Effect of Different Sources of Organic Fertilizer with Different Combination of N, P and K on Yield of Wheat (*Triticumaestivum*).

B.ScHonours (Project)

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CERTIFICATE

It is my pleasure to certify that the research works (Project) presented in this dissertation entitled study on "**Effect of Different Sources of Organic Fertilizer with Different Combination of N, P and K on Yield of Wheat (*Triticum aestivum*)"** is submitted by Mst. Tohomina Akter in partial fulfillment for the requirements of the degree of science in Botany, to the Department of Botany, University of Rajshahi, Bangladesh. The work or part of it has not been submitted before as candidature for my other degree.

....

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DECLARATION

I hereby declare that B.Sc project entitle study on "**Effect of Different Sources of Organic Fertilizer with Different Combination of N, P and K on Yield of Wheat (*Triticum aestivum*)"** submitted to the Department of Botany, University of Rajshahi, Bangladesh forms independent work carried out by me in the Plant Breeding and Gene Engineering Laboratory, Department of Botany, University of Rajshahi under the supervisor of Dr. M. Monzur Hossan, Professor, Department of Botany, University of Rajshahi. The project has not been forms previously the basis for the award of any degree.

....	....
Prof. Dr. M. Monzur Hossan	Mst. Tohomina Akter
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The Author

ABSTRACT

A field experiment was conducted in two areas (Paba and Patnitola) with the objective to identify the best sources of organic fertilizer and optimum combination of N (urea) P and K (MOP) for achieving the maximum yield of wheat (*Triticum aestivum* L.) cv. BARI Gom-26. The experiment was laid out in randomized complete block design (RCBD) with two replications. Twelve different doses and combinations of organic and inorganic fertilizers were applied to the field. Data were recorded on plant height, number of fertile tillers/hill , grain per panicle thousand grain weight and grain yield from 1m^2 area from randomly selected plants their maturity. The results show that the plant height, number of fertile tillers/hill, number of grain/panicle, thousand grain weight and grain yield ton/hac were significantly increased over control. However the significant differences were also observed regarding these quantitative characters among the fertilizer combination and doses. Among the twelve different fertilizer treatments plant height was the highest in treatment T_1(6 PL+0.18 N+0.075 P+). Higher number of fertile tillers/hill was recorded in treatment T_1, T_2, T_3 and T_7. The maximum number of grain/panicle was recorded in the treatment T_2 (6 PL +0.18 N +0.0375 P +0.045 K). On the other hand the thousand grain weight was the maximum in T_1, T_2 and T_3. Among the treatment the highest grain yield ton/hac was recorded in the treatment T_7 (6 FYM +0.36 N +0.15 P +0.18 K).These results lead to conclusion that addition of bio fertilizers in the form of PL and FYM significant increased the yield of wheat. Among 12 treatments T_7 (6 FYM +0.36 N +0.15 P +0.18 K) was found to be the optimum combination of organic and inorganic in order to set maximum wheat production.

CONTENT

CHAPTER IV

CHAPTER V

CHAPTER VI

TABLE INDEX

INTRODUCTION

Wheat (*Triticum aestiveum* L) is the world's leading grain crop. It is the 3rd major cereal crop in Bangladesh (BBS 2012). Wheat is one of the first cereals known to have been domesticated and wheat's ability to self-pollinate greatly facilitated the selection of many district domesticated varieties. Wheat is a cereal grain, originally from the levant region of the Near East and Ethiopian Highl and, but now cultivated worldwide. In 2010, world production of wheat was 651 million tons, making it the third most produced cereal after maize (844 million tons) and rice (672 million tons). Wheat was the second most produced cereal in 2009, world production in that year was 682 million tons.

Wheat is grown on more than 240,000,000 hectares (590,000,000 acres), larger than for any other crop. World trade in wheat is greater than for all other crops combined. Globally, wheat is the leading sources of vegetables protein in human food having a higher protein content than other major cereals maize or rice. Wheat was a key factor enabling the emergence of city based societies at the start of civilization because it was one of First crops that could be easily cultivated on a large scale, and had the additional advantage of yielding that provides long-term storage food.

Wheat is planted to a limited extent what as a forage crop for livestock, and its straw can be used as a construction material for roofing thatch. The whole grain can be milled to leave just the endosperm for white flour. The by- products of this one bran and germ. The whole grain is a concentrated sources of vitamins, minerals and protein, while the refired grain is mostly starch.

Table 1.1 Nutritional value per 100 g wheat

Ingredients	Amount
Energy	1,368 kJ (327 kcal)
Carbohydrates	71.18 g
Sugars	0.41
Dietary fiber	12.2 g
Fat	1.54 g
Protein	12.61 g
Thiamine (vit. B_1)	0.383 mg (33%)
Riboflavin (vit. B_2)	0.115 mg (10%)
Niacin (vit. B_3)	5.464 mg (36%)
Pantothenic acid (B_5)	0.954 mg (19%)
Vitamin B_6	0.3 mg (23%)
Folate (vit. B_9)	38 µg (10%)
Vitamin E	1.01 mg (7%)
Vitamin K	1.9 µg (2%)
Calcium	29 mg (3%)
Iron	3.19 mg (25%)
Magnesium	126 mg (35%)
Manganese	3.985 mg (190%)
Phosphorus	288 mg (41%)
Potassium	363 mg (8%)
Sodium	2 mg (0%)
Zinc	2.65 mg (28%)

Source: “Nutrient data laboratory”. United States Department of Agriculture. Retrieved January 2012.

1.1 Botanical Aspect of Wheat

The common wheat (*Triticum aestivum* L.) is a hexaploid (6n=42) belongs to the family Graminae and is worldwide popular grain crop. The plant is erect, usually umbranched, herb and annual in nature. It usually growing up to 2-5 feets. The wheat species of the genus *Triticum* are characterized by spikelets placed flatwise at each rachis joint. The plant is a midtall annual or winter annual grass with flat blades and a terminal spike. The spikelets are solitary with 1-5 flowers, sessile and arranged alternately on the nodes of a zig-zag, channeled or articulate rachis. The glumes are keeled, with three or more nerves and obtuse, acute or acuminate.

The wheat inflorescence is terminal spike which is usually 3-4 inches in length, but it may very from 3-5 inches. Spikes may be flattened parallel or at right angles to the plane of the face of the spikelets. They may be fusiform, oblong, clavate or elliptical in shape. Spikes also may be lax, mid dense or dense. The spike bears 10-30 spikelets which are borne singly at nodes no alternate side of zig-zag rachis. The spikelet consists of 1-5 flowers or florets attached alternately to opposite sides of a central axis or rachilla. Flowers are bisexual, stigma feathery, anther three in number, the mature grain consists of an embryo and a starchy endosperm.

