Original Article

Asian J Agri Biol, 2013, 1(3):141-148.

CROP STAND AND PHENOLOGY OF WHEAT AS AFFECTED BY INTEGRATED USE OF ORGANIC AND INORGANIC FERTILIZERS

Sajjad Khan[1*], Shad Khan Khalil[1], Amanullah[1], Zahir Shah[2]

[1]*Department of Agronomy, University of Agriculture, Peshawar, Pakistan*

[2]*Department of Soil and Environmental Sciences, University of Agriculture, Peshawar, Pakistan*

ABSTRACT

Integrated use of organic and inorganic fertilizers play a vital role in the establishment of good crop stand and phenology. In this regard a field experiment was conducted at Livestock Research and Development Station, Surezai, Peshawar, for two crops seasons 2010-11 and 2011-12. The experiment was laid out in randomized complete block design with four replications. Experimental treatments consisted of poultry manure (2, 4 and 6 ton ha^{-1}) farm yard manure (2, 4 and 6 ton ha^{-1}) and nitrogen (60 and 90 kg N ha^{-1}). Eighteen different combinations of organic and inorganic fertilizers were applied to wheat crop. Poultry manure, farm yard manure and nitrogen significantly affected, leaves tiller^{-1}, plant height, spike length and days to maturity. Higher leaves tiller^{-1}, plant height and more days to maturity was observed with application of 6 tons poultry manure, 6 tons farm yard manure ha^{-1} and 60 kg N ha^{-1}, while poor crop stand and phonological characteristics were observed in control plots. Good crop stand and phenological characteristics were observed with integrated application of organic and inorganic fertilizers. It is concluded that a combine dose of 6 ton poultry manure, 6 tons farm yard manure ha^{-1} and 90 kg N ha^{-1} is recommended for good crop stand and phenology in wheat.

Keywords: Wheat crop stand, Phenology, Poultry manure, Farm Yard Manure, Nitrogen

INTRODUCTION

Wheat (*Triticum aestivum* L.) the so called "King of Cereals" is the world leading food crop. In Pakistan, it ranks first among the cereal crops and occupies about 66% of the annual food cropped area. It is the staple food for the people of Pakistan and meets the major dietary requirements, supplies about 60% of the calories and protein of the average diet (Khalil and Jan, 2002). Wheat is an important staple food and most widely grown cereal of the world. The dependence of large population on this food crop and increasing population of the world requires much more wheat to be produced (Rana *et al*. 2013a).

Wheat production is affected by different factors such as climatic condition, irrigation, fertilizers and soil fertility although plant scientist have developed a lot of high yielding varieties (Rana *et al*., 2013b). Among fertilizers, organic fertilizers are most important because they besides nutrition increase soil physical and chemical conditions. Sushila and Gajendra (2000) indicated that application of farmyard manure (FYM) increased the growth, yield and water use efficiency of wheat under limited water supply.

Application of organic materials alone or in combination with inorganic fertilizer helped in proper nutrition and maintenance of soil fertility (Salim *et al*., 1988; Talashiker and Rinal, 1986). Hussain *et al*. (1988) reported that organic manures increased the efficiency of chemical fertilizers. Beneficial effects of farm yard manure on crop production through improved fertility and physical properties of soil are established facts.

Poultry manure is an excellent organic fertilizer, as it contains high nitrogen, phosphorus, potassium and other essential nutrients. In contrast to mineral fertilizer, it adds organic matter to soil which improves soil structures, nutrient retention, aeration, soil moisture holding capacity, and water infiltration (Deksissa *et al*., 2008).

A large amount of animal waste is produced in Pakistan every year and the bulk of it is applied to agricultural lands. It has been estimated that about 1.5 million tones of nutrients are available from FYM in the country. About 50 percent of the dung remains uncollected and out of collected animals dung about 50 per cent is used as fuel. Similarly poultry production is an important and growing industry in Pakistan and use of poultry manure as a crop N resource

**Corresponding author:* e-mail: agronomist_kpk@yahoo.com

is increasing. Poultry manure has a higher nutrient content than livestock manure. According to estimates the available poultry manure can contribute about 101,000 tones of nitrogen, 58,000 tones of phosphorous and 26,000 tones of potash.

