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Integrated Use of Farm Yard Manure and Urea Fertilizer Enhanced Tissue Nitrogen of Wheat at Different Growth Stages

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Abstract
Efficient nitrogen (N) use is one of the most critical issues for crop management. Field trials were carried out in 2009-10 growing years to investigate response of seven Farmyard Manure (FYM) doses and three N rates (0, 45 and 90 kgha^{-1}) for agronomical traits in wheat. In the research the traits such as at boot, anthesis (leaf, stem), and maturity (leaf, stem, grain and straw) nitrogen content were investigated. Plant tissue analysis is very helpful to detect plant nutritional problems or to observe the usefulness of a soil fertility program. It is a chemical estimation of nutritional condition and concentrations of important elements found in for nutritional condition of plants. Proper understanding of plant tissue analysis results is critical to effective use of this management device. The objectives of this study were to clarify the N condition of different layers at different growth stages and at various N treatments and provide new data on wheat quality factors in combination with N of different canopy layers potentially effect wheat quality during growth. It was demonstrated from the experimental results that the uses of FYM with urea before and at sowing have the potential to enhance the tissue nitrogen content of wheat.
Keywords: Wheat, F YM, Urea, Tissue nitrogen

INTRODUCTION

Nitrogen (N) is one of the most essential nutrients for plant growth and development. Wheat (Triticum aestivum L.) is primarily used as a staple food providing more protein than any other cereal crop. It is used in various forms like bread, biscuits, cakes, bakery products, and numerous other products. Its straw is used as manufacturing paper and also for animal feed (Zahoor, 2014). Winter wheat grain N produces from both the active uptake and assimilation of N and from the remobilization of vegetative tissue N during grain filling (Frederick, 1997). There are significant correlations between plant tissue N and grain nitrogen (Boman et al., 1995; Woodard and Bly, 1998). There is no reservation that understanding the system N affects the quality of winter wheat is essential (Zahoor, 2014; Jamieson and Semenov, 2000).

Several researches have been conducted on the correlation between grain quality and N management and N use efficiency (NUE) of winter wheat (Du et al., 2001; Hou et al., 2002). Serious investigations on plant N status evaluation have also been reported (Roth et al. 1989) pointed out that total N can be used to calculate N fertilizer requirements in winter wheat (Le Bot et al. 1998) observed that critical N concentration and plant N concentrations during crop growth will be used to identify an N deficiency in plants (Tindall et al. (1995) investigate that the plant tissue main components is N, such as flag leaf N have a very good response for grain protein content when its apply in late season. A rapid process to find out the status of N in wheat plant tissue can be expensive in improving N fertilizer management. These facts will support in the progress of fertilizer recommendations and also decrease the effects of N deficiency in crops and the environmental risks of excess rates of fertilization (Alt et al., 2000). As N is the largest mobile element present in all parts of the plant (Anten et al., 1995).

Several studies have been carried out on the relationship between leaf nitrogen content and leaf irradiance. In several investigations, canopy photosynthesis is predicted by means of model calculations determined by the measurement of the N content of selected leaves (Evans, 1993). However, little research has been conducted to examine the relationship between N gradients in tissue and grain quality. Nitrogen (N) application is one of the most important agronomic management practices, however the quantity and timing of N remains a big challenge for farmers. Crops growing with N deficiency lose greenness, they are frequently smaller with less biomass, and have decreased photosynthetic capacity consequential in reduced yield and low protein content. Optimization of mineral N fertilization estimated to increase N use efficiency is a fundamental problem and target of applied research in agricultural systems. Nitrogen use efficiency of worldwide cereal crops was ranging from 14 to 59% in wheat (Delin et al., 2008); which suggests that present N strategies are extremely unproductive. Kaur and Benipal, (2006) studied that the combination of crop residue and farmyard manure on nutrients, maximized the amount of N released at 84 days of incubation. Khan et al. (2008) observed that N sources, FYM application @ of 20 tons ha^{-1} joint with 60 kg N ha^{-1} delayed phonology, but enhancing crop stand and plant height relative to all other treatments and reported that FYM application in mixture with minimum N (30 or 60 kg N ha^{-1}) was an alternative and sustainable way to enhance crop growth and stand. Naeem et al. (2009) observed that the use of organic and inorganic fertilizer increases microbiological property of eroded soil. The uses of urea and FYM mixture have a rewarding increase in soil fertility (Shah and Ahmad, 2006). Integrated supply of organic and inorganic fertilizer has enhanced water use efficiency and soil chemical properties (Fan et al., 2005), and suggested to use integrated FYM and N for sustainable crop production (Hussain et al., 1992). The enhancing soil fertility based on the balanced use of lime with the combination of inorganic fertilizer is aimed to increase crop productivity and agriculture sustainability (Zhang et al., 2008).