1.2 Nutritional Composition of Farm Yard Manure

Farm yard manure consists of three main components namely litter, like straw another vegetable refuse dung and urine of animals. Composition of farmyard manure varies according to the composition and the proportion in which they are present. However, in our country litter is seldom used to collect dung and urine. Almost the whole of urine is wasted as it is not properly collected. Hence farm yard manure as prepared in the country consists, almost entirely at cattle dung mixed with farm refuse like stalks and stubbles. It also contains house hold wastes like garbage and kitchen wastes.

Table 1.2 Average nutrient content of the dung of farm animals (%) on organic matter.

Serial No.	Ingredients (%)	Poultry	Sheep	Horse	Pig	Cattle	Buffalo
1	Water	57.0	61.9	76.8	80.7	82.4	81.1
2	Organic matter	29.3	33.1	21.0	17.0	15.2	12.7
3	Mineral matter	-	4.7	3.9	3.0	3.6	5.3
4	Nitrogen	1.46	0.70	0.47	0.59	0.30	0.26
5	Phosphorus	1.17	0.51	0.30	0.46	0.18	0.18
6	Potash	0.62	0.29	0.30	0.43	0.18	0.17
7	Lime	-	0.46	0.17	0.09	0.36	0.46

Table 1.3 Average nutrient content of urine of various farm animals (%) on original matter.

Serial No.	Ingredients (%)	Horse	Cattle	Buffalo	Sheep	Pig
1	Water	89.6	92.6	81.0	86.0	96.6
2	Organic matter	8.0	4.8	-	3.3	1.5
3	Mineral matter	8.0	2.1	-	4.6	1.0
4	Nitrogen	1.29	1.21	0.62	1.47	0.38
5	Phosphorus	0.01	0.01	Trace	0.05	0.1
6	Potash	1.39	1.35	1.61	1.96	0.99
7	lime	0.45	0.01	Trace	0.16	-

Table 1.4 Average N.P and K contents of common straws and farm yard organic wastes.

Serial No.	Substances	Nitrogen (%)	Phosphorus (%)	Potash (%)	Water absorbing capacity
1	Wheat straw	0.43	0.17	0.91	100
2	Rice straw	0.40	0.26	1.16	-
3	Out straw	0.55	0.24	1.39	-
4	Barley straw	0.44	0.19	1.07`	-
5	Jowan straw	0.40	0.23	2.17	-
6	Bajra straw	0.65	0.75	2.50	-
7	Bean straw	1.57	0.74	1.62	127
8	Dry gran	0.28	0.08	0.32	-
9	Dry leaves (mixed)	1.51	0.18	0.57	91
10	Rice husk	0.45	0.25	0.45	-
11	Ground nout hulls	1.75	0.45	1.50	-
12	Peat	0.65	0.09	0.12	272
13	Saw dust	0.24	0.20	0.45	197

1.3 Nutritional Composition of Poultry Manure

Table 1.5 Average Nutrient Composition of Broiler Manures

Manure Type	Total N	Ammonium NH_4^+-N	Phosphorus P_2O_5	Potassium K_2O
		lb/ton		
Fresh (no litter)	26	10	17	11
Broiler house litter[1]	72	11	78	46
Roaster house litter[1]	73	12	75	45
Breeder house litter[1]	31	7	54	31
Stockpiled litter[1]	36	8	80	34

Table 1.6 Average Nutrient Composition of Layer Manures

Manure Type	Total N	Ammonium NH_4^+-N	Phosphorus P_2O_5	Potassium K_2O
		lb/ton		
Fresh (no litter)	26	6	22	11
Undercage scraped[1]	28	14	31	20
Highrise stored[2]	38	18	56	30
		lb/1,000 gallons		
Liquid slurry[3]	62	42	59	37
Anaerobic lagoon sludge	26	8	92	13
		lb/acre-inch		
Anaerobic lagoon liquid	179	154	46	266

1.4 N, P and K Contents of Chemical Fertilizers and its Effects

- Urea [co $(NH_2)_2$]: Urea contains 45-46% Nitrogen.
- TSP (3 $CaH_4(PO_4)_2 4H_2O$): TSP contains 44-52% phosphate.
- MOP (KCl): Mop contains 50-52% potassium.

Effect of N, P and K on the growth and development of crops plants

Effect of Nitrogen

Nitrogen plays an impenitent role to increase the plant *height.* There are reports that plant height increased progressively with the increase in the level of nitrogen from 0 to 125 kg per hectare or from 60 to 120 1b per acre (Anonymous, 1973; Jevtic and Drezgic, 1970; Tiway and Singh, 1969).

Increased level of N significantly increased the number of spikelet per ear (Spike) (Kumar and Prasad 1986). Rao and Bhardwaj (1981) stated that a higher level of nitrogen and water supply increased the number of spikelets per spike. On the other hand it was observed that number of spikelets per spike increased with the increase of N rate fro 0-80 kg/ha (Pandey *et al.*, 1986) or 0-160 kg/ha (Gami *et al.*, 1986; and karabinova, 1986.

Gami *et al.*, (1986) and Karabinova (1986) noticed that number of grain/ear increased with the increased level of N doses up to 160 kg/ha.

Effect of Phosphorus

Phosphorus also increases the grain yield of wheat. Lomako (1981) found the relationship between increase in wheat grain yield with rates of P fertilizers and P contents in different soils. Pasashnikova (1990) conducted an experiment in Novosibirskayaoblast, USSR and stated that greatest wheat yields were obtained by applying 60 kg P/ha. Harmati and Szemes (1982) observed that P increased the number of grains/ear.

Effect of potassium

Wheat yield has been reported to be increased with judicious application of potassium fertilizer.

Here and Mihaila (1969), carried out an experiment in 1967-69, wheat and maize were given 0,50,100 or 150 kg k_2O/ha with or without 100 kg N, 100 kg P_2O_5 or both and observed that application K lone did not give significant increase in average wheat yields but increased maize yield by 0.16-0.18 t/ha/ The effect of applied K was greatest in a favorable year (1969) and the greatest yield increases were given by combinations with N and P. Dhull (1989) conducted an experiment in 1982-86 at 8 locations in the Sirsa district, Haryma, India with wheat given NPZn, the application of 30 and 60 kg K_2O/ha gave grain yields of 3.54 and 3.71 t/ha, respectively, compared with 3.28 t without k. Yields were not further increased with 90 kg K_2O/ha.