Keeping the above problems of wheat production and benefits of integrated use of organic and inorganic fertilizers in mind the present research project was conducted to investigate the integrated effect of organic and inorganic fertilizers on the crop stand and phenology of wheat.

MATERIALS AND METHODS

The experiment was conducted at Livestock Research and Development Station Surezai Peshawar from 2010 to 2012. The site is located at 34^0 N and 71.33^0 E at an altitude of 490 m above sea level in Khyber Pakhtunkhwa, Pakistan. The experimental site has a warm to hot, subtropical continental climate with mean annual rainfall less than 350 mm. The soil of the experimental site belongs to Tarnab series fine silty with mixed hyperthermic Udic Ustept of clay loam and pH ranges from 7.7-8.0. The soil is deficient in nitrogen and contains less than one percent organic matter. Soil and organic sources analysis for nitrogen, phosphorus and potash are given following.

Table 1: Soil and Organic Sources Analysis for Nitrogen, Phosphorus and Potash

Source	% N	P_2O_5 mg kg^{-1}	K_2O mg kg^{-1}
Soil	0.04	6.00	75.00
Poultry Manure	2.80	2.84 %	2.30 %
Farm Yard Manure	1.08	0.20 %	0.45 %

The experiment was conducted in Randomized Complete Block Design with four replications. Plot size was 1.8x4 m^2 having six rows and 30 cm apart. Wheat variety Fakhri Sarhad was sown @ 120 kg ha$^{-1.}$ All other agronomic practices including hoeing, weeding and irrigation were uniformly applied to each plot. Urea was applied as nitrogen source. Nitrogen was applied in two split doses one at sowing and other after first irrigation.

Following treatments and their levels were used in the experiment

Poultry manure (2, 4 and 6 ton ha^{-1}) farm yard manure (2, 4 and 6 ton ha^{-1}) and nitrogen (60 and 90 kg N ha^{-1}). Following eighteen different combinations of organic and inorganic fertilizer were made.

Treatments	PM ton ha^{-1}	FYM ton ha^{-1}	N Kg ha^{-1}
T1	0	0	0
T2	2	2	60
T3	2	4	90
T4	2	6	60
T5	2	2	90
T6	2	4	60
T7	2	6	90
T8	4	2	60
T9	4	4	90
T10	4	6	60
T11	4	2	90
T12	4	4	60
T13	6	6	90
T14	6	2	60
T15	6	4	90
T16	6	6	60
T17	6	2	90
T18	6	4	60
T19	6	6	90

Days to emergence were recorded by counting the days taken from the date of sowing to the date, when 70 – 80% emergence was completed in each treatment. Emergence m^{-2} was recorded by counting the number of seedling emerged in two central rows (when almost all the seedling emerged in each subplot) and were converted into square meter accordingly. Plant height data were recorded in randomly selected 10 plants in each plot and the height was then averaged. Leaves tillers^{-1} were recorded by counting the numbers of leaves in randomly selected 10 tillers in central two rows of each plot. Spike length data were recorded in randomly selected 10 spikes in each plot and was averaged. Days to physiological maturity were recorded by counting days from date of sowing to the date when loss of the green color of the crop was indicated in each plot.

The data were statistically analyzed using analysis of variance appropriate for randomized complete block design. Combine analysis was performed to detect the variation between the years. Means were separated using LSD test at 0.05 level of probability (Steel and Torrie, 1984).

RESULTS

Days to emergence

Statistical analysis of the data revealed that year (Y) significantly affected days to emergence while organic and inorganic sources and their interactions were not significant for days to emergence (Table 2). Emergence m^{-2} was not significantly affected by nitrogen, sulfur ratio while its interactive effects were also non significantly affected emergence m^{-2}. It might be due to genetic potential of variety for germination. For emergence, seed uses its own endosperm or reserved food for its growth until it becomes autotrophic. Mean values for years shows those maximum days to emergence (12) were taken in first year (2010-11) while minimum days to emergence (10) were taken in second year (2011-12). More days to emergence in first year (2010-11) may be due to low soil temperature (3^0 C less than 2011-12) during emergence period which may slow down the speed of emergence.

