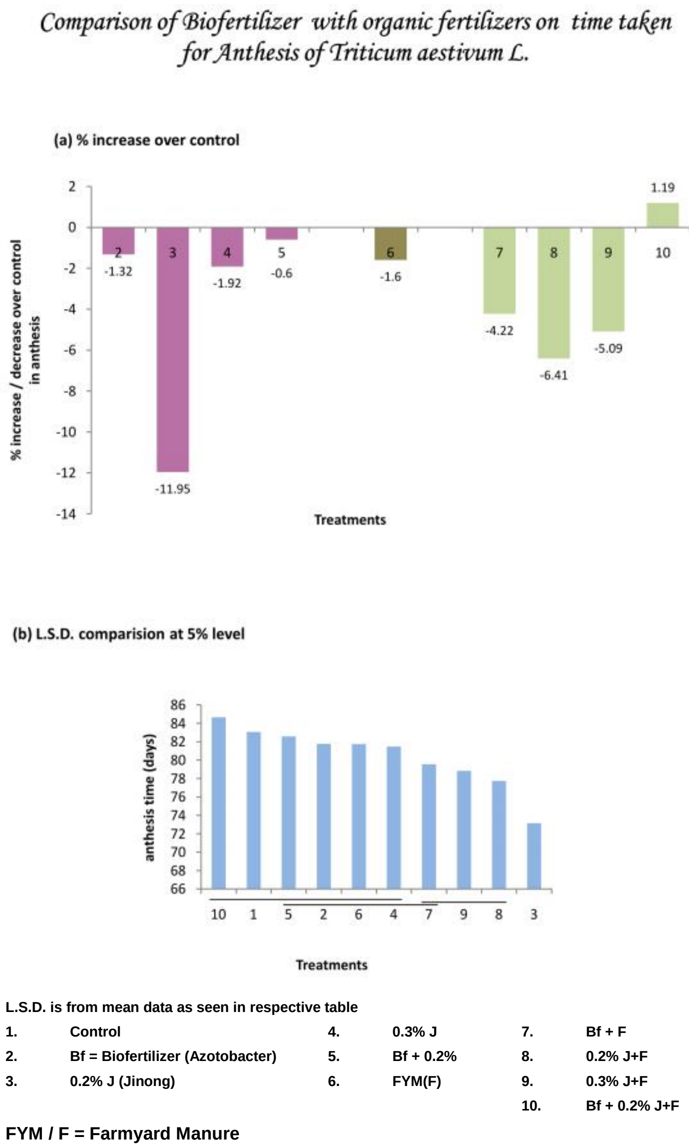
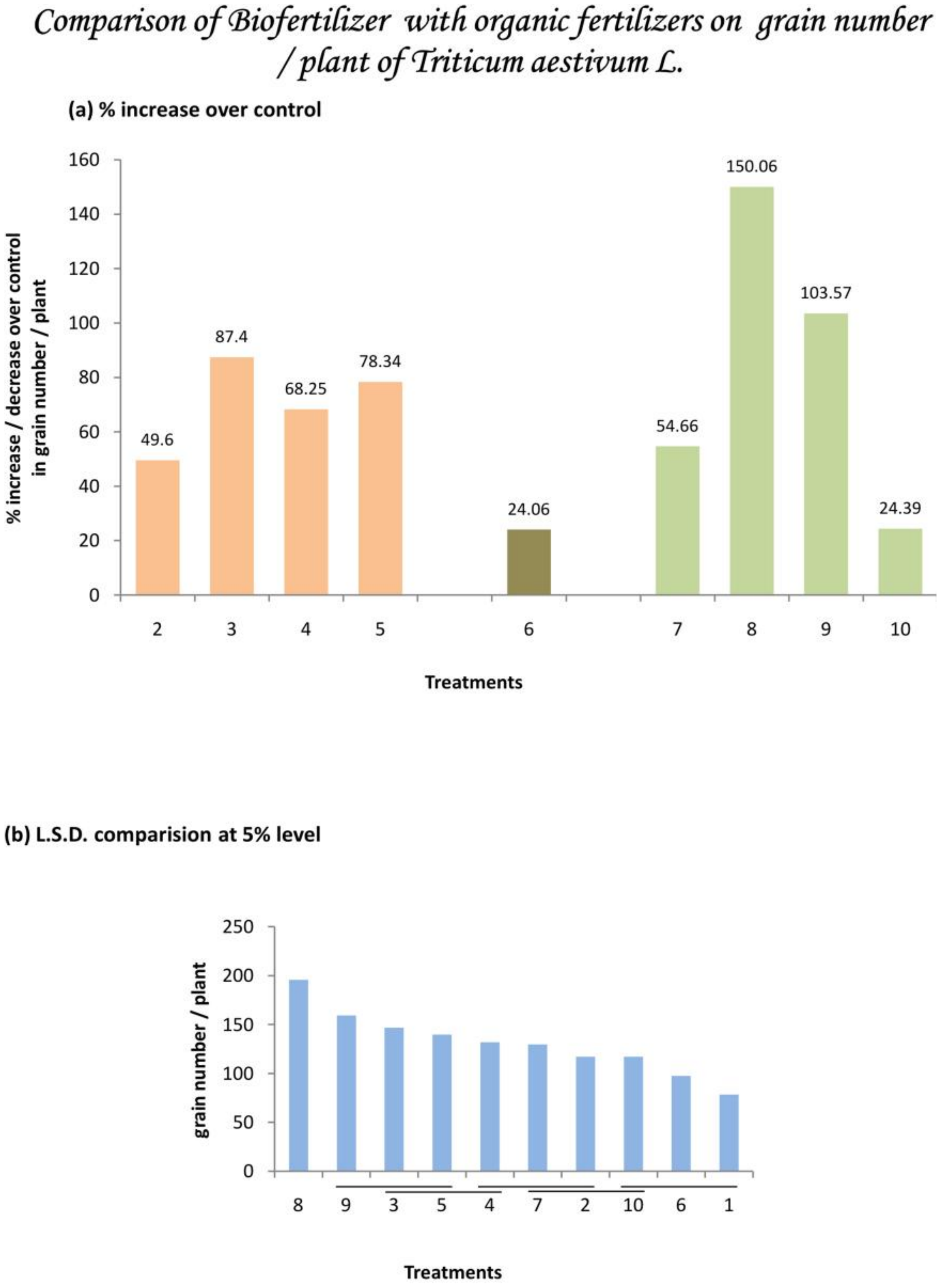


