# MORPHOLOGICAL AND SOME YIELD ATTRIBUTES IN CULTIVARS OF WHEAT IN RESPONSE OF VARYING PLANTING DATES AND NITROGEN APPLICATION

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**ABSTRACT**

Morphological and yield attributes from sowing to maturity were monitored in two varieties of wheat (Pirsabaq-2005 and Khyber-87) under the influence of four sowing dates (Oct. 24th, Nov. 13th, Dec. 3rd and Dec. 23rd) and four levels of nitrogen (0, 100, 130 and 160 Kg ha$^{-1}$) at New Developmental Farm of Agricultural University, Peshawar, Pakistan during 2008-09 and 2009-10. Analysis of the two years average data indicated that all the studied characteristics were significantly affected by sowing dates and their interaction with varieties. Early and normal (Oct. 24th and Nov. 13th) seeded crops resulted best values for morphological traits including days to seedling emergence, emergence m$^{-2}$, number of tillers m$^{-2}$, non productivity tillers m$^{-2}$ grain yield and straw yield while poor crop performance concerning all the studied characteristics were recorded in late seeded condition (23$^{rd}$ December). Similarly individual effect of nitrogen was recorded significant for all above mentioned characters while their interactive effect with varieties was observed significant for all the studied traits but noted non significant for straw yield. 130 kg N ha$^{-1}$ was observed best for seedling emergence, emergence m$^{-2}$ and number of tillers m$^{-2}$ but grain and straw yield were obtained maximum at 160 kg N ha$^{-1}$. More number of non productive tillers m$^{-2}$ was founded under 0 and 100 kg N ha$^{-1}$. All parameters under study revealed that interaction of early and normal sowing with 130 kg N ha$^{-1}$ using Khyber-87 cultivar were founded best The overall findings concluded that growing wheat variety Khyber-87 on Oct. 24th and Nov. 13th having fertilized with 130 kg N ha$^{-1}$ could be more beneficial for days to seedling emergence, emergence m$^{-2}$, number of tillers m$^{-2}$, non productivity tillers m$^{-2}$ but for grain and straw yield, 160 kg N ha$^{-1}$ along with early sowing were recorded best.

**Keywords:** wheat, planting dates, nitrogen, morphological traits, grain yield.

## INTRODUCTION

Wheat (*Triticum aestivum*) is the top most dominant crop in the world as well as in Pakistan. It ranks first in area wise in the country. Nowadays the major task of wheat agronomists is to improve the productivity of this crop. The productivity of wheat crop in the region can be improve by meaningful development in the components of production technology like improvement in management practices associated with different growth stages, like germination, seedling growth, tillering, stem elongation, booting, inflorescence emergence, anthesis, milk development, dough development and ripening stages.

Research study has shown that updated and appropriate management practices are required for optimal yield. (Hickman *et al*., 1994). Planting date is on of the critical production considerations for growth, seed yield and quality. The information provided by researcher may be helpful for the recommendation of optimum sowing date in wheat production. The risk of yield losses increases with delay sowing (Ehdaie *et al*., 2001). Planting date directly related with morphological and yield traits. Mid November sowing produces highest number of tillers m$^{-2}$, spike m$^{-2}$, thousand grain weight and grain yield (Nasser 2009). Early or late sowing increases the risk of yield losses (Ehdate *et al*., 2001). Similarly biomass accumulation, grain yield, number of spikes m$^{-2}$ and thousand grain weight of wheat were increased with early (early November) sowing over late (December) sowing as reported by Aftab *et al*., (2004).

Nitrogen is one of the major plant food nutrient applied in the form of chemicals fertilizer and stimulate crop growth performance. It plays a vital role in plant life. Nitrogen application has significant effect on morphological characteristics as well as yield and yield components (Iqtidar *et al*., 2006). Similarly greater nitrogen supply increase shoot biomass by 29 %, grain yield by 16 %, protein content by 5% but decrease harvest index by 10 % (Ehdaie *et al*., 2001).

Therefore, the present contribution describes the response of planting dates and nitrogen application towards some morphological and yield traits of wheat cultivars.

## MATERIALS AND METHODS

Two years field experiment entitled "morphological and some yield attributes in cultivars of wheat in response of planting dates and nitrogen application" were made at New Developmental Farm of Khyber Pakhtunkhawa Agricultural University Peshawar, Pakistan during the two successive seasons 2008/09 and 2009/10. Soil has clay loam texture, low in organic matter (0.87 %), extractable phosphorus (6.57 mg kg$^{-1}$), exchangeable potassium (121 mg kg$^{-1}$) and alkaline in nature (pH 8.2) (Amanullah *et al*., 2009b). A trial layout consisted of Randomized Complete Block Design having split plot arrangement with four replications. The experiment comprised two factors. Factor A contained four sowing dates (Oct. 24th, Nov. 13th, Dec. 3rd and Dec. 23rd) with 20 days intervals randomly kept in main plots and factor B included two varieties (Pirsabaq-2005 and Khyber- 87) and four nitrogen levels (0, 100, 130 and 160 kg $ha^{-1}$) were randomized in the sub plots each measuring 5 x 3m. The amount of nitrogen was split into two portions. Half dose of nitrogen in the form of urea (46 % N) and whole dose of phosphorus and potash in the form of triple super phosphate (46 % $P_2O_5$) and potassium chloride (60 % $K_2O$) respectively were applied immediately at sowing time. The remaining half dose of nitrogen was given at second irrigation. Data recording days to seedling emergence was determined from the date of sowing till the date when 70-75 % plants emerged in each sub-plot. Each sub-plot is observed randomly at three different spots for emergence in per square meter sample area. Total tillers $m^{-2}$ were calculated by counting number of tillers in an area of one meter row length randomly selected in three central rows of each sub-plot at tillering stage and their mean was then recorded for tillers $m^{-2}$. In the same way non productive tillers $m^{-2}$ were also observed. Six central rows in each sub-plot were harvested and then threshed manually for recording grain yield kg $ha^{-1}$. The difference between biological yield and grain yield was used for measuring straw yield (kg $ha^{-1}$).

