EFFECT OF INTEGRATED USE OF ORGANIC AND INORGANIC NITROGEN SOURCES ON WHEAT YIELD

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ABSTRACT

The integrated use of organic and inorganic fertilizers on the yield of wheat was evaluated in a field experiment at Nuclear Institute for Food and Agriculture (NIFA), Peshawar during December 2004 to May 2005. The organic sources used were farmyard manure, poultry manure and city waste. These were integrated in different proportions with mineral nitrogenous fertilizer to supply 120 kg N ha^{-1}N. All the organic fertilizers were applied at sowing time and mineral fertilizer (urea) was applied in three splitter sowing, tillering and booting stages in equal amount. The results showed that integrated use in different proportion increased the plant height, spike length, grain per spike and 1000-grain weight. Maximum grain yield of 3.5 tha^{-1} was obtained from treatments where 25% N was applied from FYM 25% N from poultry manure or city waste and 50% from mineral source and in treatment where25% N was applied from FYM, 25% from city waste and 50% from mineral fertilizer. Application of half N from urea with 25% N from either FYM and 25% poultry manure or city waste proved beneficial and reduced 50% fertilizer cost.

Key Words: **organic N, mineral N, wheat yield, integrated use.**

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INTRODUCTION

Wheat is the major staple food of Pakistan as well as of the world. The grain is directly or in directly used as human diet and its straw is used as an animal feed. In Pakistan, wheat was grown on 7 m ha in irrigated areas with an average yield of 2566 kg ha^{-1} (MINFAL, 2004-05). In KP, irrigated wheat was grown on 0.316 m ha with an average yield of 2018 kg ha$^{-1.}$ The average yield is very low as compared to other advance countries of the world. Low yield of wheat in Pakistan may be attributed to many factors including imbalance fertilizer application. The alkaline and calcareous soils of Pakistan are extensively deficient in nitrogen, phosphorus, zinc and organic matter, hence application of fertilizer is considered imperative for increasing crop production (Memon, 1996). Mineral fertilizers play a significant role in boosting crop production on alkaline calcareous soils of Pakistan (Ahmad, 2000). Despite increased use of the fertilizers, per hectare yield has not been increased proportionally rather stagnation occurs (Ali, 2000). This has been attributed to the imbalanced use of mineral fertilizers and inappropriate method of their application that culminated in low efficiency. According to Zia *et al.* (2000), continuous use of chemical fertilizers even in balanced proportion will not be able to sustain crop productivity due to deterioration in soil health. Application of organic manures or some organic wastes alone was found useful (Ibrahim *et al.*, 1992; Alam and Shah, 2003), but integrated use of organic wastes and chemical fertilizer has proved more rewarding (Mian *et al*., 1989, Nasir and Qureshi, 1999; Khanam *et al.* 2001, Alam *et al.*, 2003, 2005). Limited availability of additional land for crop production, along with declining yield of major food crops, have heightened concerns about agriculture's ability to feed the growing population expected to exceed 7.5 billion by the year 2020. Future strategies for increasing agricultural productivity will have to focus on using available nutrient resources more efficiently, effectively, and on sustainable basis. Integrated nutrient management are essential for proper plant growth, water use, soil, and land management, that will be critical for the sustaining agriculture productivity over the long term. The overall strategy for increasing crop yields and sustaining them at a high level must include an integrated approach to the management of soil nutrients. An integrated approach recognizes that soils are the storehouse of most of the plant nutrients essential for plant growth and have a major impact on soil fertility, and agricultural sustainability. In addition to farm manures, a huge amount of wastes generated in all big cities, town and villages of Pakistan, which pollute the atmosphere of these cities, and villages, can be used for enhancing soil fertility and crop productivity. Keeping these facts in view, the present investigation was carried out to study the effect of mineral N (urea), and organic manures (farm yard manure, poultry manure and municipal waste) alone and in various combinations on yield and yield components of wheat.

MATERIALS AND METHODS

Location

A field study was conducted at Research Farm of Nuclear Institute for Food and Agriculture (NIFA) during Rabi 2004-05. The site is located at 34^0 00/N and $71^0$33/E at an altitude of 400m above sea level in Khyber Pakhtunkhwa Province of Pakistan.

Soil of the Experimental Site

The soil of the experimental site belonged to Tarnab series fine silty, mixed hyperthermic Udic Ustept.