A number of experiments in winter cereal have exposed that split applications of N fertilizer relating identical amounts of N applied before and after seeding are agronomical strategies to improve N utilization efficiency (Basso and Ritchie, 2005). Organic manures maintaining soil structural, it enhances the air ability, roots extend and develop a larger volume of soil in accumulation to enhancing water withholding in the soil profile (Sarkar et al., 2003). Input of chemical fertilizer addition to organic manure plays a vital role in declining the soil nitrate content (Yang et al., 2005). Soil microbial biomass and activity influences the crop and soil management practices such as organic manure and inorganic fertilizer input (Livia et al., 2005). N-containing fertilizers bring about to acidify soil, the acidifying due to the critical situation of many types of microorganisms i.e., bacteria and actinomycetes (Kaur et al., 2008). The relations of organic and inorganic fertilization increase, the accumulation of soil organic matter (Banger et al., 2009).

Literature on the combine use of organic and inorganic nitrogen at different growth stages is not available in the study area. Therefore, the present research was designed to study the effect of farm yard manure and nitrogen at sowing and before sowing on the yield and yield component of wheat in agro-climatic condition of Peshawar.

MATERIALS AND METHODS

The experiment was conducted at the New Development Farm, The University of agriculture, Peshawar, throughout Rabi season 2009-10. The area is located at 34^0 01N latitude 71^0 33E longitudes and an altitude of 450 m higher than the ocean level. The soil of the location was clay loam texture, alkaline, organic matter, low in NPK and extremely calcareous in nature.

The study was carried out in Randomize complete block design (RCBD) with a split plot arrangement and 3 replications. Main plots were followed by Farmyard manure having seven different treatments and nitrogen was applied to the subplots. The experimental details are given in (Table 2). A sub plot size of the 5x3m^{-2}30cm row to row distance, having ten rows per treatment, Wheat selection (Pirsabak-2005) was planted in (18 November 2009) and harvested at (5 June 2010). A basal dose of P and K was applied according to recommended rate as a source of single super phosphate and potassium sulphate. Nitrogen was applied in split application, half at sowing time and the other half of first irrigation. A composite soil sample was taken and analyzed for soil physical- chemical analysis (Table 1). Soil texture was determined by the hydrometer system developed by (Moodi et al. 1959). For determination of the organic matter black technique was used (Black 1965). In the combined soil sample, total nitrogen was found by Kjeldhal digestion technique and available P was determined by Olsen Method. FYM was integrated within the field thirty days before seed sowing (BS) and at sowing time. All other cultural practices, including, hoeing, irrigation and weeding were carried out equally for all subplots.

The data was statistically analyzed by using analysis of variance (ANOVA) was used to detect the significance of treatment effects the various variable measured. In case of considerable variations, the least significance difference (LSD) check and special planned mean comparisons were made to achieve the specific objective of the research (Jan et al., 2009).

Table 1. Basic properties of the experimental soil and organic material.

Texture	PH	Organic matter	Soil total N	Rainfall	Farmyard manure			
					%N	% P	% K	C: N
Silty clay loam	8.2	0.87%	< 0.5 g kg-1	< 360 mm	0.6	0.44	1	14.1

Table 2. FYM and nitrogen treatments details.