Emergence m^{-2}

Analysis of the data showed that year (Y) and Control (C) Vs Rest significantly affected emergence m^{-2} (Table 2) while organic and inorganic sources and their interaction showed non significant effect on emergence m^{-2}. Emergence m^{-2} is dependent on quality of seed, soil moisture, temperature and proper oxygen supply. Organic or inorganic fertilizers have no key role in seed germination. Mean values for years revealed that more emergence m^{-2} (161) was recorded in second year (2011-12) as compared to (155) in first year (2010-11). More emergence m^{-2} in second year may be due to high soil temperature (3^0 C more than 2010-11) during emergence period. Among control Vs rest higher emergence m^{-2} (158) was recorded for treated plots compared to control plots, while low emergence m^{-2} (148) was recorded for control plots.

Leaves tiller^{-1}

Statistical analysis of the data revealed that farm yard manure (FYM), FYM x N, Control (C) Vs Rest and PM x FYM x N significantly affected leaves tiller^{-1}(table 2). All other organic sources and their interaction were not significant for leaves tiller^{-1}.

In case of FYM maximum leaves tiller^{-1} (5.38) were recorded in treatments which received 6 tons FYM ha^{-1} while minimum leaves tiller^{-1} (5.23) were recorded at 4 tons FYM ha^{-1}. This increase in number of leaves is due to more vegetative growth due to more organic fertilizer. Ahmad *et al*. (2011) obtained same results who reported that increasing level of FYM increased leaves tiller^{-1}.In case of control Vs rest higher leaves tiller^{-1} (5.29) were recorded for treated plots as compare to control plots, while in control plots (4.92) leaves tiller^{-1} were recorded.

Interaction between FYM x N shows that increase of FYM and N levels linearly increased number of leaves per tiller up to 6 tons FYM ha^{-1} and 90 kg N ha^{-1}. In case of interaction PM x FYM x N leaves tiller^{-1}increased with increased level of FYM at 2 tons PM ha^{-1} with 60 kg N ha^{-1} while with 90 kg N ha^{-1} leaves tiller^{-1} decreased with increased level of FYM at 4 tone PM ha^{-1}and increased (fig. 4).

Plant height (cm)

Plant height was significantly affected by year (Y), poultry manure (PM), farm yard manure (FYM), nitrogen levels (N), FYM x N, Year x treatments (Y x T), Control (C) Vs Rest and Y x C x Rest (Table 2). Mean values for years revealed that plants attained more height (105.4 cm) in second year (2011-12) as compared to (99.4 cm) in first year (2010-11). Taller plants in year two may be due to carrying over effect of nitrogen from the organic sources applied to the previous wheat crop.

Means values for PM shows that maximum plant height (103.52 cm) was recorded at 6 tons PM ha^{-1} while minimum plant height (100.89 cm) was recorded at 2 tons PM ha^{-1}. These results indicate that increasing level of PM increased plant height of wheat. Similarly means values for FYM shows that maximum plant height (103.87 cm) was recorded at 6 tons FYM ha^{-1} while minimum plant height (101.93 cm) was recorded at 4 tons FYM ha^{-1}. These results indicate that increasing level of FYM increased plant height of wheat. As PM and FYM has high N content and N is responsible for vegetative growth therefore plant height increased. These results are in line with Kumar and Puri (2001) and Song *et al*. (1998) who reported that increasing level of FYM and PM increased plant height.

In case of nitrogen level maximum plant height (103.64 cm) was recorded in plots which received 90 kg N ha^{-1} while minimum plant height (101.17 cm) was recorded in plots which received 60 kg N ha^{-1}. These results indicate that increasing level of N increased plant height. These results are in line with Gerri (1993) who reported that increasing level of N increased plant height. In case of control Vs rest higher plant height (102.40 cm) was recorded for treated plots as compare to control plots, while very low plant height (76.40 cm) was recorded for control plots. Interaction between FYM x N shows that linear increase of FYM with 90 kg N ha^{-1}linearly increased plant height up to 6 tons FYM ha^{-1} (fig 1) while incase of FYM with 60 kg N ha^{-1} plant height decreased upto 4 tons FYM ha^{-1} and then increased (fig. 5).

