INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
ISSN Print: 1560–8530; ISSN Online: 1814–9596
09–213/MFA/2010/12–1–111–114
http://www.fspublishers.org

Full Length Article

Evaluating the Response of Wheat Genotypes to Forage Clipping

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ABSTRACT

Searching to explore the new avenues is the basis of science. An experiment consisting of six spring wheat genotypes viz. Pirsbak-85, Dera-98, Ghaznavi-98, Fakhr-e-Sarhad, Takbeer and SARC-3 were planted at Malakandher Research Farm, NWFP Agricultural University Peshawar during, 2004-2005. The experiment was laid out in randomized complete block design with split plot design with three replications. Clipping was made before booting stage. The results obtained showed that the effect of clipping was significant forage yield, spike weight, spikelets per spike, 1000-grain weight, biological yield, grain yield and harvest index, while no differences were observed for plant height, tillers per m^2 and spike length. Pirsabak-85 showed significantly higher plant height, while minimum was observed in Ghaznavi-98. Pirsabak-85 showed maximum number of tillers in clipped, while Fakhre-e-Sarhad in un-clipped treatment. In both cases, minimum tillers were recorded for SARC-3. Similarly, maximum spike weight was recorded in Pirsabak-85 and minimum in Dera-98. Likewise Pirsabak-85 showed significantly higher spikes length, while Takbeer showed significantly higher spike length in un-clipped. In both treatments, minimum spike length was recorded in Dera-98. Finally, grain yield, harvest index, spikelets per spike and spike weight were increased due to clipping, when compared with un-clipped treatments. To sum up, clipping at an early stage of vegetative growth produced almost higher grain yield with an additional forage yield. Though the results obtained are appreciating, yet it needs to be reaffirmed via extensive experimentation approach. © 2010 Friends Science Publishers

Key Words: Wheat; Genotypes to Forage Clipping; Pirsbak-85; Dera-98; Ghaznavi-98; Fakhr-e-Sarhad; Takbeer; SARC-3

INTRODUCTION

Only through continuous research, crops can be employed for their best productivity. Much work has been done regarding soil nutrient resources (Hussain *et al.,* 2002), water use efficiency (Arif & Malik, 2009), disease (Diani *et al.,* 2009) and genetic manipulation (Yao *et al.,* 2006). Being a leading cash and grain crop in many parts of the world (Ali *et al.,* 2007), wheat should be subjected to non-traditional growing methodologies to gain the grain yield benefit, as well as to overcome the scarcity of forage. Wheat (*Triticum astivum* L.) belongs to the family of Poaceae, wheat has a fibrous root system, hollow stem and simple leaf with venation. Wheat has spike inflorescence with sissile spikelets placed at each notch of the zigzag raches. Wheat kernel is composed of a single cotyledon (monocot) and is technically known as caryopsis. Wheat is normally a self pollinated plant, but natural cross pollination also occurs in 1 to 4% of the flowers (Mian, 2001).

Wheat is traditionally grown for the purpose of grain production only, which is not sufficient. In some countries like Australia, Turkey, USA, etc. wheat is commonly grown for the dual-purpose of producing forage and grain from the same crop. Dual purpose wheat provides high quality forage for stocker cattle during the season, when other forage sources are low in quantity and quality (Krenzer, 2000).

Wheat for the dual purpose is generally planted early to have ample forage for cattle grazing during winter and early spring. Grain yield often decline in an early planted, forage-plus-grain system compared with a later planted grain-only system. Yield reductions of 30% in clipped plots (Ud-Din *et al.*, 1993), or 20 to 50% in grazed plots (Winter & Thompson, 1990; Winter & Musick, 1991) may occur depending on the genotype, severity and termination date of forage removal and the environment. Grazing the excess forage in early-planted wheat may have minimal effects on grain yield, however if soil moisture fertility is adequate, if grazing is terminated before the first-hollow-stem stage and if leaf regeneration potential is good following cattle removal (Redmon *et al.*, 1995). Yield per unit area can be increased through the release of cultivars with better performance. Moreover, crop improvement is a regular and continues process. Researchers have always a high desire of the identification of genotypes, which could give higher yield to replace the existing ones.

To cite this paper: Shuja, M.N., D. Nayab, M. Ali, A. Iqbal and I.H. Khalil, 2010. Evaluating the response of wheat genotypes to forage clipping. *Int. J. Agric. Biol.*, 12: 111–114

The present study is an attempt to know the comparative performance of wheat cultivars released by different institutes/stations overtime under artificially clipped and un-clipped treatments.