All the data collected during two years were subjected to statistical analyses using MSTAT-C. Least Significant Difference Test at 5 % probability was used to test the significant differences among mean values of each treatment (Steel and Torrie, 1997).

## RESULTS AND DISCUSSIONS

### Days to seedling emergence

Results regarding days to seedling emergence (Table-1) of two wheat varieties were observed in two years. Sowing dates (D), nitrogen levels (N) and their interaction with varieties (V) were significantly affect the days to seedling emergence. Similarly significant differences were found among the interaction of sowing dates with nitrogen (D x N), with years and varieties (Y x D x V) and with varieties and nitrogen (D x V x N) for days to seedling emergence. Late sown plots (23rd December) took maximum days to seedling emergence (15.31) while early planting (24th October) took minimum days to seedling emergence (7.89). The possible reason could be high temperature during early sowing which shortened the days required for seedling emergence and low temperature during late sowing extended the days to seedling emergence. The same report was given by Benjamin (1990) who observed that low temperature during emergence and seedling growth has detrimental effect on the crop establishment and productivity. Similarly the days to emergence of both varieties (Pirsabaq-2005 and Khyber-87) of wheat were exceeding under late planting (23rd December) and reduce under early sowing (D x V interaction). The individual comparison and interaction (N x V) of treatment means reflect that different levels of nitrogen produce minimum differences in days to seedling emergence of both varieties. These results are also in line with Hameed *et al*., (2003) who determined that nitrogen dose at 60 kg $ha^{-1}$ increase days to emergence while 120 kg N $ha^{-1}$ decreases the days to emergence of wheat. Interactions D x N (Fig-1A) and D x V x N (Fig-2) were also explained through trend lines. The other interactions were non significant responses for days to seedling emergence of wheat.

### Emergence $m^{-2}$

The main effect of planting dates (D), nitrogen levels (N) and there interactive effect with varieties (V) was significantly assessed for emergence $m^{-2}$ during two years (Table-1). Statistical analysis revealed that early sowing (24th October) accelerated the emergence (108.30 $m^{-2}$) while late sowing (23rd December) declined the seedling emergence (77.31 $m^{-2}$). Khyber-87 in term of emergence (109.75 $m^{-2}$) performed better under early planting (24th October) and produce lower seedling emergence (74.06 $m^{-2}$) in delay planting (23rd December). Variation in emergence of varieties might be due to their genetic diversity as reported by Aslam *et al*., (2003). The individual comparison of treatments means shows that 65 kg N $ha^{-1}$ (half of 130 kg) produce maximum emergence (91.75 $m^{-2}$) as compared to control treatment (85.86 $m^{-2}$). These results are in line with Hossain *et al*., (2006) who determined that 75 kg N $ha^{-1}$ (half of 150 kg) gave maximum emergence $m^{-2}$. Khyber-87 responds more when fertilized with 80 kg N $ha^{-1}$ (half of 160 kg). The interactions of D x N and D x V x N were contributed significantly towards emergence $m^{-2}$ (Fig-1B and Fig-3). The other interactions were statistically non significant.

### Total number of tillers $m^{-2}$

The statistical analysis of the data showed that sowing dates (D), nitrogen levels (N) and their interaction with varieties (D x V and N x V) were detected significant differences ($P \leq 0.05$) among the mean values of total tillers $m^{-2}$ (Table-1). The main effect of year (Y) and their interactions with other factors indicated non significant ($P \geq 0.05$) response for the studied character. Maximum tillers $m^{-2}$ (376.11) were achieved under early sown plots (24th October) and reduces the tillers $m^{-2}$ (327.89) with delay sowing (23rd December). These results may be justified by poor crop establishment due to low temperature and winter injury under late sowing and so the low temperature fails to fulfill the tillering requirement. These results are in line with the findings of Murungu and Madanzi, (2010) who observed that late sowing reduces the tiller number. Khyber-87 contributed more in term of tillers production (401.44 $m^{-2}$) by early sowing while Pirsabaq-2005 loss their performance (277.81 $m^{-2}$) in delay sowing. The genetic diversity of the cultivars creates differences in response to various sowing dates (Shah *et al*., 2006). The plots fertilized with 130 kg N $ha^{-1}$ yielded maximum tillers $m^{-2}$ (395.67) while plots having no

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fertilizer (0 kg N $ha^{-1}$) were observed for minimum tillers $m^{-2}$ (269.06). The increased tillers $m^{-2}$ at higher level of nitrogen may be due to vigorous growth and development of wheat. These results are matched with the work of Rehman *et al*., (2010)). Both varieties responded differently to various levels of nitrogen. 100 and 130 kg $ha^{-1}$ was found best for Khyber -87 and for Pirsabaq-2005 respectively. These results were matched with Khalifa *et al*., (2009) conclusion. The other significant interactions of D x N was shown by trend line in Fig. 1C.