Spike length (cm)

Data regarding to spike length is presented in Table 13. Statistical analysis of the data revealed that year (Y), poultry manure (PM), farm yard manure (FYM) nitrogen levels (N), Year x treatments (Y x T), Control (C) Vs Rest and Y x C x Rest significantly affected spike length. Mean values for years revealed that more spike length (10.72 cm) was recorded in first year (2010-11) as compared to (10.25 cm) second year (2011-12). More spike length in year one may be in year two may be due to more vegetative growth due to carrying over effect of nitrogen from the organic sources applied to the previous wheat crop.

Means values for poultry manure shows that maximum spike length (10.78 cm) was recorded for plots which received 6 tons PM ha^{-1} while minimum spike length (10.08 cm) was recorded in those plots which received 2 tons PM ha^{-1}. Similarly means values for FYM shows that maximum Spike length (10.70 cm) was recorded at 6 tons FYM ha^{-1} while minimum Spike length (10.29 cm) was recorded at 2 tons FYM ha^{-1}. These results correlate with Iqbal *et al*. (2002) who reported that high level of FYM and PM increased spike length. Similar results were also reported by Singh and Agarwal (20 01), and Zeidan and Kramany (2001)

Mean values nitrogen levels showed that maximum Spike length (10.62 cm) was recorded in plots which received 90 kg N ha^{-1} while minimum Spike length (10.35 cm) was recorded in plots which received 60 kg N ha^{-1}. Among control Vs rest higher Spike length (8.10 cm) was recorded for treated plots as compare (10.48 cm) for control plots. Same results obtained by Khan *et al*. (2005) who reported longer spikes by the application of mineral N and organic N. The lowest spike length was noted in control.

Days to maturity

Days to maturity were significantly affected by year (Y), poultry manure (PM), farm yard manure (FYM), nitrogen levels (N), PM x N, Year x Nitrogen (Y x N), Y x FYM, Control (C) Vs Rest and Y x C x Rest (Table 2). Mean values for years revealed that more days to maturity (172) were recorded in second year (2011-12) as compared to (171) days in first year (2010-11). More days to maturity in year two may be due to more vegetative growth, more leaf area, more biological yield and more plant height because of more residual effect of organic fertilizers.

Means values PM shows that maximum days to maturity (173) was recorded at 6 tons PM ha^{-1} while minimum days to maturity (170) was recorded at 2 tons PM ha^{-1}. Similarly means values for FYM shows that maximum days to maturity (172) was recorded in treatments which received 6 tons FYM ha^{-1} while minimum days to maturity (170) was recorded in treatments which received 2 tons FYM ha^{-1}. Means values of days to maturity for Nitrogen levels showed that maximum days to maturity (172) was recorded in plots which received 90 kg N ha^{-1} N while minimum days to maturity (171) was recorded in plots which received 60 kg N ha^{-1}. Among control Vs rest higher days to maturity (181) was recorded for treated plots as compare to control plots, while very low days to maturity (163) was recorded for control plots. These results indicate that high level of PM and FYM increased days to maturity of wheat as high level of PM, N and FYM increased days to maturity due to more vegetative growth. These are in line with Iqtidar *et al*. (2006) and Ayoub *et al*. (1994). Interaction between PM x N shows that increase of PM and N levels linearly increased days to maturity up to 6 tons FYM ha^{-1} and 90 kg N ha^{-1} (Fig. 6). Incase of YxFYM interaction days to maturity were increased by increasing levels of FYM in first year (2010-11) while in second year (2011-12) increasing levels of FYM decreased days to maturity (fig. 7). Interaction Y x N is gieven in fig. 8 shows that in first year (2010-11) days to maturity were same for both levels of nitrogen but in second year (2011-12) days to maturity increased with increase levels of nitrogen.