MATERIALS AND METHODS

This research was conducted at Malakandher Research Farm, NWFP Agricultural University Peshawar during, 2004-2005. Six wheat cultivars (Pirsabak-85, Dera-98, Ghaznavi98, Fakhr-e-Sarhad, Takbeer & SARC-3) were evaluated under clipped and un-clipped treatment. Split-plot treatment arrangement in Randomized Complete Block Design (RCB) with three replications was used. The clipped and un-clipped treatments were assigned to main plots, while cultivars to subplots. There were six rows per plot. The row length was 5 m and row to row distance was kept 30 cm (0.3 m), making a plot size of 9 m^2. The seed was sown at recommended rate of 120 kg ha^{-1}. Recommended dose of fertilizer 120 kg N ha^{-1} fertilizer were applied at sowing time. When first cut was taken, an additional 50 kg N ha^{-1} was applied again. Standard agronomic practices were carried out during the growing season. For the collection of data four central rows were selected.

Forage was clipped about 1 inch above the ground level before development of hollow stem during last week of December, 2004 and forage yield was measured with the help of physical balance. In each sub-plot, plant height was taken on five randomly selected plants, one from each row from the four central rows and measured from the ground level to the tip of plant (excluding awns) by means of meter rod and at the time of physiological maturity and then heights were recorded from the ground level. For every cultivar in each sub-plot, the central rows were used for estimating tillers per m^2. The total numbers of productive tillers were counted in 1 m^2 area of the plot. The weight of each of the 5 spikes of the selected plants was measured with the help of the electric balance to determine spike weight. For each cultivar in the sub-plot, spike length of five randomly selected spikes was measured from the base of first spikelet to the tip of spike by means of a scale at the time of maturity excluding awns. The 5 spikes of the selected plants were used for the data. The total numbers of spikelets per spike were determined by actual counting of the total number of productive and un-productive spikelets per spike. After threshing a random sample of 1000-grains were counted of the each cultivar from the total grain of each cultivar in the sub-plots and weighed with the help of electronic balance. At the end of maturity, each plot was harvested and each cultivar was kept separate and weigh by using Physical balance. The mature harvested plant of each cultivar was threshed by a machine and weighed separately by a physical balance and then yield per plot was converted into yield per hectare in kilogram.

Harvest index for each cultivar was calculated as the ratio between grain yield and biological yield. The data recorded were analyzed using statistical computer Software MSTATC following the appropriate model for a Split-plot design. Least Significant Differences (LSD) test was also applied to separate significant means.

RESULTS

Non-significant ($P > 0.05$) differences were observed among the clipped and un-clipped cultivars for the forage yield (Table I). Mean forage yield of the cultivars ranged from 9755.56 to 17055.56 kg ha^{-1} (Table III). Analysis of variance for plant height showed non-significant differences ($P > 0.05$) for clipped and un-clipped cultivars. But the interaction between clipping and cultivars were observed as significant ($P \leq 0.05$) (Table I). Pirsabak-85 showed maximum plant height (115 cm), whereas minimum plant height (89 cm) was observed for Ghaznavi-98 in clipped conditions (Table III). Analysis of variance for the number of productive tillers per m^2 showed highly significant differences ($P \leq 0.01$) for the cultivars, whereas both clipping and clipping interaction with cultivars were found non-significant ($P > 0.05$) (Table I).

Analysis of variance for spike weight showed highly significant ($P \leq 0.01$) differences for clipping, as well as for cultivars, whereas interaction between clipping and cultivars was found as non-significant ($P > 0.05$). Mean data revealed that spike weight among the cultivars ranged from 1.72 to 3.28 g. Cultivar Pirsabak-85 had maximum spike weight (3.28 g) than others in both clipped and un-clipped conditions. Minimum spike weight was observed in Dera-98 (Table IV). In spike length, non-significant ($P > 0.05$) differences were observed for clipping, as well as for cultivars (Table I). Analysis of variance for the number of spikelets per spike showed highly significant ($P \leq 0.01$) differences for clipping, as well as among the cultivars (Table II) and the interaction between clipping with cultivar was also found highly significant ($P \leq 0.01$). Number of spikelets per spike among the cultivars ranged from 19 to 25. Pirsabak-85 produced significantly higher number of spikelet per spike both in clipped, as well as un-clipped conditions. In clipped, minimum numbers of 19 spikelets per spike were observed in SARC-3, while in un-clipped condition, 18 spikelets per spike were observed in Dera-98 (Table IV).