Figure 1.

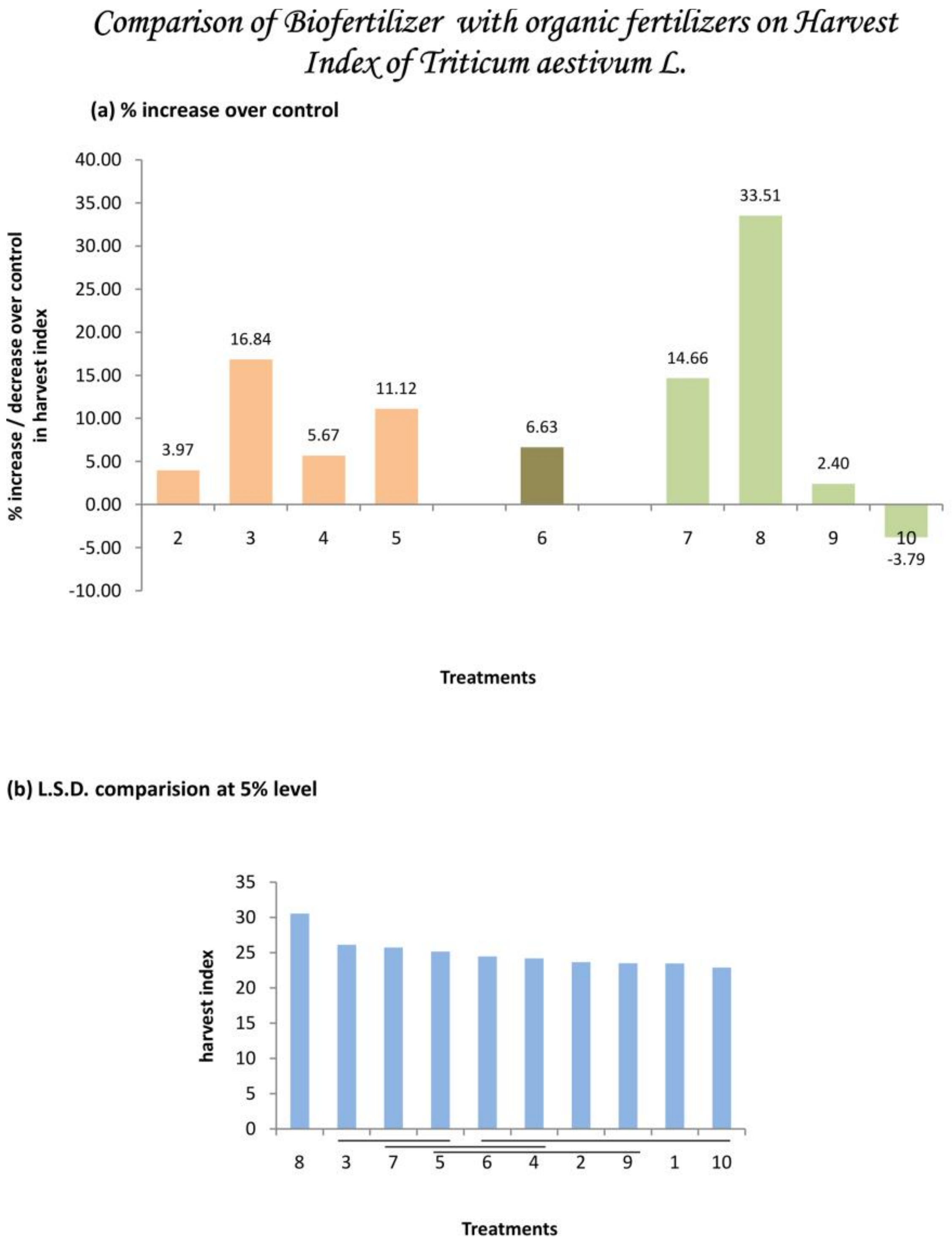


L.S.D. is from mean data as seen in respective table

1.	Control	4.	0.3% J	7.	Bf + F
2.	Bf = Biofertilizer (Azotobacter)	5.	Bf + 0.2%	8.	0.2% J+F
3.	0.2% J (Jinong)	6.	FYM(F)	9.	0.3% J+F
				10.	Bf + 0.2% J+F

FYM / F = Farmyard Manure

Figure 2.



L.S.D. is from mean data as seen in respective table

1.	**Control**	**4.**	**0.3% J**	**7.**	**Bf + F**
2.	**Bf = Biofertilizer (Azotobacter)**	**5.**	**Bf + 0.2%**	**8.**	**0.2% J+F**
3.	**0.2% J (Jinong)**	**6.**	**FYM(F)**	**9.**	**0.3% J+F**
				10.	**Bf + 0.2% J+F**

FYM / F = Farmyard Manure

Figure 3.

Addition of Farmyard manure to Biofertilizer was less effective combination than Bf + 0.2% J and the readings were 9.50%, 54.66%, 13.92%, 35.36%, 12.93% and 14.66%, respectively. When combination of Biofertilizer, Jinong and Farmyard manure were applied together there was a tremendous fall in the values and was 6.14%, 24.39%, 7.59%, 9.27%, 14.91% and -3.79%, respectively. Astonishingly 0.2% Jinong, the newly available liquid organic fertilizer mainly containing humic acid applied alone was more effective than Biofertilizer. The percentage increase here was 14.70%, 87.40%, 18.99%, 54.78%, 25.86% and 16.84%, respectively. Addition of Farmyard manure to this organic fertilizer further enhanced the values to maximum of 18.97%, 150.06% (Fig.2), 22.78%, 101.15%, 35.69% (Fig.3) and 33.51%, respectively.