**Non productive tillers $m^{-2}$**

The main effect of various planting dates listed in Table-1 shows significant response towards non productive tillers. Non productive tillers (73.83 $m^{-2}$) were higher in December 23rd sowing and lower (23.84 $m^{-2}$) in October and November sowing. This may be justified by lower days to heading, forced maturity and short grain filling period during late sown condition which in turn increases the number of non productive tillers. These results are in line with those of Tashiro and Wardlaw (1999). Significant differences among the interaction of sowing dates and varieties were observed for non productive tillers. Higher non productive tillers (93.47 $m^{-2}$) in Pirsabaq-2005 were produced in late sowing as compared to early sowing (23.5 $m^{-2}$). Genetic variation and short anthesis period of varieties under delay sowing are the possible contributing factors. Significant variation among the various nitrogen levels and their interaction with varieties were detected for the trait. 130 and 160 kg N $ha^{-1}$ reduces the production of un productive tillers as compared to other levels (0 and 100 kg N $ha^{-1}$). Pirsabaq-2005 responded more to minimum (100 kg $ha^{-1}$ and control (0 kg $ha^{-1}$) levels of nitrogen in term of higher non productive tillers (58.10 and 54.06 $m^{-2}$) respectively than maximum levels. More nutrients are required for fertile tillers production and when there is shortage of nutrients then the risk of non effective tillers per unit area become increases. The significant interaction like D x N are explained through graph (Fig. 1D). The remaining interactions were non significantly assessed.

**Grain yield (kg $ha^{-1}$)**

The data (Table-1) revealed that highly significant values for grain yield kg $ha^{-1}$ were recorded under the main effect of sowing dates, nitrogen levels and interactive effect with varieties. Highest grain yield (3681.25 kg $ha^{-1}$) was recorded on 24th October sowing while late sowing in December decreases the grain yield (1117.17 kg $ha^{-1}$). It might be due to higher number of spikes $m^{-2}$, number of grains $spike^{-1}$ and grain weight under early sowing. These results are in agreements with the finding of Akhtar *et al.*, (2006). Both cultivars performed differently in term of grain yield at different sowing dates. Khyber-87 produced maximum grain yield (3753.125 kg $ha^{-1}$) under early sowing (24th October) as compared to delay sowing (1103.813 kg $ha^{-1}$). The superiority of Khyber-87 in grain yield is due to that it has more spikes $m^{-2}$ and number of grains $spike^{-1}$. The similar observation was recorded by Dokuyucu *et al*., (2004). 160 kg N $ha^{-1}$ produced maximum grain yield (2847.39 kg $ha^{-1}$) while wheat crop without fertilization (0 kg N $ha^{-1}$) produce minimum yield (1347 kg $ha^{-1}$). Nutrients invested as assimilates in sink production (grains) and contributing in the increase of grain yield. Similar evidence was provided by Mosalem *et al*., (2006) who documented that nitrogen fertilizations increase growth traits, yield and its components. Similarly nitrogen fertilization bringing significant variation in grain yield of both varieties. Khyber-87 produced higher grain yield (2994.781 kg $ha^{-1}$) at 130 kg N $ha^{-1}$ while lowest grain yield (1208.688 kg $ha^{-1}$) was recorded under no fertilization. Trend lines (Figure-1E) show significant association among the interaction of D x N for grain yield. Grain yield have no significant response across the years and other interactions.

**Straw yield (kg $ha^{-1}$)**

The data revealed that main effect of sowing dates and interactive effect with varieties were statistically significant for straw yield (Table-1). Normal planting contributed more in the highest production of straw yield kg $ha^{-1}$ (10581.30) while delay sowing negatively affects the straw yield (3977.70 kg $ha^{-1}$). These results are in accordance with Qasim *et al*., (2008) who observed higher straw yield in early sowing due to more number of tillers. Both Varieties perform better and reflect positive association among sowing dates and straw yield. Maximum straw yield (10895.41 kg $ha^{-1}$) was recorded in Pirsabaq-2005 under normal planting date and the same variety was observed for low straw yield (3843.255 kg $ha^{-1}$) under late sowing. Significant differences were found among the mean values of straw yield under the effect of different levels of nitrogen. Higher nitrogen application (160 kg $ha^{-1}$) has more contribution in higher straw yield production (9098.65 kg $ha^{-1}$) as compared to control treatment (5302.97 kg $ha^{-1}$). These results were strongly supported by Hussain and Radwan (2001). The significant interaction D x N was explained by Figure-1F, while other interactions have no effect on the straw yield.