1.5 Benefits of Organic Fertilizer

- Organic fertilizers are excellent for the soil. The organic matters in such fertilizers are essential for microorganisms, which build up the soil rich in humus.
- The organic fertilizers release the nutrients in a slow and consistent rate that the plants can utilize. Since the microbes break down the materials, there is little risk of over concentration of any element.
- The plants are provided balanced nutrition because of the presence of a broad range of trace elements.
- Organic fertilizers are safe for all types of plants and there is no danger of burning due to salt concentration.
- Organic matter binds to the soil where the roots can access it. So, it is long lasting as the organic fertilizers do not leach out.
- The fertility level of the soil can be maintained with less work once the healthy soil condition is reached.
- There is also less risk of over stimulation. Organic fertilizers do not lead to exceptional growth, which can lead to a variety of problems. The plants grown on organic fertilizers have a controlled growth.
- Organic fertilizers also make the plants stronger to resist disease and pest attacks. Plants fed on organic fertilizers are also able to resist the advance of weeds and other parasitic plants.

1.6 Disadvantage of Inorganic Fertilizer

Salt Accumulation: Reputed application of inorganic fertilizer can lead to the buildup of salt in your soil. Salt accumulation in the soil forces our plants to expend more energy to draw water from the soil and can cause them to appear wilted on dried out.

Plant Damage: Incorrectly applied inorganic fertilizer can damage the plants that they are supposed to feed. Fertilizer that comes in contact with the leaves of plants can cause leaf scorching if the leaves of the plant are wet. Common symptoms of over fertilization include decrease growth, defoliation, wilting or plant death in extreme cases.

Leaching: In sandy soils, drainage ditches and other areas where large volumes of water percolate through the soil, inorganic fertilizers can leach away from the root zone of the plant.

Application: Inorganic fertilizer that are spread over the surface of the soil can cause phosphorous and potassium to build up on the surface of the soil. Nutrients on the surface of the soil are unavailable to the roots of your plants until they are tilled into the soil, however, disturbing the soil-around established plants can damage the root surface of the soil can decrease soil pH with in the upper 2 to 3 includes of the soil.

The potential of wheat can only be fully exploited by judicious use of inputs, proper plant protection measures and sufficient irrigation at critical stages, because of this, agricultural scientists are engaged in establishing an agricultural system which can lower production cost and conserve the natural resources. Therefore, recent interest in manuring has reemerged because of high prices of inorganic fertilizers and the importance of green, farmyard and other types of organic manures that provide long term soil productivity besides meeting nutrient requirements becomes obvious.

Organic farming is a production system which provides or largely excludes the use of synthetic inorganic fertilizers, pesticides and growth regulators. Organic manures in combination with each other render greater beneficial effects (Channabasanagowda *et al.*, 2008) on plant growth and yield. The soils of Bangladesh are generally low in organic matter. Firstly because of arid climate resulting in rapid decomposition of organic matter and secondly, because very little organic matter is added to soils during cultivation. Soil fertility can be increased through the utilization of minerasl as well as organic matter (Azad and Yousaf, 1982).

Worldwide, there is growing interest in the use of organic manures due to depletion in the soil fertility. Organic fertilizers including farmyard manure (FYM), sheep manure and poultry manure may be used for crop production as substitute of chemical fertilizers because the importance of organic manures cannot be overlooked. Economic premiums for certified organic grains have been driving many transition decisions related to organic farming. Farmyard manure and composts are in limited supply and may have low and variable nutrient contents. This has necessitated the practice of green manuring and the use of farmyard manure which are readily available and are valuable sources of both nitrogen and organic matter (Korsaeth *et al.,* 2002). Continuous use of fertilizers creates polluting effects in the environment. Synthesis of chemical fertilizers consumes a large amount of energy and money. However, an organic farming approach with or without chemical fertilizers seems to be possible solution for these problems. Type of organic material and its quality influence the soil characteristics and nutrient supply to the crops variably (Ahmad *et al.,* 2007).

The biological manure has many attributes. It supplies a wide variety of nutrients along with organic matters that improves the physical characteristics of soil. Its beneficial effects on plant growth are sometimes difficult to duplicate with other materials. There is also a positive interaction between the combination of organic manures and NPK (Pong and Laty, 2000). However, in the long term use, organic manures hold great promise for improving soil characteristics (Hussain *et al.,* 1999; Khaliq *et al.,* 2006).

Because of rapidly rising energy costs and the uncertain availability of chemical fertilizers, in the developing countries, the need for using organic manures was realized. Present study was designed to evaluate the effect of organic manure with chemical fertilizers on the yield of wheat.

1.7 Objectives

REVIEW OF LITERATURE

Integrated plant nutrient management (IPNM) from organic and inorganic sources bears great significance for sustaining the soil productivity. Inorganic sources mainly include chemical fertilizers, while major organic sources are farm yard manure (FYM) and poultry litter crop residues and green manures etc.

Positive effects of synergistic use of organic, and chemical fertilizers are well established. Crop yields are improved if organic manure is supplemented with mineral fertilizers (Kanchikerimath and Singh, 2001). In addition to increasing the nitrifying activities of microorganisms, organic manures also reduce the N losses (Gasser, 1964).

Gill *et al.* (1994) obtained significantly higher grain yield of rice and succeeding wheat with the application of 6 t ha^{-1} FYM and *Dhaincha* green manure supplemented with 100 per cent NPK through fertilizers over 100 per cent NPK applied through chemical fertilizers alone. It was further concluded that addition of organic manure with recommended dose of chemical fertilizers produced the grain yield equal to the application of 150 per cent of NPK through chemical fertilizers; hence a net economization of 33 per cent NPK could be achieved in rice-wheat system.

Gupta *et al.* (1995) reported that application of organic manures like FYM, rice husk, saw dust and green manures in rice increased grain yield of rice-wheat cropping system. An increase in the productivity of rice-wheat sequence was reported from 4.35 to 8.40 t ha-1 in control arid with green manuring with *Dhaincha*, respectively (Mahapatra and Sharma 1995).

Application of FYM to rice increased the grain yield of both rice and wheat over control showing marked residual effect on soil fertility (Brar *et al.* 1995). A significant increase in grain and straw yields of rice over control by 5.90 and 6.36 per cent and of wheat by 13.73 and 14.06 per cent was obtained with the application of 10 t ha^{-1} FYM to rice crop (Singh *et al.* (1996). While Dubey *et al.* (1997) reported that 25-50% of chemical fertilizers can be substituted by FYM or *Sunnhemp* green manure without scarifying grain yield in rice-wheat sequence.

Yaduvanshi (2001) reported that mean rice and wheat yields obtained from combined application of 100% NPK through inorganic fertilizers + organic manures (FYM or *Sesbania* greefa manure) were significantly higher than those obtained from the application of 100% NPK through chemical fertilizers alone.