In the present investigation (Biofertilizer and organic fertilizer) when given alone or as combination increased the flag leaf area, spike length, peduncle and awn length. Flag leaf plays an important role in grain yield (**Sheela *et al.*, 1990; Raj and Tripathi, 2000**), spikelet fertility (**Sheela *et al.*,1990; Regina *et al.*, 1994**); spike length (**Bashar *et al.*, 1990; Rao, 1992**) and grain size and weight (**Das *et al.*, 1981**). The grain yield and yield related traits were positively related to flag leaf area (**Ashrafuzzaman, *et al.*, 2009**). Broader flag leaves help in greater yield (**Datta *et al.*, 2002**) as also observed in the present investigation. Flag leaf area, awn length, number of grains per spike and 1000 grain weight demonstrated positive and significant association with grain yield / plant (**Ali *et al.*, 2010**) in wheat as also observed in the present work. Awns and flag leaf play a dominant role in carbohydrate production in wheat (**Li *et al.*, 2006; Khaliq *et al.*, 2008**). Early tillering, early booting, early anthesis and early maturity of grain was a phenomenon observed with treatments. The results of many researchers revealed the application of balanced fertilization significantly increased grain yield. Increase harvest index was observed in *Stevia reboundrana* with Biofertilizer (**Dube 2011**) as also seen in the present study. A comparative study of the effect of Biofertilizer and or organic fertilizers used has been expressed in Chart C+D. It also indicates the best effect for each parameter. The right treatment may help increase yield and grain quality of *Triticum aestivum* L.

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