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**Table-1.** Mean table for days to seedling emergence, emergence $m^{-2}$, total number of tillers $m^{-2}$, non productive tillers $m^{-2}$, grain yield (kg $ha^{-1}$) and straw yield (kg $ha^{-1}$) of wheat varieties as affected by sowing dates and nitrogen fertilization.

| | **Days to seedling emergence** | | | **Emergence** ($m^{-2}$) | | | **Total tillers** ($m^{-2}$) | | | **Non prod. tillers** ($m^{-2}$) | | | **Grain yield** (kg $ha^{-1}$) | | | **Straw yield** (kg $ha^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatments | V1 | V2 | Mean | V1 | V2 | Mean | V1 | V2 | Mean | V1 | V2 | Mean | V1 | V2 | Mean | V1 | V2 | Mean |
| 24th October | 8a | 8e | 8d | 107 a | 110a | 108a | 351cd | 401a | 376a | 23e | 24e | 24d | 3609.38a | 3753.13a | 3681.25a | 9238.31b | 8668.75 bc | 8953.53b |
| 13th November | 12d | 13d | 12 c | 86cd | 97b | 91b | 364bc | 363bc | 364b | 31d | 36d | 33c | 2448.44b | 2782.81b | 2615.63b | 10895.41a | 10267.19a | 10581.30a |
| 3rd December | 14b | 12c | 14b | 76ef | 89c | 82c | 338d | 356c | 347c | 42c | 45c | 43b | 2620.31b | 2076.56c | 2348.44c | 7332.81d | 8164.06c | 7748.44c |
| 23rd December | 15a | 16a | 15a | 81de | 76f | 77c | 278e | 378b | 328d | 94a | 54b | 74a | 1130.53d | 1103.81d | 1117.17d | 3843.26 e | 4112.15e | 3977.70d |
| 0 kg N $ha^{-1}$ | 12b | 12b | 12b | 83d | 89bc | 86b | 249f | 290e | 269c | 54a | 47b | 50a | 1490.97c | 1208.69 c | 1347.83b | 5532.50 | 5073.44 | 5302.97 c |
| 100 kg N $ha^{-1}$ | 12b | 12b | 12b | 90b | 91b | 91a | 318d | 423a | 371b | 58a | 38c | 48a | 2639.41b | 2879.69ab | 2759.55a | 7987.33 | 8007.45 | 7997.39b |
| 130 kg N $ha^{-1}$ | 13a | 1b | 13a | 92b | 91b | 92a | 396b | 395b | 396a | 39c | 38c | 38b | 2620.66b | 2994.78a | 2807.72a | 8664.61 | 9095.32 | 8879.96a |
| 160 kg N $ha^{-1}$ | 13a | 12b | 12ab | 84cd | 98a | 91a | 368c | 391b | 379b | 38c | 38c | 38b | 2827.25 ab | 2867.53ab | 2847.39a | 9125.36 | 9035.94 | 9080.65a |
| 2008-09 | 13 | 12 | 11.96 | 87 | 87 | 91 | 330 | 336 | 354 | 48 | 40 | 44 | 2505.03 | 2591.83 | 2548.43 | 8313.08 | 8213.89 | 8263.48 |
| 2009-10 | 13 | 12 | 12.48 | 94 | 91 | 89 | 378 | 372 | 354 | 47 | 40 | 43 | 2381.89 | 2279.69 | 2332.41 | 7341.81 | 7392.19 | 7367.00 |
| Mean | 13 | 12 | | 87 | 92 | | 333 | 375 | | 47 | 40 | | 2486.86 | 2392.36 | | 7827.45 | 7803.04 | |
| LSD values | | 0.8952 | | | 8.125 | | | 5.159 | | | 2.343 | | | 251.2 | | | 396.4 | |
| | | 0.3612 | | | 3.642 | | | 11.86 | | | 1.916 | | | 248.5 | | | 586.5 | |
| D x V | | 0.5108 | | | 5.150 | | | 16.77 | | | 2.710 | | | 351.4 | | | 829.5 | |
| N x V | | 0.5108 | | | 5.150 | | | 16.77 | | | 2.710 | | | 351.4 | | | ----- | |
| Y x V | | ---- | | | ---- | | | ---- | | | ---- | | | ---- | | | ---- | |
| Interactions | | P-value | | | P-value | | | P-value | | | P-value | | | P-value | | | P-value | |
| Y x D | | >1 | | | >1 | | | >1 | | | >1 | | | >1 | | | >1 | |
| Y x N | | >1 | | | >1 | | | >1 | | | >1 | | | >1 | | | >1 | |
| D x N | | 0 | | | 0 | | | 0 | | | 0 | | | 0 | | | 0 | |
| Y x D x N | | >1 | | | >1 | | | >1 | | | >1 | | | >1 | | | >1 | |
| Y x D x V | | 0 | | | >1 | | | >1 | | | >1 | | | >1 | | | >1 | |
| Y x V x N | | >1 | | | >1 | | | >1 | | | >1 | | | >1 | | | >1 | |
| D x V x N | | 0.001 | | | 0.031 | | | 0 | | | 0 | | | >1 | | | >1 | |
| Y x D x V x N | | >1 | | | >1 | | | >1 | | | >1 | | | >1 | | | >1 | |