Table 2: Days to emergence, emergence m^{-2}, leaves tiller^{-1} plant height, spike length and days to maturity of wheat as affected by organic and inorganic fertilizers

Years	Days to emergence	Emergence m^{-2}	Leaves tiller^{-1}	Plant height (cm)	Spike length (cm)	Days to maturity
2010-11	12.35a	155a	5.30	99.44 b	10.25b	171b
2011-12	9.99b	161b	5.29	105.36 a	10.72a	172a
LSD	0.27	4.6	ns	0.86	.092	0.98
Poultry manure (ton ha^{-1})						
2	11.29	153a	5.26	100.89 b	10.08b	170b
4	11.15	155a	5.28	102.80 a	10.60a	171b
6	11.06	166b	5.33	103.52 a	10.78a	173a
LSD	Ns	5.66	ns	1.1	.1130	1.20
Farm yard manure (ton ha^{-1})						
2	11.10	156a	5.27b	101.93 b	10.29c	170b
4	11.23	157a	5.23b	101.41 b	10.46b	172a
6	11.17	162b	5.38a	103.87 a	10.70a	172a
LSD	ns	5.64	.071	1.05	.11	1.21
Nitrogen (kg ha^{-1})						
60	11.22	153a	5.28	101.17 b	10.35b	171 b
90	11.11	156 b	5.30	103.64 a	10.62a	172 a
LSD	ns	4.60	ns	.85	.092	.98
Control vs. Rest						
Control	11.50	148	4.93	76.40	8.10	163
Rest	11.16	158	5.29	102.40	10.48	171
Interactions						
PMxFYM	ns	Ns	ns	Ns	ns	Ns
PMxN	ns	Ns	ns	Ns	ns	Fig. 6*
FYMxN	ns	Ns	fig. 3*	fig. 5*	ns	Ns
PMxFYMxN	ns	Ns	fig. 4*	Ns	ns	ns
YxPM	ns	Ns	ns	Ns	ns	ns
YxFYM	ns	Ns	ns	Ns	ns	fig. 7*
YxN	ns	Ns	ns	Ns	ns	fig. 8*
YxPMxFYM	ns	Ns	ns	Ns	ns	ns
YxPMxN	ns	Ns	ns	Ns	ns	ns
YxFYMxN	ns	Ns	ns	Ns	ns	ns
YxPMxFYMxN	ns	Ns	ns	Ns	ns	ns

NS= Not significant *= Significant at P≤0.05

Mean followed by same letter(s) with in the same category are not different statistically using least sig nificant difference (LSD) test at 5% level of probability.

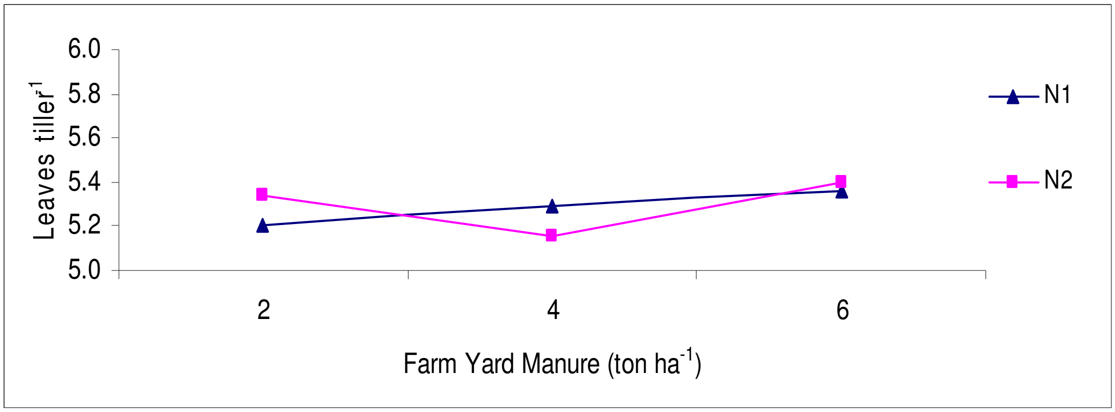

Figure 3. Leaves tiller^{-1} as affected by interactive effect of farm yard manure and nitrogen