Ghosh and Singh (2003) evaluated the effect of conjoint use of farmyard manure and nitrogen on rice-wheat system in Uttaranchal mid-hill soils. They observed that grain and straw yields increased with increasing rates of FYM and N fertilizer for both the crops, and the highest yields were obtained with 15 t ha^{-1} FYM + 60 or 80 kg ha^{-1} N. Phogat *et al.* (2004) found that the total productivity of rice-wheat system increased significantly with green manure and FYM compared to control, and with FYM over green manure in all the years. Mljat *et al.* (2004) carried out a field experiment on sandy loam soil of Modipuram and reported that *In situ* burning of rice residue + enriched photocompose resulted in maximum grain yield during both the years. Debtanu and Das (2005) obtained highest grain yield of rice and wheat (4.25 and 4.78 t/ha) with NP + Zn + FYM treatment.

Efthimiadou *et al.* (2009) observed that growth and yield of sweet corn were significantly higher with poultry manure than obtained from conventional fertilizers. Moreover, poultry manure increased the photosynthesis rate, stomatal conductance and chlorophyll content in the plants. Integration of mineral fertilizers and FYM significantly enhances the grain yields of maize and wheat as compared to that with chemical fertilizers (Sharma and Subehia, 2003). Similarly, an increase from 83.9 to 108.7 % in yield of maize grain was recorded with the integration of organic and inorganic fertilizers (Sial *et al*, 2007). Ahmad *et at.* (2002) observed that root length and nutrient uptake of wheat increased significantly by combining organic manure and N fertilizer, which ultimately enhanced grain and straw yield.

Integrated use of FYM and inorganic fertilizers (NPK+Zn) significantly increased maize grain yield by 89 % over NPK fertilizer alone (Adhikari *et al*, 2001). Further, NPK fertilizer + compost produced three times higher maize biomass than obtained in non-treated plots. Combined application of organic and chemical fertilizers as 25 % N from FYM and 75 % N from urea produced significantly higher wheat grain and straw yield than 0:100 and 50:50 combination of N from FYM and urea (Mahmood-Ul-Hassan *et al*, 1989). Application of 30 t FYM ha^{-1} + 270 kg N ha^{-1} chemical fertilizers to potatoes produced statistically significant and positive cumulative effects (Roy *et al*, 2001). It was result of organic matter increase in soil that sustains productivity in the long-term. Similar results for yield increase of maize and wheat with synergistic use of organic matter and mineral N fertilizers were obtained by Thind *et al* (2002) and Mugwe *et al* (2009). Ahmad *et al* (2002) observed that plant height and leaf area of wheat significantly increased by combining organic and inorganic N fertilizers. Hati *et al* (2006) observed that using

10 t FYM + NPK in soybean for three years improved the seed yield (103 %), water-use efficiency (76 %), and root length density (70.5 %) as compared to control.

Low rate of NP fertilizer integrated with 5 t ha-1 organic manure is the most economical practice for maize (Negassa *et al,* 2001). Use of FYM + Effective Microorganisms (EM) + ½ rate of NPK fertilizer produced seed cotton yield similar to that with full rate NPK, enhanced NPK content in plants, and saved 85 kg N ha^{-1} (Khaliq *et al.,* 2006). In rain-fed sub-mountainous region of India, wheat and maize yields increased significantly with soil and nutrient management practice (75 % NPK + FYM 10 t ha^{-1}) over the farmer practice under wheat-maize cropping system (Hadda and Arora, 2006). Sheeba and Chellamuthu (2000) observed that application of 100 % NPK + FYM enhanced the grain yield of maize.

Yadav *et al.* (2006) observed that combined use of N, FYM and Zn proved the best in term of maize grain and Stover yield, nutrient uptake, gross return, net return and benefit cost ratio against their sole application and farmers' practice. Economic analysis suggested that use of ½ mineral N + ½ organic N along with EM in maize had better performance (Ahmed *et al*, 1999). Application of chemical fertilizer + 15 t FYM ha-1 to sugarcane produced the highest leaf area index, chlorophyll content, cane yield, and sugar content (Bokhtiar and Sakurai, 2005). Macro- and micro-nutrient concentrations in leaves were greater with organic manure than with mineral fertilizer. Continuous application of FYM enhanced crop growth and increases root biomass (Naeem *et al,* 2009).

MATERIAL AND METHODS

3.1 Materials

The materials for the present study comprised twelve Treatment combinations on *Triticum aestivum* cultivar BARI 26.

Organic manure of two different types

1. Poultry litter 3t/ha
2. Farm yard manure 3t/ha
3. -Poultry litter or Farm yard manure (Control)

The various doses of chemical fertilizers

1. Nitrogen: ½ of the recommended dose + ½ of MOP +1/2 TSP =CFL1
2. Nitrogen: ½ of the recommended dose + ¼ of MOP +1/4 TSP = CFL2
3. Full (N) + Full (P) + Full K =CFL3
4. -CFL (Control)

Treatment combinations: Following 12 treatments were used in study

T1 = PL+CFL1	T5= FYM+CFL1	T9 = -PL/FYM+CFL1
T2 = PL+CFL2	T6= FYM+CFL2	T10 = -PL/FYM+CFL2
T3 = PL+CFL3	T7= FYM+CFL3	T11 = -PL/FYM+CFL3
T4 = PL+ (-CFL)	T8= FYM+ (-CFL)	T12 = -PL/FYM/CFL

T_1= 6 (PL) +0.18(N) +0.075(P) +0.09(K)

T_2= 6 (PL) +0.18(N) +0.0375(P) +0.045(K)

T_3= 6 (PL) +0.36(N) +0.15(P) +0.18(K)

T_4= 6 (PL) +0

T_5= 6 (FYM) +0.18(N) +0.075(P) +0.09(K)

T_6= 6 (FYM) +0.18(N) +0.075(P) +0.09(K)

T_7= 6 (FYM) +0.36(N) +0.15(P) +0.18(K)

T_8= 6 (FYM) +0

T_9= 0+0.18(N)+0.075(P)+0.09(K)

T_{10}= 0+0.18(N) +0.0375(P) +0.049(K)

T_{11}= 0+0.36(N) +0.15(P) +0.18(K)

T_{12}= 0+0

3.2 Methods

The experiment was set at the Paba Upazila and Patnitala Upazila.