Farmyard manure (main plot)

F_0 = Control
F_1 = 5 tons FYM ha^{-1} before sowing (BS)
F_{2} = 5 tons FYM ha^{-1} at sowing (AS)
F_3 = 2½ tons FYM ha^{-1} BS + 2½ tons FYM ha^{-1} AS
F_4 = 10 tons FYM ha^{-1} before sowing
F_5 = 10 tons FYM ha^{-1} at sowing
F_6 = 5 tons FYM ha^{-1} BS + 5 tons FYM ha^{-1}

Fertilizer N Urea (sub plot)

$N_{0=0}$ Kg ha^{-1}
N_1 = 45 Kg ha^{-1}
$N_{3=}$ 90 Kg ha^{-}

RESULTS

Total nitrogen at boot stage in leaves (Table. 3 and 4) were higher (6.46 g kg^{-1}) in plot 5 tons FYM ha^{-1} before sowing + 5tons FYM ha^{-1} after sowing as compared to the control plots (3.44 g kg^{-1}). Increased nitrogen rates, more quantity of total nitrogen (5.62 g kg^{-1}) were counted from the plots having 90 kg N ha^{-1} compared to plot with zero nitrogen (4.70 g kg^{-1}). FYM increased nitrogen content in stem showed that more quantity of total nitrogen at boot stage in stem (7.82 g kg^{-1}) were recorded by plot 5 tons FYM before sowing + 5 tons after sowing as compare to the control (3.51 g kg^{-1}). Rate of nitrogen quantity of total nitrogen (6.46 g kg^{-1}) in the plots applying 90 kg N ha^{-1} compared to plot with zero nitrogen (4.78 g kg^{-1}). Incorporation of FYM increased the quantity of nitrogen in leaves, higher amount of total nitrogen in leaves (3.92 g kg^{-1}) were taken by plot 5tons FYM before sowing + 5 tons FYM after sowing over the control (2.88 g kg^{-1}). Increasing the rate of nitrogen, more quantity of total nitrogen (4.37 g kg^{-1}) was counted from the plots had 90 kg N ha^{-1} compared to plot with zero nitrogen (2.51 g kg^{-1}).

Incorporation of high quantity of FYM increased total nitrogen at the anthesis stage (Table.3 and 4) in stem (5.37 g kg^{-1}) in the plots having 10 tons FYM ha^{-1} (before sowing) over the control (2.94 g kg^{-1}). Interestingly, application of FYM increased total amounts of nitrogen. Furthermore, higher amount of total nitrogen at maturity stage of leaves (4.04 g kg^{-1}) were observed in the plot having 10tons FYM ha^{-1} (before sowing) than the control (2.82 g kg^{-1}). Increased the rate of nitrogen, more quantity of total nitrogen (4.12 g kg^{-1}) were counted from plots of 90 kg N ha^{-1} compared to plot of zero nitrogen (2.51 g kg^{-1}). Finally, nitrogen content in the stem is increased by the application of FYM, ((1 and 2) Higher N at maturity stage in stem (3.79 g kg^{-1}) were taken by plot 5tons FYM before sowing + 5tons FYM at sowing as compare to the control (2.56 g kg^{-1}). Rate of nitrogen increased, more quantity of total nitrogen (4.12 g kg^{-1}) were counted from a plot which had Appling 90kg N ha^{-1} compared to plot with zero nitrogen (2.51 g kg^{-1}).

Application of FYM increased nitrogen content in straw. Table (3 and 4) showed that higher amount of total nitrogen at maturity stage of straw (5.22 g kg^{-1}) was recorded from the plot 10 tons FYM ha^{-1} (before sowing time) compared to the control (3.68 g kg^{-1}). In case of nitrogen rate increasing, more quantity of total nitrogen (5.10 g kg^{-1}) were counted at 90kg N ha^{-1} application plots compared to plot with zero nitrogen (3.91 g kg^{-1}). Similarly incorporation of FYM increased nitrogen contents in grain. Therefore, it is pointed out that higher amount of total nitrogen at maturity stage of grain (21.23 g kg^{-1}) was observed in the plot having 10 tons FYM ha^{-1} (before sowing) than the control (15.02 g kg^{-1}). In case of nitrogen rate increasing, more quantity of total nitrogen in grain (20.33 g kg^{-1}) were counted from the plots that had 90kg N ha^{-1} compared to plot with zero nitrogen (15.57 g kg^{-1}).