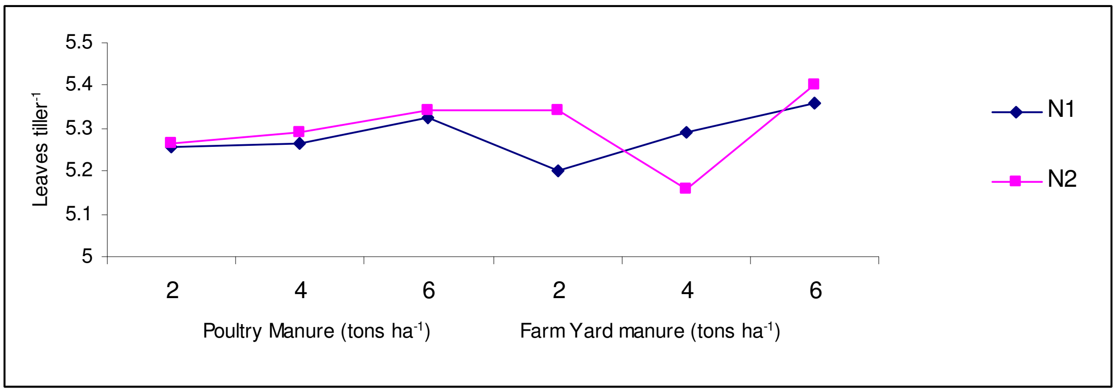

Figure 4. Leaves tiller^{-1} as affected by interactive effect of poultry manure, farm yard manure and nitrogen

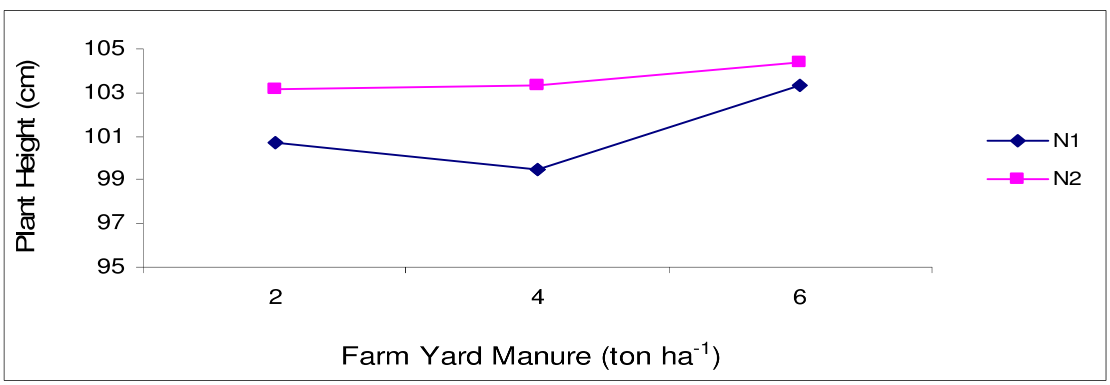

Figure 5. Plant height as affected by interactive effect of farm yard manure nitrogen

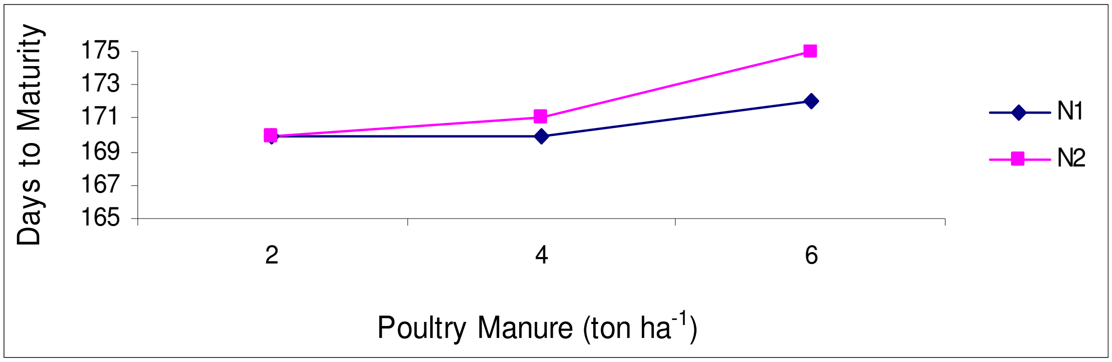

Figure 6. Days to maturity as affected by interactive effect of poultry manure and nitrogen