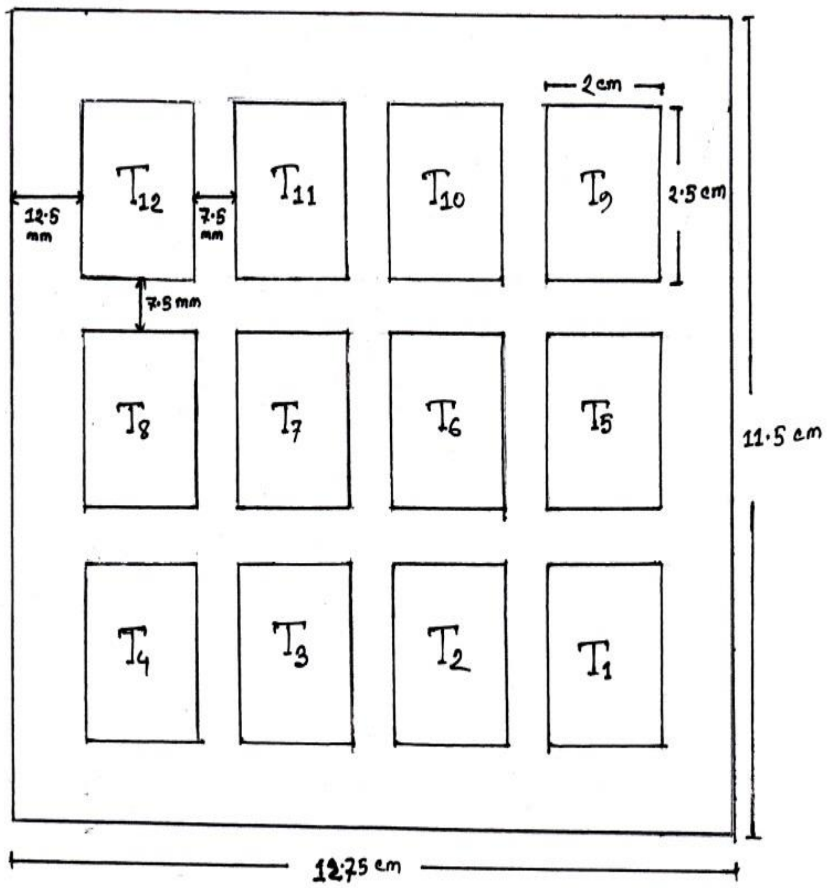
3.2.1 Preparation of the Experimental Field

Application of poultry litter and FYM 7-10 days before final land preparation. Inorganic (Chemical) fertilizers (IF) were applied during final land preparation. Fertilizer dose: Urea: 300 kg/ha, TSP: 125 kg/ha and MOP: 240 Kg/ha. Half of the urea and all other fertilizers were applied during final land preparation. The remaining urea was applied at CRI before 1st irrigation.

The experimental field was ploughed 4 times repeatedly. Weeds were removed completely before layout of the field and sowing of the seeds. The field was pulverized and leveled properly.

As the experimental was given before sowing of the seeds. Thus prepared, the experimental field was ready for sowing of the seed.

Layout of the experimental field (Randomized complete Block design). Plot sine 3m×4m and spacing 25cm×15cm.



Experimental Design (Randomized Complete Block design)

Fig. A: Experimental field in seed germinating stage

Fig. B: Experimental field of weeding

Fig. C: Experimental field of booting stage

Fig. D: Experimental Shows Mature stage

3.2.2 Sowing of Seeds

Sowing of seed (*Triticum aestivum* cut: BARI 26) according to clesign on November 30, 2012 by hand.

3.2.3 Weeding

One weeding operations was done to control weeds in the experimental plot.

3.2.4 Irrigation

Irrigation was applied twice at 21 days after seeding (CRI stage) and grain filling stage from pond water.

3.2.5 Data Collection

The data were collected on individual plant basis. The measurement of Character was done following C.G.S system. The agronomical characters measured are as follows.

Plant height: Distance in cm from the base of the stem to the tip of the spike of the tallest tiller including awns.

Fertile tillers/hill: It include the total number of fertile tiller of the main hill.

Number at grain per panicle: Number of grain bearing spikelet at harvest.

Thousand grain weight: Thousand grain weight (g) was calculated from dividing the seeds weight per plant by the number of grain per plant and was multiplied by thousand.

Grain Yield (t/ha): Yield was converted to ton per hectare

3.2.5 Data Analysis:

The collected data were analyzed following biometrical techniques developed by Mather (1949) based on the mathematical models of Fisher *et al.* (1932) and those of Hayman (1985), De-Wey and Lu (1959) and Allard (1960).

The techniques used are described under the following sub heads.

Means

Data on individual plant were added together then divided by the total number of observations and the mean was obtained as follows:

$$\overline{X} = \frac{\sum_{i=1}^{n} Xi}{n}$$

Where,

X= The individual reading recorded on each plant.

n= Number of observations.

i= 1, 2, 3....................................n.

Σ= Summation

Variance analysis was made on the mean values.

Analysis of variance

Variance analysis is a measurement of dispersion of a population. So, for testing the significant differences among the populations the analysis of variance is necessary. Variance analysis for each character was carried out separately.

The variance due to different sources such as Replication (R), Organic Manure (OM), Fertilizer dose (F), Introduction (OM×F) and within error of a population were calculated as per following skeleton of analysis.

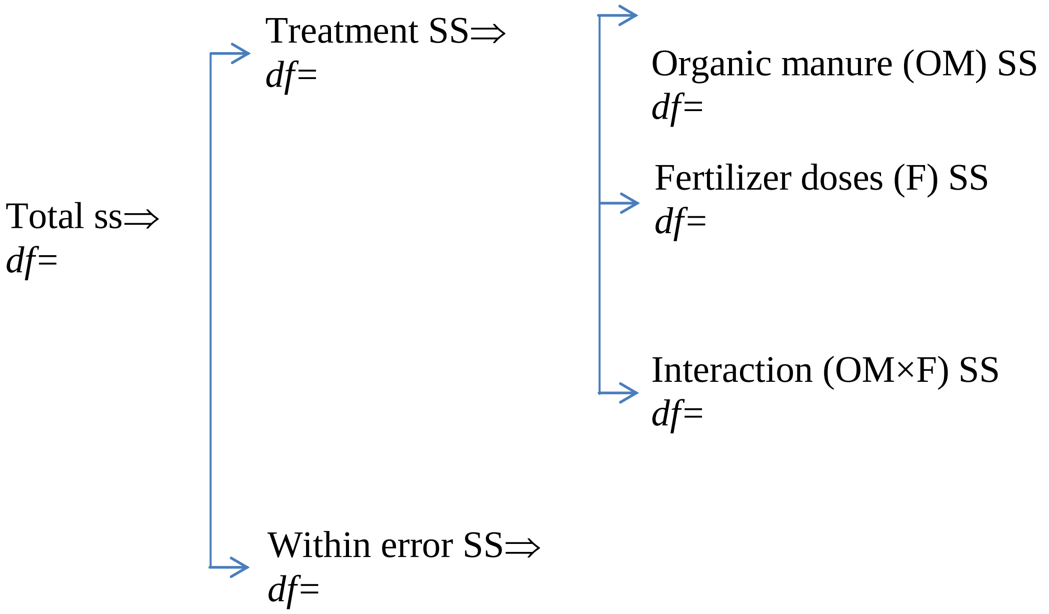


Table 3.1 Analysis of variance (ANOVA format).

