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MORPHOLOGICAL AND AGRONOMIC TRAITS OF WHEAT GENOTYPES INFLUENCED BY PLANTING DATES

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Number of leaves and specific leaf area are important traits affecting physiological processes including photosynthate production, assimilate accumulation and partitioning. Wheat planted later than optimum-planting time usually reduces leaves per plant and other parameters. The objective of this study was to quantify the reduction in leaf traits and grains per spike of wheat varieties if planting is delayed. Three wheat varieties (Bakhtawar-92, Inqulab-91, and BNS) were planted on six dates from October 15 to December 30 with 15 days interval at New Developmental Farm, Agricultural University Peshawar, Pakistan. Planting date and varieties significantly affected number of leaves per plant, leaf weight, specific leaf weight, days to maturity and number of grains per spike. Wheat planted on October 15 produced heavier leaves and took maximum days to maturity, while leaves per plant increased upto October 30 planting. Specific leaf area and number of grains per spike increased up to November 30, thereafter both parameters decreased. Variety Bakhtawar-92 and BNS took more days to maturity; produced more leaves per plant, specific leaf area and more grains per spike. It can be concluded that all the three varieties can be planted upto 30th November as it produced more grains per spike and specific leaf area, however, leaves per plant increased upto October 30, thereafter no increase was observed in Peshawar valley, NWFP, Pakistan.

Keywords : Planting date, Variety, Leaf traits, Maturity, Grain per spike, Wheat.

1. Introduction

Wheat yield in Pakistan is almost three fold lower than other major wheat producing countries [1]. In addition to other factors responsible for low yield, planting time and selection of proper genotype are the two major yield limiting factors [2]. Wheat is usually planted after the harvest of sugarcane or rice on irrigated land and thus its timely planting becomes practically impossible in those areas [2]. This delay in planting reduces number of leaves per plant and other leaf traits such as specific leaf area, which in turn affect photosynthates production and thus results in less number of grains per spike and low total dry matter production [3].

Planting time is crucial in many farming systems as delayed planting may increase the risk of exposure of crops to drought, pests or diseases, which may occur either early or late in the growing season [3]. The research results revealed that leaf area, stem weight, spike weight biomass and grain yield decreased when wheat planting was delayed from October [2, 3]. Dry matter accumulation decreased with delay in planting [4, 5, 6]. Ansary *et al*. [7] evaluated the effect of six sowing dates on growth and yield of wheat and reported significantly higher yield from early planting due to an increase in the yield components. However, delayed sowing suppressed the yield caused by reduction in the yield contributing traits such as grains per spike and grain yield per spike. The present research was conducted to study the effect of planting dates on leaf traits, grains per spike and maturity of wheat varieties under climatic conditions of Peshawar and to quantify that how much reduction in the above parameters will occur if planting is delayed.

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2. Materials and Methods

To study leaf traits, grains per spike and maturity of wheat varieties planted on different dates, an experiment was conducted at New Developmental Farm, NWFP Agricultural University, Peshawar during 1997-98. Three varieties i.e. Inqulab, Bakhtawar-92 and BNS were planted on six dates starting from October, 15 till December 30, 1997 with 15 days interval. Variety BNS was included as control. The experiment was laid out according to randomized complete block design with split plot arrangement, replicated three times. Planting dates were allotted to main plots while varieties were maintained in subplots. A subplot size of 3 x 1.8 m having six rows, 3 m long, 30 cm apart was used. Crop was sown in rows using a seed rate of 100 kg ha^{-1} on a well prepared seed bed with a single row hand drill. A basal dose of 135-55 kg NP ha^{-1} in the form of diammonium phosphate (DAP) and urea was applied. Uniform hand weeding and irrigation were carried out when needed. Daily meteorological observations were recorded at weather station located at the experimental site as reported [2]. Data were recorded on leaves per plant, leaf weight, specific leaf area, days to maturity and number of grains per spike.

Leaves per plant data were recorded by counting number of leaves in ten randomly selected tillers and converted into leaves per tiller. The leaf weight data were recorded by picking leaves from ten randomly selected tillers, sun dried and weighed with electronic balance and converted into leaf weight per tiller. To record specific leaf area data, the leaf area of ten randomly selected tillers were measured on leaf area measuring machine (LI-COR, Model LI-3000 A) and converted into specific leaf area per tiller using the following formula:

Specific leaf area = Leaf area/leaf weight (cm^2g^{-1})

Days to maturity data were recorded by counting the number of days from sowing till 80% of the spikes reached physiological maturity. Data on number of grains per spike were recorded by counting number of grains from five randomly selected spikes from each subplot and converted into grains per spike. Data were statistically analyzed according to randomized complete block design with split plot arrangement and Least Significant Difference (LSD) Test was employed upon obtaining significant F- value. Regression analysis of the data was performed using the above parameters on planting dates [8].