Mean of the same category followed by different letters are significantly different ($P \leq 0.05$) using LSD test.
V1 = Pirsabak-2005
V2 = Khyber-87
D = Dates of sowing
N = Nitrogen
V = Varieties
Y = Year
LSD = Least Significant Differences

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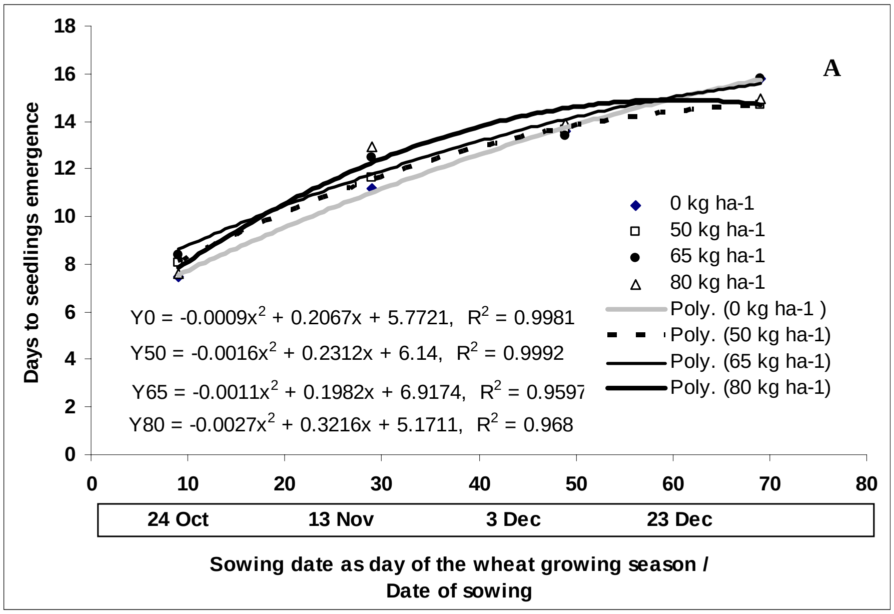
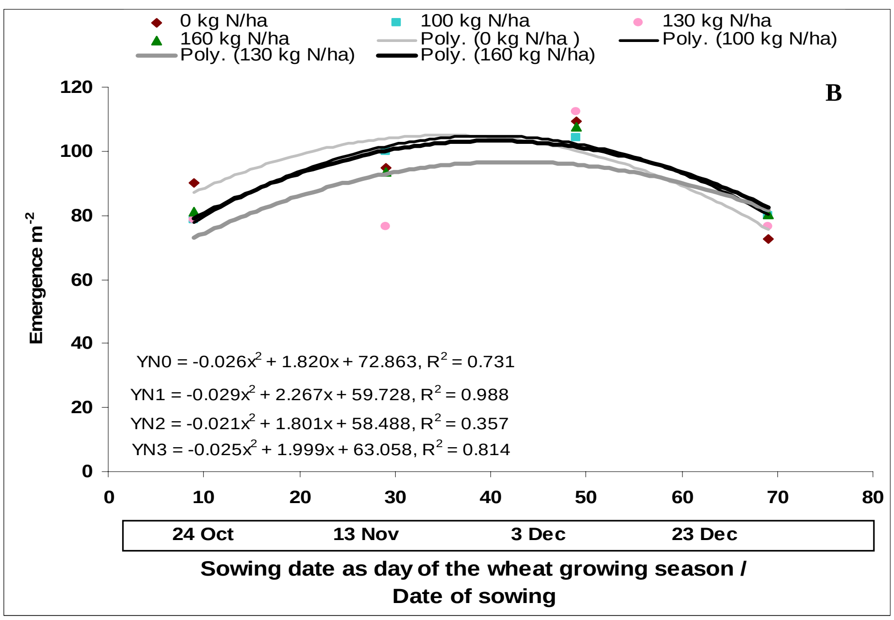
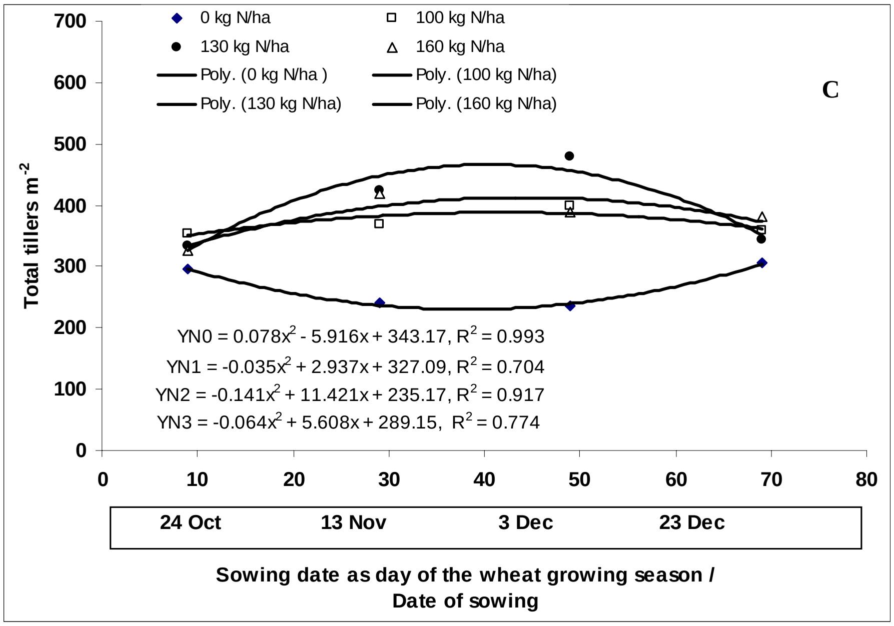
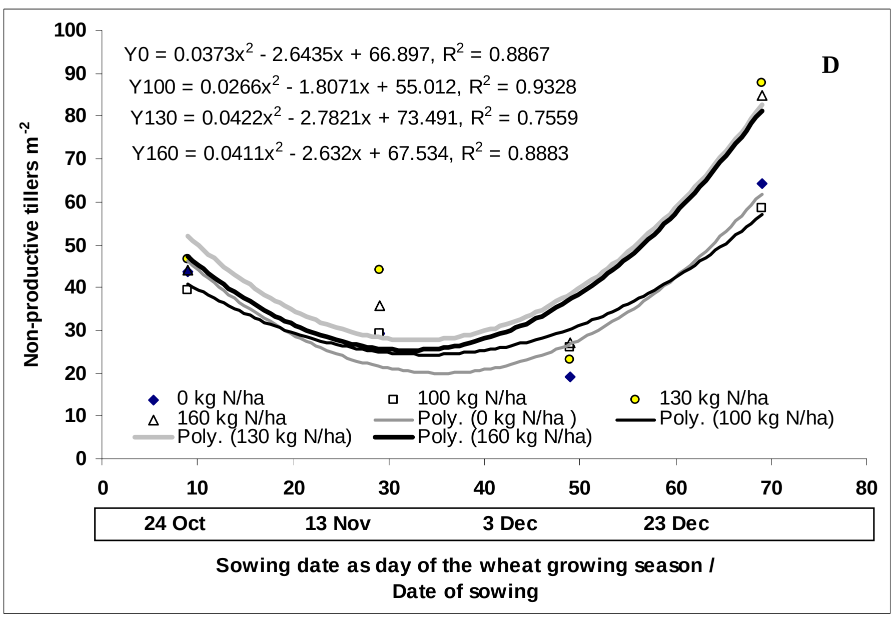