Table 3: Farmyard manure (FYM) t ha^{-1} affected the nitrogen content (g kg^{-1}) in tissues of wheat.

Farmyard manure (FYM) (t ha^{-1})	Boot stage leaf	Boot stage Stem	Anthesis stage Leaf	Anthesis Stage Stem	Maturity stage leaf	Maturity stage stems	Maturity stage Straw	Maturity stage grain
0 (Control)	3.44 c	3.51 c	2.88 d	2.94 c	2.82 c	2.56 c	3.68 c	15.02 d
5 before sowing (BS)	4.54 bc	6.59 b	3.61 b	4.35 b	3.41 b	3.51 a	4.20 bc	16.46 cd
5 at sowing (AS)	4.26 bc	4.28 c	3.19 c	4.56 ab	3.17 bc	3.13 b	4.25 bc	17.31 bcd
2½ BS + 2½ AS	4.88 bc	6.28 b	3.61 b	4.16 b	3.47 b	3.75 a	4.61 ab	20.09 ab
10 before sowing	5.29 ab	6.88 ab	4.03 a	5.37 a	4.04 a	3.71 a	5.22 a	17.44 bcd
10 at sowing	4.97 b	5.80 b	3.38b c	4.12 b	3.43 b	3.65 a	4.57 ab	18.48 abc
5 BS + 5 AS	6.46 a	7.82 a	3.92 a	4.70 ab	3.67 ab	3.79 a	5.12 a	21.23 a

The means of the same entry followed by similar letters are nonsignificant at ($P \leq 0.05$) using LSD.

Table 4: Nitrogen fertilizer (kg ha^{-1}) affected the nitrogen content (g kg^{-1}) in tissues of wheat.

Nitrogen (kg ha^{-1})	Boot stage leaf	Boot stage Stem	Anthesis stage Leaf	Anthesis Stage Stem	Maturity stage leaf	Maturity stage Stem	Maturity stage Straw	Maturity stage grain
0	4.70 b	4.78 b	2.51 c	3.45 c	2.51 c	2.76 c	3.91 c	15.57 c
45	4.19 ab	6.40 a	3.67 b	4.57 b	3.67 b	3.54 b	4.56 b	18.11 b
90	5.62 a	6.46 a	4.37 a	4.94 a	4.12 c	4.02 a	5.10 a	20.33 a

The means of the same entry followed by similar letters are nonsignificant at ($P \leq 0.05$) using LSD.

At boot stage, there was a significant difference seven FYM and three N forms for the control plants, with leaf and stem materials having the highest and lowest total nitrogen amount , respectively (a,b) in (Fig 1.). In addition, application of FYM at different time and rate significantly increased amount of total nitrogen in leaf and stem comparison with the control. Similarly the rate of chemical fertilizer also increases tissue nitrogen in wheat. Finally, we suggested that the integrated use of FYM and N activity for all treatments have a positive response instead of control treatment. But the highest amount is detected in FYM (5 BS + 5 AS) and 90 KgN / ha. At anthesis stage, there was a significant change occurs between control treatment and nitrogen application from different times and sources (c, d) (Fig. 1). The organic and inorganic nitrogen shows a positive effect on the total nitrogen amount in leaf and stem. So for sustainability its need more attention to find the specific and more effective time, the rate and source of nitrogen for controlling nitrogen losses and negative effect. From results, highest tissue nitrogen amount was found at FYM (2½ BS + 2½ AS) and 90kgN/ ha inorganic fertilizer.