Analysis of variance for the 1000-grain weight showed significant ($P \leq 0.05$) differences for clipping, while the variance was highly significant ($P \leq 0.01$) among the cultivars, whereas non-significant ($P > 0.05$) differences were observed for the interaction between cultivar and clipping (Table II). Analysis of variance for the biological yield showed highly significant ($P \leq 0.01$) differences among the cultivars, while clipping and clipping interaction with cultivars was found significantly ($P \leq 0.05$) different (Table II). Mean biological yield ranged from 6518 to 13190 kg ha^{-1}. In clipped treatment, Pirsabak-85 produced maximum (10852 kg ha^{-1}) biological yield, while in un-

Table I: Mean squares for forage yield, plant height, tillers/m^2, spike weight and spike length of 6 wheat cultivars evaluated at NWFP Agricultural University Peshawar during, 2004-2005

Source	Degree of Freedom	Forage yield	Plant height	Tillers/m^2	Spike weight	Spike length
Replication	2	12.66	79.80 NS	2541.77 NS	2.54**	0.50
Clipping	1	-	144.8 NS	930.25 NS	9.92**	3.48 NS
Error-A	2	-	35.60	2032.33	0.02	2.71
Cultivar	5	-	577.2**	2169.29**	1.77**	3.24 NS
Clipping X Cultivar	5	17.00 NS	95.8**	236.99 NS	0.45NS	1.93 NS
Error-B	20	7.85	20.9	281.45	0.18	2.83
CV %	-	24.03	4.43	11.45	17.57	15.36

NS = Non-significant; *, ** = Significant at 5 and 1% probability level, respectively

Table II: Mean squares for spikelets/spike, biological yield, grain yield and harvest index of 6 wheat cultivars evaluated at NWFP Agricultural University Peshawar during, 2004-2005

Parameters	Degree of freedom	Spikelets per spike	1000-grain weight	Biological yield	Grain yield	Harvest index
Replication	2	6.9*	66.29*	7016646.77 NS	20226.02	51.01 NS
Clipping	1	10.02**	78.32*	107934784.02*	6740946.77**	2248.81**
Error-A	2	0.03	1.29	3458051.44	64964.52	15.49
Cultivar	5	22.58**	333.50**	28381944.09**	2618743.51**	96.22**
Clipping X Cultivar	5	5.13**	35.87 NS	7477886.89*	447258.24*	68.40**
Error-B	20	1.04	18.53	1942266.44	114371.14	14.58
CV %	-	4.84	12.61	13.74	16.03	16.91

NS = Non-significant; *, ** = Significant at 5 and 1% probability level, respectively

Table III: Mean values for forage yield, plant height and tillers per m^2 of six wheat cultivars evaluated at NWFP Agricultural University Peshawar during, 2004-2005

	Forage yield (kg ha^{-1})	Plant height (cm)		No. of tillers per m^2	
Cultivar	Clipped	Un-clipped	Clipped	Un-clipped	Clipped
Pirsabak-85	9755.56	115.50	115.80	149.66	161.33
Dera-98	11455.56	106.83	103.53	162.66	138.66
Ghaznavi-98	11477.78	84.83	89.00	154.66	142.33
Fakhre- sarhad	14833.33	109.56	107.06	175.333	155.33
Takbeer	13166.67	99.83	96.30	154.3	143.66

Table IV: Mean values for spike weight, spike length and spikelets spike^{-1} of six wheat cultivars evaluated at NWFP Agricultural University Peshawar during, 2004-2005

	Spike weight (g)		Spike length (cm)		No. of spikelets per spike	
Cultivar	Un-clipped	Clipped	Un-clipped	Clipped	Un-clipped	Clipped
Pirsabak-85	3.2	3.3	10.86	12.36	24	25
Dera-98	1.00	2.4	9.40	10.16	18	20
Ghaznavi-98	1.8	3.3	9.57	11.33	20	22
Fakhr-e-sarhad	1.5	3.1	10.36	11.53	21	22
Takbeer	1.6	2.5	11.86	10.70	19	22
SARC-3	2.2	3.1	11.83	11.53	21	19

clipped condition, Fakhre-sarhad produced maximally (16741 kg ha^{-1}). In contrast, minimum biological yield were obtained from SARC-3 in both cases (Table V).