C
0 kg N/ha
100 kg N/ha
130 kg N/ha
160 kg N/ha
Poly. (0 kg N/ha )
Poly. (100 kg N/ha)
Poly. (130 kg N/ha)
Poly. (160 kg N/ha)
YN0 = 0.078x2 - 5.916x + 343.17, R2 = 0.993
YN1 = -0.035x2 + 2.937x + 327.09, R2 = 0.704
YN2 = -0.141x2 + 11.421x + 235.17, R2 = 0.917
YN3 = -0.064x2 + 5.608x + 289.15, R2 = 0.774
Total tillers m-2
24 Oct
13 Nov
3 Dec
23 Dec
Sowing date as day of the wheat growing season /
Date of sowing


D
Y0 = 0.0373x2 - 2.6435x + 66.897, R2 = 0.8867
Y100 = 0.0266x2 - 1.8071x + 55.012, R2 = 0.9328
Y130 = 0.0422x2 - 2.7821x + 73.491, R2 = 0.7559
Y160 = 0.0411x2 - 2.632x + 67.534, R2 = 0.8883
Non-productive tillers m-2
0 kg N/ha
100 kg N/ha
130 kg N/ha
160 kg N/ha
Poly. (0 kg N/ha )
Poly. (100 kg N/ha)
Poly. (130 kg N/ha)
Poly. (160 kg N/ha)
24 Oct
13 Nov
3 Dec
23 Dec
Sowing date as day of the wheat growing season /
Date of sowing