Source	Degree of freedom	Sum of squares	Mean Square	F-value
Organic Manure (OM)				
Fertilizer dose (F)				
Interaction (OM×F)				
Error				

Test of significance

Analysis of variance provides the basis for test of significance.

Significance of differences among the population were worded out by F test (variance ratio) as follows:

$$F - test = \frac{MS}{Mse}$$

Where, MS= Mean squar

Mse= Error mean square.

LSD:(Least Significant Differenc)

$$\text{LSD}= t_{(0.05)} \times \sqrt{\frac{2MSe}{r}}$$

Here,

$t_{(0.05)}$= Table value of 5% significant level at Error df.

MSe= Error Ms

r= Replication times.

RESULT

Two sources of organic fertilizers poultry litter (PL) and farm yard manures (FYM) along with different combinations of urea (N), TSP (P) and MOP (K) were used in order to study their effect on different yield contributing characters of wheat CV.BARI Gom-26. The data were recorded on plant height, fertile tillers/hill, grains per panicle, TGW and grain yield (ton/ha) in order to assess the effect of the fertilizer types and combinations the result of this experiment are discussed below.

4.1 Plant Height

Plant was influenced with the types and doses of fertilizers used (Table 4.1). Results showed that all the treatment increased plant height significantly over control (Table 4.1). The highest plant height was noted in T_1. In contrast, the lowest plant height was recorded in T_{12} (control).

4.2Fertile Tillers/Hill

Statistically significant variation was recorded among the treatments. Results showed that all the treatment increased number of fertile tillers/hill significantly over control (Table 4.1). In respect of fertile tiller/hill the highest number of fertile tillers/hill (7) was recorded in the treatments T_1, T_2, T_3, T_6 (Table 4.1).The lowest number of fertile tiller/hill was recorded in T_{12}.

4.3 Grain per Panicle and TGW (Thousand Grain Weight)

Grain per panicle and TGW significantly affected by the treatments as indicated for fertile tillers. Details of the results are shown in (Table 4.1). In grain per panicle results showed that, all the treatments produced significantly higher grain per panicle than control (Table 4.1). The maximum numbers of the grains per panicle (43.5) were obtained in treatment T_2 where 6 (PL) +0.18(N) +0.0375(P) +0.045(K) was applied from recommended doses. On the other hand, the lowest grain per panicle found in T_{12}. In thousand grain weight results showed that all the treatment increased TGW significantly over control (Table 4.1). Maximum 1000 grain weight of 37.5 g was found in treatment T_1, T_2, T_3. On the other hand, the lowest TGW found in T_{12}.

Table 4.1. Summary result of the interaction effect of fertilizer doses and organic matter on productive tiller, plant height, thousand grain weight, grains per panicle, grain yield of wheat.

Treatments	Plant height (cm)	Number of fertile tillers/hill	Number of grain/ panicle	Thousand grain weight (g)	Grain yield ton /hac.
T_1 (6 PL +0.18 N +0.075 P +0.09 K)	107.13a	7a	42.5ab	37.5a	3.45a
T_2 (6 PL +0.18 N +0.0375 P +0.045 K)	106.65a	7a	43.5a	37.5a	3.17ab
T_3 (6 PL +0.36 N +0.15 P +0.18 K)	97.99bcd	7a	41abc	37.5a	3.4a
T_4 (6 PL +0)	96.57cd	5c	37.5cdef	36.5a	2.55de
T_5 (6 FYM +0.18 N +0.075 P +0.09 K)	97.56bcd	6b	41abc	37.5a	3.4a
T_6 (6 FYM +0.18 N +0.075 P +0.09 K)	100.99b	7a	41abc	37a	3.2ab
T_7 (6 FYM +0.36 N +0.15 P +0.18 K)	99.99bc	6b	40abcd	37a	3.47a
T_8 (6 FYM +0)	94.42d	5c	37.5cdef	36.5a	2.4e
T_9 (0+0.18 N+0.075 P+0.09 K)	99.85bc	5c	40abcd	37.5a	2.77cde
T_{10} (0+0.18 N +0.0375 P +0.049 K)	99.85bc	6b	39abcde	37.5a	2.92bcd
T_{11} (0+0.36 N +0.15 P +0.18 K)	100.71bc	5c	36.5cef	36b	2.97bcd
T_{12} (0+0)	90.14e	4d	28.5g	34.5c	1.84f
LSD (0.05)	4.20972	0.635374	5.064003	1.2552567	0.42

4.4 Grain Yield

Grain yield of wheat was influenced mainly by different chemical fertilizer level with organic fertilizers PL or FYM (Table 4.1) ANOVA (Table 4.2) indicated that individual effect organic manure(OM), inorganic fertilizer (IF) and their interactions were varied significantly for grain yield of wheat . The main effect of organic manure varied statistically from control only. Both PL and FYM performed statistically similar for grain yield indicating either PL or FYM are equally effective irrespective of chemical fertilizer level (Fig.4.1).

Table 4.2 ANOVA for yield of wheat in integrated organic and inorganic fertilizer trial.

Source of variation	Degree of freedom	Sums of squares	Mean squares	F-ratio	Prob
Organic Manure (OM)	2	2.033	1.016	15.80	0.0
Inorganic fertilizer (IF)	3	5.980	1.993	30.97	0.0
OM x IF	6	0.243	0.406	0.63	0.705
Residual	24	1.544	0.643		
Total	35	9.802			

Irrespective of organic manure, among the chemical fertilizer level CFL3 performed the best with mean grain yield 3.33 t/ha followed by statistically similar with CFL1 (3.20 t/ha) where ½ of the recommended chemical fertilizer applied with either PL or FYM. CFL2 were in the next order where ½ of the N and $1/4^{th}$ P and $1/4^{th}$ K were applied. In contrast, the lowest yield was recorded with absolute control where neither PL/FYM nor chemical fertilizers were applied (Table 4.2 and Fig 4.2). Our findings revealed that organic manure @3.0 t/ha along with ½ of the recommended chemical fertilizer might be sufficient to obtain optimum yield of wheat.