3. Results and Discussion

3.1. Leaves per tiller

Statistical analysis of the data revealed that planting dates (D), varieties (V) and DxV interaction significantly affected number of leaves per tiller (Table 1). Variety BNS produced the maximum number of leaves per tiller (4.1), while variety Inqulab-91 produced the minimum number of leaves per tiller (3.7). Wheat planted on October, 30 produced the maximum number of leaves per tiller (4.3) whereas the minimum number of leaves $tiller^{-1}$ (3.5) was produced by wheat planted on December, 15. The interaction between DXV showed that variety BNS planted on October, 15 produced the maximum leaves per tiller (4.6) while

Table 1. Number of leaves per plant of wheat varieties as affected by planting dates.

Planting dates	Varieties			Mean
	Bakhtawar-92	Inqulab-91	BNS	
Oct., 15	4.2bc	3.3i	4.6a	4.0ab*
Oct., 30	4.5ab	3.8efg	4.5ab	4.3a
Nov., 15	4.1cde	4.1cd	4.5ab	4.2a
Nov., 30	3.8efg	3.9def	3.7fgh	3.8b
Dec., 15	3.4hi	3.5hi	3.6 gh	3.5c
Dec., 30	3.5hi	3.4hi	3.7fgh	3.5c
Mean	3.9b	3.7c	4.1a	

LSD value at p= 5% for dates = 0.286
LSD value at p= 5% for varieties = 0.286
LSD value at p= 5% for interaction = 0.286

Table 2. Specific leaf area (cm^2g^{-1}) of wheat varieties as affected by planting dates.

Planting dates	Varieties			Mean
	Bakhtawar-92	Inqulab-91	BNS	
Oct., 15	1.57	1.77	2.04	1.79b*
Oct., 30	1.82	1.38	1.75	1.65c
Nov., 15	1.86	1.65	1.89	1.80b
Nov., 30	2.65	1.81	2.01	2.16a
Dec., 15	1.70	1.36	1.68	1.58c
Dec., 30	1.51	1.41	1.74	1.55c
Mean	1.85a	1.56b	1.85a	

LSD value at p= 5% for dates = 0.253

LSD value at p= 5% for varieties = 0.206

*= Means followed by different letters are significantly different using LSD test at 5% probability level.

Table 3. Leaf weight (g) of wheat varieties as affected by planting dates.

Planting dates	Varieties			Mean
	Bakhtawar-92	Inqulab-91	BNS	
Oct., 15	9.23	10.94	9.46	9.88a*
Oct., 30	6.28	9.47	6.92	7.56c
Nov., 15	7.15	8.48	7.17	7.60b
Nov., 30	4.30	5.93	4.76	5.00c
Dec., 15	4.96	5.80	4.20	4.98c
Dec., 30	4.70	5.13	4.20	4.67c
Mean	6.10b	7.62a	6.12b	

LSD value at p= 5% for dates = 0.591

LSD value at p= 5% for varieties = 0.454

the minimum leaves per tiller (3.3) were produced by variety Inqulab-91 planted on October, 15. Early planted crop produced more leaves than late planted crop. This was due to the prevalence of low temperature for longer duration in case of early planted crop as compared with late planted crop. Meteorological data recorded at experimental station are reported [2]. The low temperature favoured more vigorous growth and development and thus resulted in more leaves per tiller.

3.2. Specific leaf area

Significant differences in specific leaf area were observed due to planting dates (D), varieties (V) and DxV interaction (Table 2). Data showed that wheat planted on November, 30 produced the maximum specific leaf area of 2.16 cm^2g^{-1}, while the minimum specific leaf area of 1.55 cm^2g^{-1} was recorded from wheat planted on December, 30. Both varieties Bakhtawar-92 and BNS produced equal specific leaf area of 1.85 cm^2g^{-1}, while variety Inqulab-91 produced the minimum specific leaf area of 1.56 cm^2g^{-1}. The interaction between DXV showed that variety Bakhtawar-92 planted on November, 30 produced the maximum specific leaf area of 2.65 cm^2g^{-1}, while the minimum specific leaf area of 1.36 cm^2g^{-1} was produced by variety Inqulab when planted on December, 15. Specific leaf area increased as planting was delayed up to November, 30. Thereafter specific leaf area decreased.

Table 4. Days to maturity of wheat varieties as affected by planting dates.

Planting dates	Varieties			Mean
	Bakhtawar-92	Inqulab-91	BNS	
Oct., 15	182.0a	171.0a	181.7a	178.2a*
Oct., 30	171.3b	168.0c	171.0b	170.1b
Nov., 15	165.0d	162.0e	165.0d	164.0c
Nov., 30	155.3f	154.7f	155.3f	155.1d
Dec., 15	144.7g	144.0g	145.0g	144.6e
Dec., 30	134.7h	133.3h	134. 7h	134.6f
Mean	58.8a	155.7b	158.8a	

LSD value at p= 5% for dates = 0.924

LSD value at p= 5% for varieties = 0.808

LSD value at p= 5% for interaction = 1.980

* = Means followed by different letters are significantly different using LSD test at 5% probability level.

Table. 5. Number of grains per spike of wheat varieties as affected by planting dates.