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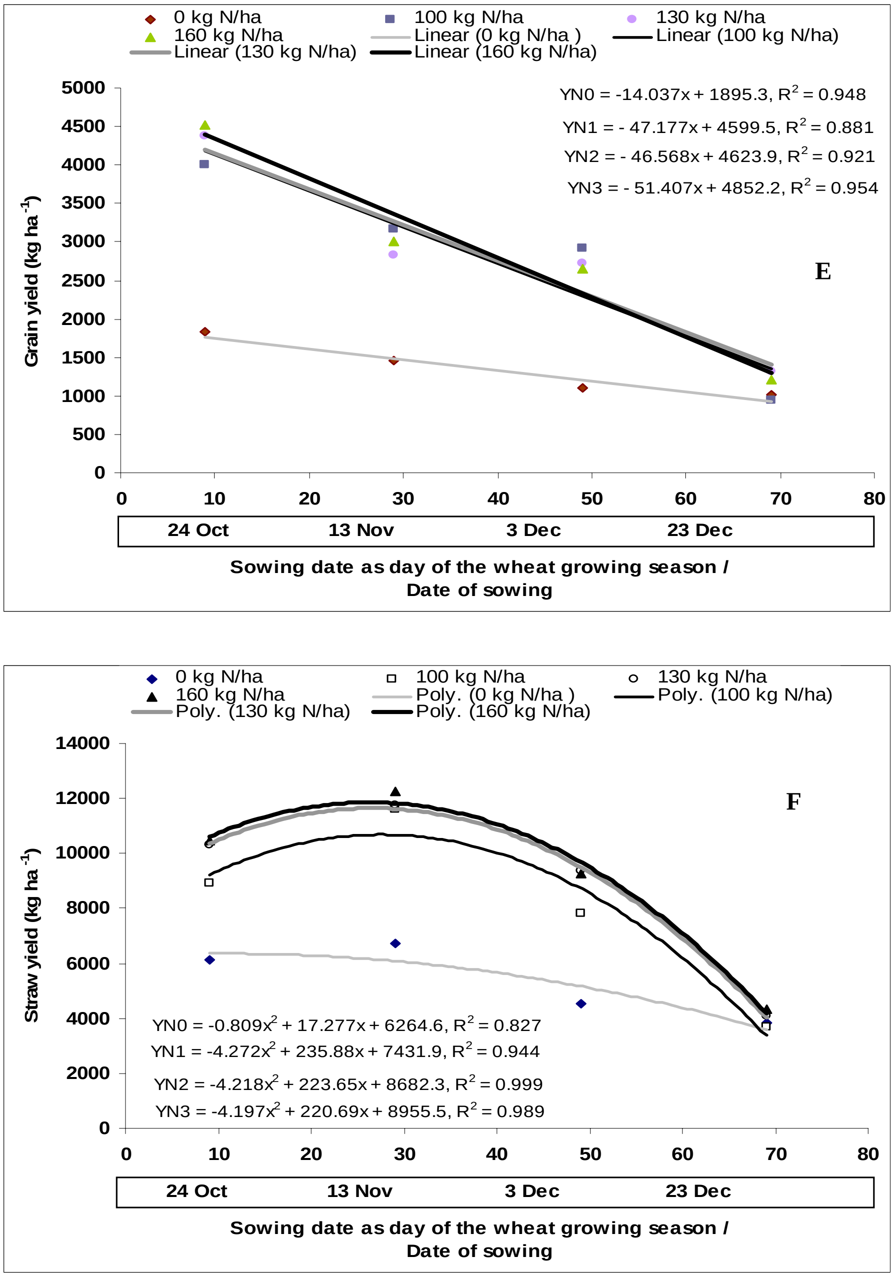


**Figure-1.** Days to seedling emergence (A), Emergence $m^{-2}$ (B), total tillers $m^{-2}$ (C), non productive tillers $m^{-2}$ (D), grain yield (E) and straw yield (F) of wheat as affected by nitrogen application and date of sowing; the date of sowing was coded as day of the wheat growing season starting from 15 October in Peshawar.

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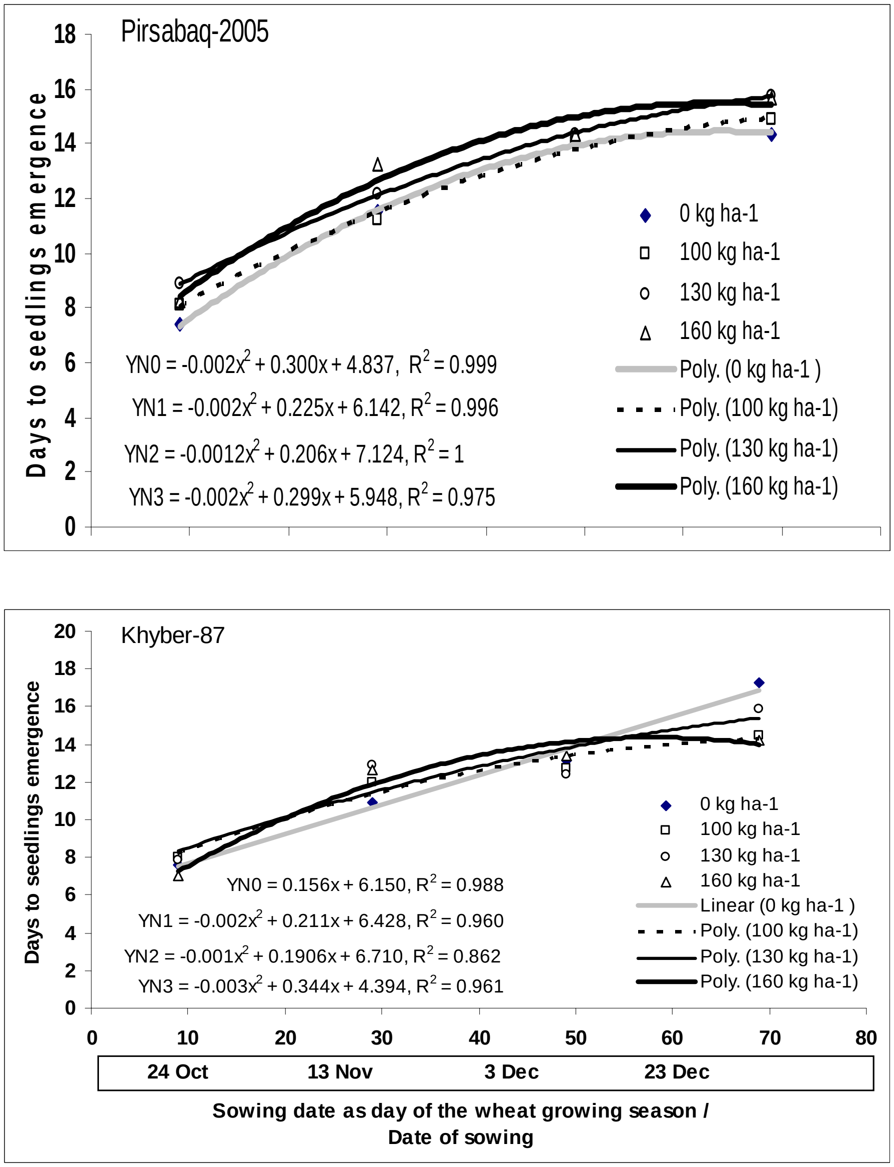