Experimental Lay Out and Procedure

Nitrogen was applied @ 120 kg ha^{-1} from organic and mineral N sources in different proportion. The organic sources used were farm yard manure, poultry waste, and muncipal waste. The organic manure was applied at sowing time and the mineral N (urea) was applied at three splits i.e. sowing, tillering and booting stage of crop. The experiment was laid out according to Randomized Complete Block design (RCB) and was replicated four times; Plot size was 20 m^2. P and K were applied at recommended rate in the form of single super phosphate and potassium sulphate as basal dose to the crop and adjusted on the basis of P and K present in the organic sources. All other cultural practices i.e. weeding, hoeing, irrigation as when required was adopted uniformly. Row to row distance was 30 cm and plant to plant 6 cm. The variety used was F. Sarhad. The experimental details are given in Table III. Before sowing, a composite soil sample was collected from the field and was analyzed for physico-chemical properties (Table I) Soil texture was determined by hydrometer method as described by Moodi *et al.* (1959). The pH and E.C in soil was determined by water suspension (1:2.5) with the help of pH and conductivity meters according to method outlined by Richard, (1954). Organic matter was determined by the method given by Walkley and Black (Black, 1965). In composite soil sample total nitrogen was determined by Kjeldhal digestion method and available P was determined by Olsen Method. In the organic manures total nitrogen was determined by Kjeldhal digestion method and total P and K were determined by method given in (AOAC, 1979) (Table II). At maturity the crop was harvested during third week of May 2005. Biological yield was recorded and straw and grain were separated with mini thresher. The data collected were statistically analyzed through MSTATC statistical package.

Table I ***Basic properties of the experimental soil***

Texture	**Silty clay loam**
pH (1:25 suspension)	8.10
EC (1:25 suspension)	0.56 dS m^{-1}
$CaCO_3$ equivalent	18 %
Organic matter	0.86%
$NaHCO_3$ extra-P	4.57 mg kg^{-1}
Total N	0.11%

Table II ***Organic manures composition***

Organic manures	**%N**	**% P**	**% K**
Farm Yard Manure	0.6	0.44	1
Poultry waste	2.87	1.30	1.75
Municipal waste	0.50	0.72	1

Table III ***Treatment details***

Organic Nitrogen * (%)			**MineralNitrogen****
FYM	**PW**	**MW**	**(%)**
0			0
0	-	-	100
25	-	-	75
-	25	-	75
-	-	25	75
25	25	-	50
25	-	25	50
-	25	25	50

* FYM =Farm Yard Manure. PW= Poultry waste. MW= Municipal waste

** Mineral nitrogen Urea

RESULTS AND DISCUSSION

Plant Height

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 treatment increased plant height significantly ($P< 0.05$) over control. Taller plants were observed in treatment where 75% N was applied from urea and 25% N from municipal waste followed by treatment where 50% N was applied from urea, 25% from farmyard manure and 25% from municipal waste. The reason for maximum height in FYM plus mineral N combine treatment might be, that mineral N source fulfill the N requirements at early growth stages while farmyard manure facilitated crop with maximum nutrients in later stages. In combination (mineral +FYM) nourished the crop in initial stages as well as in later stages. Thus excellent vegetative growth and development resulted in maximum plant height. 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.

Spike Length

Spike length is another important yield component, which affect the number of grains per spike. Application of both organic and inorganic N sources had significant effect ($P< 0.05$) on spike length. The highest spike length (9.2 cm) was recorded in treatment where 50% N was applied from mineral source (urea), 25% from poultry waste and 25% from municipal waste followed by treatment where 75% N was applied from mineral source (urea) and 25% were supplied from farm yard manure (Table IV). Results showed that either mineral N or organic N both helped the plants to produce well developed spikes. Similar results were also reported by Singh and Agarwal (2001), Zeidan and Kramany (2001), Iqbal *et al.* (2002) Khan *et al.* (1996) reported longer spikes by the application of mineral N and organic N The lowest spike length was noted in control.