Planting dates	Varieties			Mean
	Bakhtawar-92	Inqulab-91	BNS	
Oct., 15	52.7e	38.0 hi	59.7d	50.1b*
Oct., 30	55.0e	39.7gh	61.7cd	52.1b
Nov., 15	60.0cd	41.7fg	66.0ab	56.1a
Nov., 30	63.0bc	40.0gh	67.3a	56.8a
Dec., 15	55.7e	35. 3l	65.3ab	52.1b
Dec., 30	44.0f	40.3gh	54.3e	46.2c
Mean	55.2b	39.2c	62.4a	

LSD value at p= 5% for dates = 2.861

LSD value at p= 5% for varieties = 1.307

LSD value at p= 5% for interaction = 3.202

* = Means followed by different letters are significantly different using LSD test at 5% probability level.

3.3. Leaf weight

Planting dates (D) and varieties (V) significantly affected leaf weight, while DxV interaction showed no significant effect on leaf weight (Table 3). Variety Inqulab produced the maximum leaf weight of 7.62 g, while variety Bakhtawar-92 produced the minimum leaf weight of 6.10 g. Mean values for planting dates revealed that wheat planted on October, 15 produced the maximum leaf weight of 9.88 g. Leaf weight progressively decreased as planting was delayed and the minimum leaf weight of 4.67 g was recorded for wheat planted on December, 30. The interaction between VXD showed that variety Inqulab-91 produced the maximum leaf weight of 10.94 g when planted on October, 15 while the minimum leaf weight of 4.20 g was produced by variety BNS sown on either December, 15 or 30. Variety Inqulab-91 produced heavier leaves than other two varieties. However, variety Inqulab-91 produced less number of leaves. There seems to be some trade off between number of leaves per tiller and leaf weight. It is physiological phenomena that assimilates produced are partitioned to growing leaves and other plant parts [9]. In case of variety Inqulab-91 the number of leaves were comparatively less and more assimilates partitioned to leaves thus resulted into heavier leaves. Similarly the reason for heavier leaves in case of early planted wheat

might be the production of more photosynthates due to favourable environment.

3.4. Days to maturity

Planting dates (D), varieties (V) and DxV interaction significantly affected days to maturity (Table 4). Data presented in Table 4 revealed that variety Bakhtawar-92 took the maximum days to maturity (158.8 days), while the minimum days to maturity (111.3 days) were taken by variety Inqulab-91.

Wheat planted on October, 15 took the maximum days to maturity (178.2 days). Days to maturity decreased with delay in sowing and the minimum days to maturity (134.6 days) were taken by crop planted on December, 30. The interaction between DXV revealed that variety Bakhtawar-92 planted on October, 15 took the maximum days to maturity (182.0 days), while the minimum days to maturity (134.3 days) were taken by variety Inqulab-91planted on December, 30. The results indicated that early-planted wheat required more days to reach maturity compared with late planted crop. It might be due to the fact that early planted crop remained exposed to low temperature for longer duration and the crop utilized most of the assimilates for the vegetative growth resulting in more vigorous crop as compared with late planted crop. Moreover, there is a temperature limit up to which the crop is utilizing most of its photosynthates for its vegetative growth and shift from vegetative to reproductive growth when the temperature and day length exceed a certain limit [10]. If the temperature increases further the crop reaches the maturity irrespective of fact that how much growth, grain formation and development of the grains have been taken place [10]. These results are in line with Khalil *et al*. [2, 3] who reported that wheat planted on earlier dates took maximum days to maturity compared with late planted wheat.

3.5. Number of grains per spike

Planting date, variety and interaction between DxV significantly affected number of grains per spike (Table 5). The maximum number of grains per spike (62.4) were noted in the variety BNS, while the lowest number of grains (19.2) were recorded in variety Inqulab-91. Wheat planted on 30th November gave the maximum number of grains per spike (56.8), while the minimum number of grains per spike (46.2) was recorded for wheat planted on December, 30. The interaction between VXD showed that variety BNS produced the maximum number of grains per spike (67.3) planted on November, 30 while the minimum grains per spike (35.3) were produced by the variety Inqulab-91 sown on December, 15. The production of the maximum grains per spike by variety BNS shows its better genetic make up and could be a good variety to boost up the national wheat production provided it shows its superiority in other agroclimatic conditions also. Early planted wheat produced more grains per spike than late planted wheat, simply because of longer growth duration, vigorous growth and production of more photosynthates which were being utilized for the development of spike and thus resulted in more grains per spike than late planted crop. These results are in line with the findings of Khan [5], Khalil *et al*. [2, 3] and Ansary *et al*. [7] who reported the maximum number of grains per spike as compared with late planted wheat. Less number of grains per spike in case of late planting may be due to short growth period, improper canopy development including leaf area, less assimilate partitioning to the grain and thus ultimately resulted in less number of grains per spike. These results agree with the findings of Kumar *et al*. [11], Pelikan [12] and Rajput and Verma [13] who reported reduction in the yield with delayed planting mainly due to production of less number and lighter grains. It can be concluded that all the three varieties can be planted upto November, 30 as it produced more grains per spike and specific leaf area, however, leaves plant^{-1} increased upto October, 30 thereafter no increase was observed, while leaf weight and days to maturity increased up to October ,15 in Peshawar Valley, Pakistan.

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