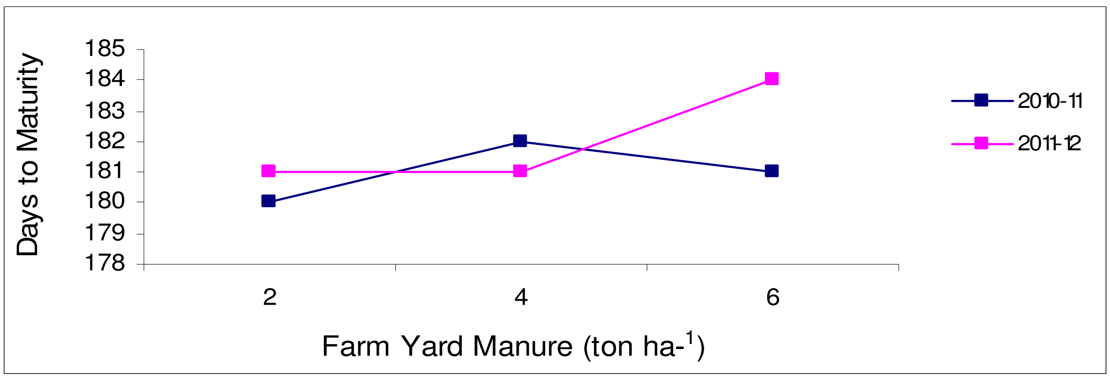

Figure 7. Days to maturity as affected by interactive effect year X poultry manure

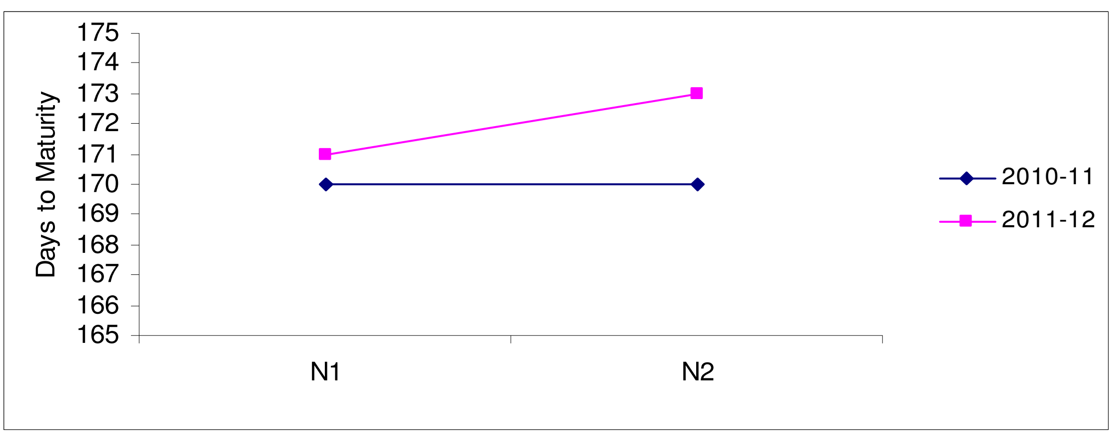

Figure 8. Days to maturity as affected by interactive effect year and nitrogen

RECOMMENDATIONS

It is concluded from the present study that integrated use of organic and inorganic sources are recommended for good crop stand and phenology. The plots which received combined dose of 6 tons poultry manure 6 tons farm yard manure and 90 kg nitrogen produced higher yield. Our results suggested that the integrated use of urea PM and FYM performed better in terms of improving crop stand and phenology of wheat.