**Figure-2.** Days to seedling emergence of two wheat varieties as affected by nitrogen application and date of sowing, the date of sowing was coded as day of the wheat growing season starting from 15 October in Peshawar.

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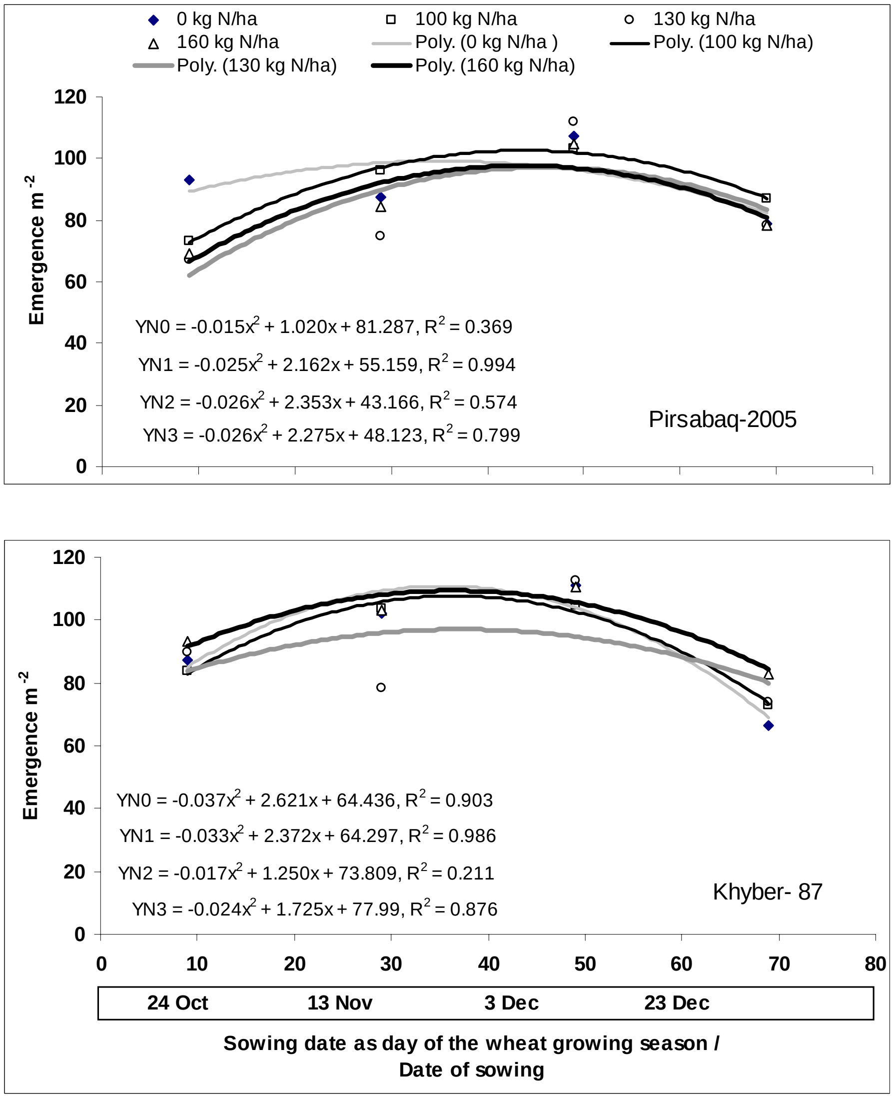


**Figure-3.** Emergence of two wheat varieties as affected by nitrogen application and date of sowing, the date of sowing was coded as day of the wheat growing season starting from 15 October in Peshawar.

## CONCLUSIONS AND RECOMENDATIONS

This study confirms by the results that planting wheat from 24th October-13th November coupled with an optimum nitrogen160 kg N $ha^{-1}$ fertilization improve morphological traits and the yield efficiency of wheat cultivar (Khyber-87). Therefore, early (24th October ) and normal (13th November) sowing along with 160 kg N $ha^{-1}$ for Khyber 87 was recommended for best crop performance in the agro-climatic condition of Peshawar valley, Pakistan.

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