Grain per Spike

As regard to grain per spike, all the treatments produced significantly higher grain per spike than control. The maximum numbers of the grains per spike (43.5) were obtained in treatment where 50% N was applied from inorganic urea and 25% from poultry waste and 25% from municipal waste followed by treatment where 75% N was applied from inorganic urea and 25% from farm yard manure. 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 (g)

The differential effect of applied N on thousand-grain weight improved significantly over control (Table IV). Maximum 1000 grain weight of 42.8 g was found in treatment where 25% FYM and 25% poultry manure were applied in combination with 50% N from urea followed by treatment where 25% FYM and 25% city waste were applied with 50% of inorganic N. 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 from fertilizers the where 50% N was applied from organic sources and 50% from mineral source.

Grain Yield

The differential effect of applied N significantly ($P<0.05$) affected grain yield compared to control. The maximum grain yield of 3.05 t ha^{-1} was recorded in treatment where 50% N was applied from urea, and 25% from farm yard manure and 25% from poultry manure and in treatment where 50% N was applied from urea, and 25% from farm yard manure and 25% from municipal waste. 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. Grain yield or economic yield is an important characteristic and the ultimate output of any crop depends on grain yield. The grain yield usually depends upon various factors such as soil fertility

status, water availability, crop management, agronomic practices environmental factors and plant genetic characteristics. The results of our study showed that treatments received N from organic and mineral source in ratio of 25:25:50, respectively, produces higher grain yield. Yield improvement under these treatments may be due to enhanced use of N, water and other associated soil improving benefit of organic sources, which made plants more efficient in photosynthetic activity

Economic Analysis

The value cost analysis (Table V) shows that maximum net return with value cost ratio of 3.29 comes from T_6 where 25% farm yard manure, 25% poultry manure and 50% mineral nitrogen were applied. It was noted that integrated use of organic manure with mineral fertilizer at 1:1:2 ratios were economically profitable and resulted in high value cost ratio. The net income in these treatments was higher than that of the treatment where mineral fertilizer was applied alone. Similar results were reported by Yaduvanshi (2003), Alam *et al*. (2005) and Alam *et al*. (2004) who observed that higher profit was obtained when inorganic fertilizer was combined with organic manures.

Table IV ***Effect of the integrated use of different organic and inorganic nitrogen on yield and yield component of wheat crop***

Treatments	Plant height (cm)	Spike length (cm)	Number of Grain/Spike	1000 Grain weight (gm)	Grain yield (t ha^{-1})
T_1	43.40 c	3.397 c	31.16 d	20.64 e	2.15 c
T_2	93.70 a	8.445 b	39.65 bc	40.08 bcd	2.85 ab
T_3	94.05 a	8.555 b	42.35 ab	39.70 cd	2.70 ab
T_4	89.30 b	8.475 b	41.15 ab	39.35 d	2.55 b
T_5	95.05 a	8.355 b	39.85 bc	41.55 abc	2.90 ab
T_6	93.10 ab	8.422 b	39.30 bc	42.75 a	3.05 a
T_7	94.55 a	8.458 b	37.90 c	41.90 ab	3.05 a
T_8	93.00 ab	9.150 a	43.45 a	41.30 abcd	2.80 ab
LSD (0.05)	4.340	0.3385	3.116	2.063	0.7795

Table V ***Cost economics for the integrated use of N fertilizers***

Treatments	Grain yield $kgha^{-1}$	Yield increase over control $kgha^{-1}$	Value of increased yield (Rs)	Cost of fertilizer (Rs)	VCR
T_1	2150	-	-	-	-
T_2	2850	700	7700	2869.2	2.68
T_3	2700	550	6050	3401.9	1.77
T_4	2550	400	4400	2468.4	1.78
T_5	2900	750	8250	3111.9	2.65
T_6	3050	900	9900	3001.9	3.29
T_7	3050	900	9900	3644.6	2.71
T_8	2800	650	7150	2711.1	2.63

Urea @ Rs 23.91 kg^{-1}, FYM @ Rs 250 t^{-1}, P.M@ Rs 300 t^{-1}, MW @ Rs 80 t^{-1}, Wheat grain @ Rs 11kg^{-1},

CONCLUSION AND RECOMMENDATIONS

It is concluded from the present study that integrated use of organic and inorganic sources are good for wheat crop. The plots which received combined nitrogen (organic and inorganic) N produced higher yield than of plot receiving only inorganic nitrogen. The best results were obtained from plots, which receive 25% N from farm yard manure with either 25% from city waste or poultry waste and 50% mineral N (urea).

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