Table 4.3 Interaction effect of OM x CFL on mean yield (t/ha)

OM/CFL	CFL1	CFL2	CFL3	-CFL	Mean
PL	3.45	3.17	3.40	2.55	3.14
FYM	3.40	3.20	3.47	2.40	3.12
-PL/FYM	2.77	2.92	2.97	1.85	2.62
Mean	3.20	3.09	3.33	2.27	2.97

LSD 0.05 = 0.42

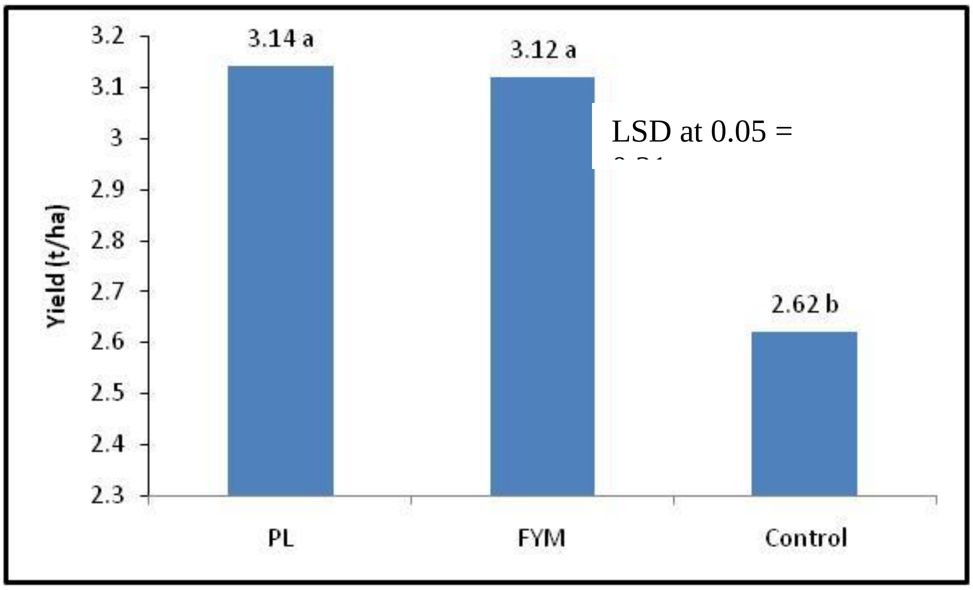


Fig4.1 Main mean effect of different sources of organic manure and control.

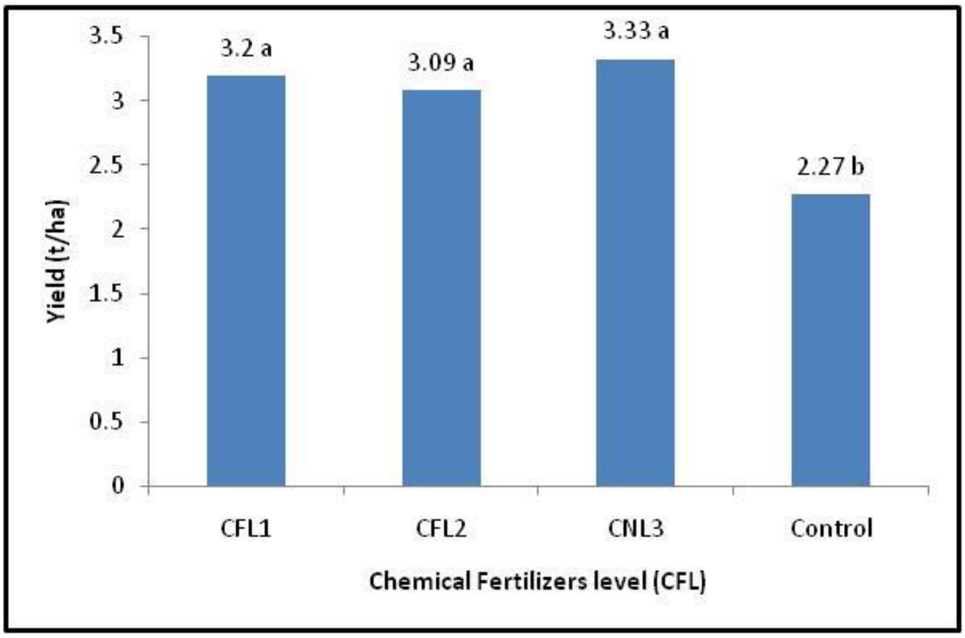


Fig 4.2 Main mean effect of different doses of chemical fertilizers and control.

Considering the overall combinations of OM and CFL, Fig 4.3 illustrated that the highest yield was noted in T7 (3.47 t/ha) where recommended fertilizers along with FYM applied however, in T3 where similar fertilizer applied and PL was used instead of FYM produced slightly lower yield (3.4 t/ha). It was observed that wheat plants in T3 were lodged partially due to excess nutrient supply from PL and chemical fertilizer. Treatments T1 and T5, where ½ of the recommended fertilizers applied, slightly higher yield 0.05 t/ha advantage was obtained with PL (T1). The crop suffers from 15 days foggy environment and receives 15 mm rain.

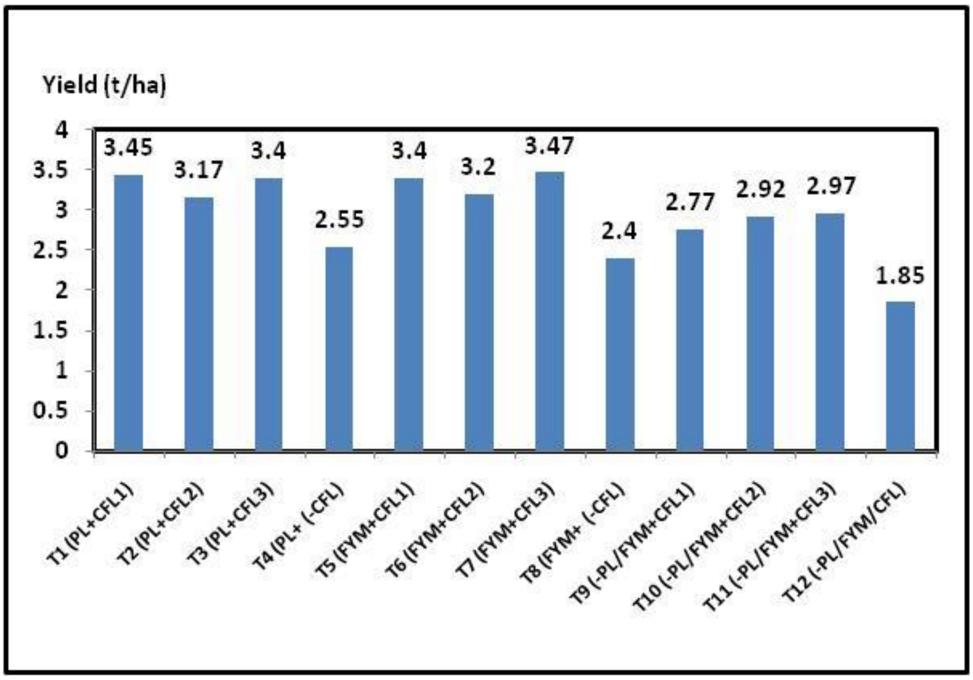


Fig. 4.3 Effect of organic and inorganic fertilizer on the yield of BARIwheat26, 2012-13.