Analysis of variance for the grain yield showed highly significant ($P \leq 0.01$) differences for clipping, as well as for cultivars, while the interaction between clipping and cultivars was found significantly ($P \leq 0.05$) different (Table II). Mean grain yield ranged from 1168 to 2980 kg ha^{-1}. In both conditions, Takbeer produced significantly higher grain yield of 3484 in clipped and 2476 kg ha^{-1} in un-clipped, followed by Pirsabak-85 and Fakhre-sarhad with 2625 and 2203 kg ha^{-1}. In contrast, minimum economical yield produced by cultivar SARC-3 with 996 and 1339 kg ha^{-1} for clipped and un-clipped conditions, respectively (Table VI).

Analysis of variance for harvest index showed highly significant ($P \leq 0.01$) differences for cultivars, clipping, as well as the interaction between the clipping and cultivars (Table II). Mean harvest index was ranged from 19.56 to 30. Cultivar Takbeer gave maximum harvest index of 38.6 in clipped and 21.4 in un-clipped, followed by Ghaznavi-98 and Pirsabak-85 with 32.5 and 21.0. In contrast, minimum harvest index produced by cultivar SARC-3 in both treatment (Table VI).

DISCUSSION

Effect of clipping was significant forage yield, spike weight, spikelets per spike, 1000-grain weight, biological

Table V: Mean values for 1000-grain weight and biological yield of six wheat cultivars evaluated at NWFP Agricultural University Peshawar during, 2004-2005

	1000-grain weight (g)		Biological yield (kg ha^{-1})	
Cultivar	Un-clipped	Clipped	Un-clipped	Clipped
Pirsabak-85	32.13	23.23	11333.67	10852.00
Dera-98	24.37	26.63	11889.00	7296.66
Ghaznavi-98	31.0	32.50	11703.66	8518.33
Fakhr-e-sarhad	34.20	34.36	16741.00	9629.66
Takbeer	43.76	38.83	11555.66	9185.33
SARC-3	48.26	40.46	8037.00	4999.66

Table VI: Mean values for grain yield and harvest index of six wheat cultivars evaluated at NWFP Agricultural University Peshawar during, 2004-2005

	Grain yield (kg ha^{-1})		Harvest index (%)	
Cultivar	Un-clipped	Clipped	Un-clipped	Clipped
Pirsabak-85	2409.33	2840.66	21.09	26.83
Dera-98	1061.00	2133.33	9.25	30.29
Ghaznavi-98	1814.66	2359.33	16.20	27.96
Fakhre-sarhad	1305.66	3100.00	7.78	32.47
Takbeer	2476.0	3483.66	21.39	38.61
SARC-3	996.33	1338.66	12.36	26.76

yield, grain yield and harvest index, while no differences were observed for plant height, tillers number and spike length (Table I & II). The results obtained showed that grain yield, harvest index, spikelets per spike, spike weight were increased due to clipping, when compared with un-clipped treatments (Table IV, V & VI). Contrary to this, biological yield decreased with clipping. Similar results were obtained by Usman *et al.* (2007), who reported significant increase in yield and forage in de-topped rice crop.

No differences were observed between clipped and un-clipped cultivars for forage yield (Table I). Our findings are in contradiction with the results of Lee *et al.* (1991), who reported that clipping might increase the forage yield significantly. This may be due to the methodology (i.e., Lee *et al.* (1991) has grown the crop only for vegetative/forage purposes) being adopted or may be due to the genotypic or environmental differences. Increased grain yield was observed in clipped treatments than in the un-clipped ones (Table VI). This is in contrast with the findings of Dann (1963), who reported reduced grain yield due to clipping. The difference of results may be due to the differences of genotypes and environment or may be the difference of use of winter or spring wheat.

Based on varietal performance, mean of the mean values for clipped and un-clipped treatments, Pirsabak-85 performed maximally for spikelets per spike (25) and for spike weight (3.25 g). In contrast, Takbeer performed maximally for harvest index (30%) and for grain yield (2980 kg ha^{-1}) (Table IV). Similarly, SARC-3 has maximum performance (44.36 g) for 1000-grain weight followed by Takbeer (41.29 g) (Table V). Overall, Takbeer performed well followed by Pirsabak-85.

CONCLUSION

This study suggests that clipping at an early stage of vegetative growth produces almost higher grain or seed yield with an additional forage yield. Regarding genotypic differences, Takbeer gave the highest forage and grain yield on clipped experiment.

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(Received 17 June 2009; Accepted 03 July 2009)