At maturity stage, there was a significant difference seven FYM and three N forms for the control plants, with leaf ,stem, Grain and straw materials having the highest and lowest total nitrogen amount , respectively (e,f,g and h) in (Fig 2.). In addition, application of FYM at different time and rate significantly increased amount of total nitrogen in leaf, stem, Grain and Straw comparison with the control at maturity. On the basis of this, the rate of chemical fertilizer also increases tissue nitrogen in different wheat parts. Finally, we suggested that the integrated use of FYM and N taking to gather all treatments have a positive response instead of control treatment. But the highest amount is detected in FYM (2½ BS + 2½ AS) and 90 KgN / ha in grain and straw. But in leaf and stem the effect of FYM is different and the maximum occurs at FYM (5 BS + 5 AS) application.

Fig 1. Mean of nitrogen content in various wheat tissues in different growth stages.

(a) Nitrogen in leaf at boot stage (NBL) **(b)** Nitrogen in stem at boot stage (NBS) **(c)** Nitrogen in leaf at anthesis stage (NAL) **(d)** Nitrogen in stem at anthesis stage (NAS).

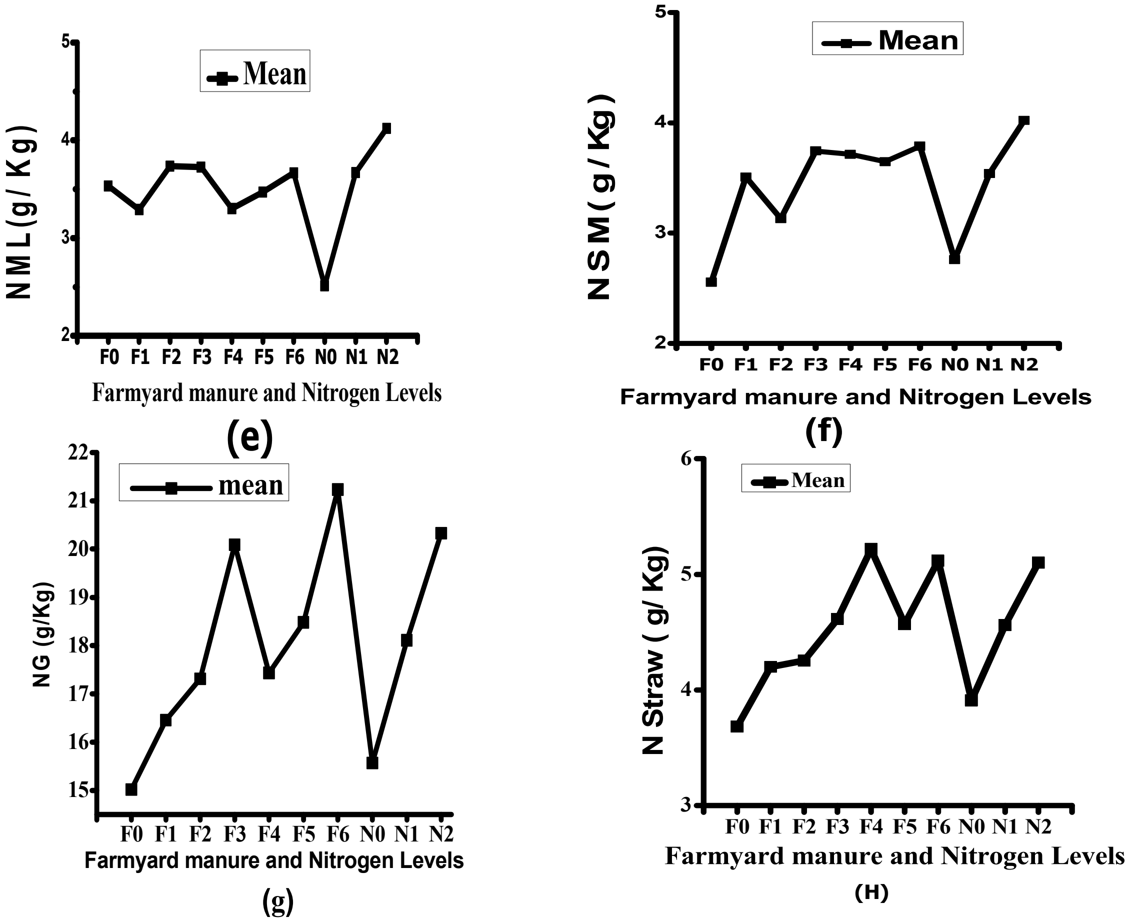

Fig 2. Mean of nitrogen content in various wheat tissues in different growth stages.
(a) Nitrogen in leaf at maturity stage (NML) **(b)** Nitrogen in stem at maturity stage (NMS) **(c)** Nitrogen in grain at maturity stage (NG) **(d)** Nitrogen in straw at maturity stage (NStraw).