REFERENCES

Ahmad AH, Wahid A, Khalid F, Fiaz K, Zamir MSI, 2011. Impact of organic and inorganic sources of nitrogen and phosphorus fertilizers on growth, yield and quality of forage oat (avena sativa l.). Cercetări Agronomice în Moldova.Vol. XLIV , No. 3 (147) .

Ayoub, M., S. Guertin, S. Lussier and D.L. Smith. 1994. Timing and level of nitrogen fertilizer effects on spring wheat yield in eastern Canada. Crop Sci., 34: 748-756.

Deksissa T, Short I, and Allen J, 2008. Effect of Soil Amendment with Compost on Growth and Water Use efficiency of Amaranth. In: *Proceedings of the UCOWR/NIWR Annual Conference: International Water Resources: Challenges for the 21st Century and Water Resources Education*, July 22 – 24, 2008, Durham, NC.

Hussain T, Jullani G, and Javaid MA, 1992. Crop production with brackish ground water throughintegrated nutrient management system. Journal of Drain and Recycling 491: 49–59.

Hussain T, G. Jullani, and Iqbal MZ, 1988. Integrated use of organic and inorganic nitrogen fertilizer in rice- wheat cropping system. Pakistan Journal of Soil Sci. 3: 19-23.

Iqbal AS, Abbasi MK and Rasool G, 2002. Integrated plant nutrition sys tem (IPNS) in wheat under rain fed condition of Rawalkot Azad Jammu an d Kashmir Pak. J. Soil Sc i. 21: 79-86.

Iqtidar H, Ayyaz KM and Ahmad KE, 2006. Bread wheat varieties as influenced by different nitrogen levels. J. Zhejiang Univer. Sci., 7: 70-78.

Khalil IA and Jan_A, 2002. Cereal crops. In: C ropping technology. A text book of Agricul ture New Million Edition. National Book F oundation. pp. 169.

Khan A, Jan A, and Alam S, 2005. Effect of nitr ogen and seed size on maize crop II: yield and yield components. J. Agric. Soc. Sci. 1(3): 18-23.

Kumar P, and Puri UK, 2001. Effect of nitrogen and farmyard manure pplication on maize (Zea mays L.) varieties. Indian J. Agron. 46(2):255-260.

Rana RM, Rehman SU, Ahmed J and Bilal M, Iqbal F, Shah MKZ, 2013a. synthetic wheat; a new hope for the hungry world . Asian J Agri Biol, 1(2):91-94.

Rana RM, Rehman SU, Ahmed J and Bilal M,2013b. A comprehensive overview of recent advances in drought stress tolerance research in wheat (Triticum aestivum L.).Asian J. Agri. Biol. 1:29-37.

Salim MS, Mian M, and Hassan M, 1988. Annual technical report of project improvement of soil productivity through biological mean. Pak. Agric. Res. Council, Islamabad.

Sharma R, Suri P, and Datt N, 2001. Integrated nutrient management in summer barley (Hordeum vulgare) in a cold desert of Himachal Pradesh Revue.Indian Journal of Agricultural Science, vol. 71. pp. 752-755.

Song YI, Ming YF, Zaohua Y and Yuan FM, 1998. A fixed location study on the effect of di fferent combination of fertilizers on biological ch aracters and yield of wint er wheat. Soil fert. Beijin g. 1: 15-18

Steel,RDG, and Torrie JH, 1984. Principles and procedures of statistics. Mecgraw Hill Book Co. Inc. New York.

Sushila R, and Gajendra G, 2000. Influence of farmyard manure, nitrogen and biofertilizers on growth yield attributes and yields of wheat under limited water supply. Indian J. of Agronomy, 45: 590-595.

Talashiker SC and Rinal OP, 1986. Studies on increasing in combination with city solid waste. J. Ind. Soc. Soil Sci. 34:780-784.

Zeidan MS, and Kramany MFE, 2001. Effect of organic manure and slow- release N-fertilizers on the productivity of wheat (Triticum aestivum L.) in sandy soil. Acta Agronomica Hungarica. 49(4): 379- 385.