In conclusion, application of both poultry litter and farm yard manure @ 3.0 t/ha can save ½ of the recommended chemical fertilizers and may be recommended for scale up in the upcoming wheat growing season 2013. 1/4th of p and K application along with ½ of the recommended doses of N required to validate further as nutrient composition of FYM in particular is composed as equal as PL. We could not monitor soil moisture using tensiometer however, it is generally believed that FYM improves soil organic matter contents better than PL and thereby increase water holding capacity to minimize drought stress.

- **Analysis of Rainfall data:**
  - **Rainfall distribution pattern of the selected upazilla:**

Details of the rainfall data from 28 November to 25 March are presented in Fig.1. Total rainfall was the highest in Paba (24mm) followed by Patnitola. Number of rainy days was 1 (Paba and Patnitoal) number of rainless days was 107 (Patnitoal) and 116 days (Paba).

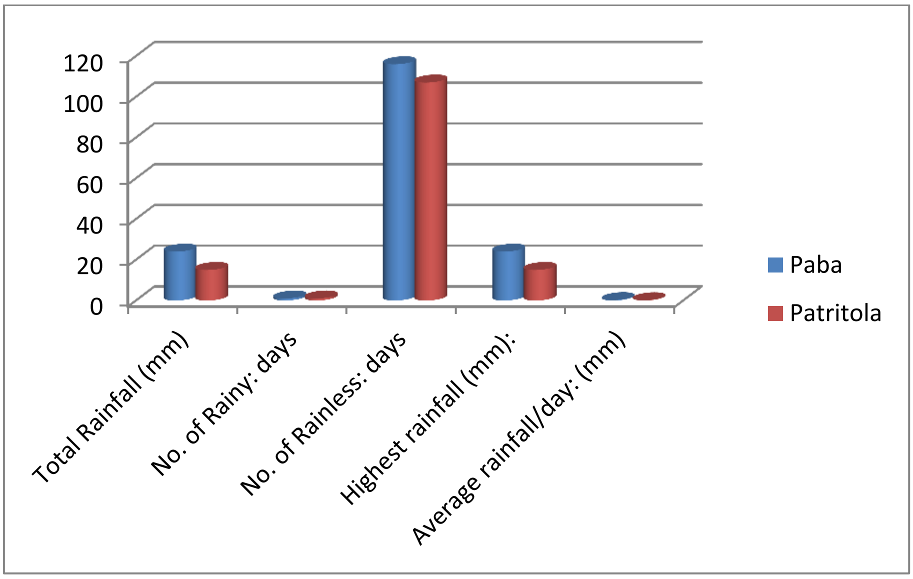


Fig.4.4 Total rainfall, number of rainy days, highest rainfall, rainless days and average rainfall in Paba and Patnitola during wet season wheat growth period.

DISCUSSION

The rapid increase in the world population demands parallel increases in food production, particularly of wheat. In order to preserve the environment and the present natural resources, further increases in global wheat production must be needed a proper management of fertilization. Integrated use of organic fertilizers and chemical fertilizers is beneficial in in proving crop yield, soil pH, organic carbon and availability of N, P and K in soil (Rautaray et al. 2003).

The plant height is an important growth character directly linked with the productive potential of the plants in terms of fodder and grain yield. Results showed that all the treatments used in this study were increased plant height significantly over control. Taller plants were observed in treatment (T1) where 6 (PL) +0.18(N) +0.075(P) +0.09(K) was applied from recommended doses Our results are in agreement with those of Iqbal *et al.* (2002), Idris *et al.* (2001), Idris and Wisal (2001), Singh and Agarwal (2001) who reported that application of mineral N alone or with organic N increased plant height significantly due to the stronger role of N in cell division; cell expansion and enlargement which ultimately affect the vegetative growth of wheat plant particularly plant height.

Tillering is an important trait for grain production and is thereby an important aspect in wheat yield. Results showed that all the treatment also increased number of fertile tiller/hill significantly over control .The maximum numbers of fertile tillers/hill were obtained in treatment T_1, T_2, T_3, T_7 . Organic sources offer more balanced nutrition to the plants, especially micro nutrients which positively affect number of tiller in plants (Miller, 2007).

As regard to grain per grain/panicle, all the treatments produced significantly higher grain/panicle than control. The maximum numbers of the grains per panicle (43.5) were obtained in treatment where T_2 , 6 PL +0.18 N +0.0375 P +0.045 K was applied from recommended doses. The probable reason could be that mineral fertilizer and mineralization of organic manures throughout the growing period did not put the plants in nutrient stress at any stage resulted in maximum grain production. These results are supported by Khan *et al.* (1996) Singh and Agarwal (2001), Akram *et al.* (1982), Iqbal *et al.* (2002), and Arif *et al.* (2006) who reported marked increase in number of grain per ear of wheat by applying organic manures and mineral fertilizer in combination.

Thousand grain weight was found to increase in all the treatment over control. The maximum TGW 37.5 g was found in treatments T_1, $T_{2,}$ T_3 . Similar results were reported by Song et al. (1998) who found that combination of organic manures plus NPK fertilizer had a significant effect on 1000 grains weight. 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 N. The large accumulation if 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.

The grain yield was also significantly increased in all the treatments from control. The maximum grain yield of 3.47 ton/ha was recorded in treatment T_7 (6 FYM +0.36 N +0.15 P +0.18 K). The lowest yield was obtained in control plots. These results are in agreement with Kumar and Sing (1997) who reported that the maximum wheat grain yield was obtained with the application of farm yard manure combined with 50% recommended NPK, which produce a significantly higher yield than the application of 100% NPK. Similarly, Nahar *et al.* (1995) reported that the grain yield of wheat was 1.33 t ha-1 in controls and 2.62 t ha-1 in plots where compost (rice straw+farm yard manure) was previously incorporated

In conclusion, application of both poultry litter and farm yard manure @ 3.0 t/ha can save ½ of the recommended chemical fertilizers and may be recommended for scale up in the upcoming wheat growing season 2013. 1/4th of P and K application along with ½ of the recommended doses of N required to validate further as nutrient composition of FYM in particular is composed as equal as PL. We could not monitor soil moisture using tensiometer however, it is generally believed that FYM improves soil organic matter contents better than PL and thereby increase water holding capacity to minimize drought stress.

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