DISCUSSION

This work exposes powerful response of N deficiency on numerous useful characteristics of the pool system supplying N for the tissue growth in different rate, time and sources. Nitrogen source (N form) had a significant effect on total nitrogen concentration and accumulation in different parts of wheat. In the earlier information, the relationship between N accumulation in the plants from organic and inorganic source are studied. By a literature investigation of different tissues parts and species (Ryan, 1991) on the basis of this, it shows a linear relationship between plant maintenance tissue N and respiration. On the basis of this dataset were resulting from leaf and whole plant by using the methods of regression, starvation and mature tissue, respectively (Ryan, 1991). But it is not widely tested for different ecosystems and species; Ryan (1995) studied other trees by sampling of 14 species by fully mature tissue method and achieved a significant linear relationship between N concentration and respiration. Recently, the involvement of plant N concentration and N status are evaluated in dry biomass for crop, and is therefore more accurate than N content. (Lemaire et al. 2008) .Show an improved ability to calculate N concentration based on the relationship between chlorophyll concentration and N concentration (Eitel et al. 2007). Increase nitrogen content in plant tissue and grain due to an adequate supply of nitrogen from the soil to plant tissue occurred. The addition of FYM and organic manure improved the soil property, nutrient availability and depletion of the pH of the soil increased the content of organic carbon and by increasing the rate of infiltration (More, 1994). Better nutrient organization processes have control drop off in soil nutrient throughout volatilization, leaching and denitrification (Pathak et al., 2006), so from this the nitrogen content increased in different parts of the wheat plant.

N fertilization was achieved micronutrient uptake in wheat grain (Rongli et al., 2010). The response of different nutrient input to soil on the farmland ecosystem is variable (Yang et al., 2004). Input of chemical fertilizer would be favorable to an alleviating environment load due to nitrogen losses (Xu et al., 2002). The use of organic matter declines the negative effects on heavy N application (Xi et al., 2004). The unwarranted nitrate has been cumulated in different soil layers of dry land during long term input of excessive organic manure (Stumborg et al., 2007). Input of chemical fertilizer accumulation with organic manure was improving sustainable agriculture by maintaining the balance of microelement and declines the risk of heavy metal pollution (Kong and Ni, 2006). Input of chemical fertilizer addition to organic manure was propitious to bring together the balance carbon and nitrogen pools and then increased system productivity (Kaur et al., 2007). N fertilizers have been affected differently microbial processes such as soil C mineralization and microbial biomass C Graham et al., (2002).

Thus, in conclusion a recovered understanding of temporal and spatial variability of soil and soil total nitrogen and related factors is essential for improving sustainable land use management (McGrath and Zhang, 2003), the integrated use of organic and inorganic fertilizers was advantageous for the accumulation of soil overall nitrogen.

CONCLUSION

Nitrogen is a fundamental element for the growth and development of plants. For crops, inorganic N fertilizers have been used to increase the yields, but due to environmental concern at excessive use are dangerous and costly. Better management practices may increase NUE and finally productivity. Wheat growers need to improve NUE by approving soil testing and also needs knowledge about the application of N fertilizers, and adopting the integrated use of the N that gives a sustainable supply of nitrogen. However, it is our opinion that the use integrated sources of nitrogen like organic and inorganic, that is less susceptible to losses, and improved N application or more efficient utilization of the N taken up for grain formation and for tissue strength. The combination of better N management practices and more efficient methods should bring about a moderate N application use and decrease its losses.

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