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Effect of different weed management techniques on the performance of wheat cultivars

Fatema Islam, ✉Md. Abdus Salam and Md. Abdul Kader

Department of Agronomy, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

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Correspondence:
Md. Abdus Salam
✉: salamma71@yahoo.com

Abstract

Weed management in a sustainable way is the ultimate target of Agronomists to maximize crop yield per unit area. To develop a sustainable weed management technique, an experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh to study the effect of different weed management techniques on the performance of wheat cultivars. The experiment comprised three wheat cultivars; viz. BARI Gom-28, BARI Gom-29 and BARI Gom-30 and five weed management techniques namely, no weeding (W_0), two hand weedings (HW) at 20 DAS and 40 DAS (W_1), use of rice straw mulch @ 6 t ha^{-1} (W_2), use of pre emergence herbicide Panida @ 1 L ha^{-1} (W_3) and use of pre emergence herbicide + one hand weeding (HW) at 40 DAS (W_4). The experiment was laid out in a split-plot design with three replications. The experimental plots were infested by different weed species. Annual weeds were outnumbered than perennial and constitute 84.74% against 15.26%, respectively. Among them, the five most dominant weed species based on the importance value in descending order were *Polygonum orientale>Chenopodium album >Cynodon dactylon>Sonchus arvensis>Cyperus rotundus* and rest of the weed species represent 8.94%. Wheat cultivar BARI Gom-29 produced the highest grain yield (3.44 t ha^{-1}). The highest grain yield (3.29 t ha^{-1}) was obtained from the application of pre emergence herbicide Panida @ 1 L ha^{-1}. But in case of interaction BARI Gom-29 in combination with use of rice straw mulch @ 6 t ha^{-1} produced the highest grain yield (4.36 t ha^{-1}). The highest grain yield obtained due to highest number of total and effective tillers hill^{-1} and highest number of grains spike^{-1} in BARI Gom-29 with application of rice straw mulch @ 6 t ha^{-1}. From the results of the study it may be concluded that BARI Gom-29 with application of rice straw mulch @ 6 t ha^{-1} technique appears to be the promising technology in controlling weeds as well as obtaining higher grain yield of wheat.

Introduction

Wheat (*Triticum aestivum* L.) is the most important cereal crop all over the world belonging to the family Poaceae. In Bangladesh wheat is the second most important staple food crop after rice. Per capita intake of wheat stands at 28-30 g/day, indicating its approximate demand at 4 million tons per annum. The facts of past three decades indicate the increasing trend of wheat consumption. To meet increasing consumers' demand, the country has to import, on an average, 1.4 million tons of wheat every year. Moreover, the total cultivable land has been decreasing day by day due to increasing population. On the other hand, farmers have the tendency to cultivate *boro* rice cultivation in November - April of wheat growing period. In Bangladesh, total area under wheat crop has been estimated 4,15,339 ha compared to 4,44,805 ha (BBS, 2016). Average yield rate of wheat has been estimated 3.03 metric t ha^{-1} which is 4.19% higher than that of last year (BBS, 2017). Though, wheat is an important cereal crop in Bangladesh, the average yield of wheat in Bangladesh is low compared to that of other wheat growing countries of the world due to lack of use of improved cultivars and appropriate management practices such as weed management techniques.

Wheat cultivars vary in their competitiveness against weeds (Christensen, 1995; Cosser *et al*., 1997; Lemerle *et al*., 2006) and those with a high degree of competitive ability, especially against aggressive weeds, are highly beneficial because they protect against the build-up of weed infestation and proliferation of the weed seed bank (Bond and Grundy, 2001; Hoad *et al*., 2008; Feledyn-Szewczyk *et al*., 2014). A review of world literature indicates that the competitiveness of wheat cultivars depends on crop density and intrinsic morphological and growth features, such as rate of growth, length of stems, tillering rate, surface and angle of leaf attachment on the wheat plant as well as any allelopathic properties (Didon, 2002; Bertholdsson, 2005; O'Donovan *et al.* 2005; Liatukas and Leistrumite, 2009; Feledyn-Szewczyk, 2013). Moreover, different cultivars respond differently for their genotypic characters, input requirement, growth process and the prevailing environment during growing season. For example BARI Gom-28 having ability of short duration, high yield and heat tolerant, BARI Gom-29 having short duration and leaf rust tolerant, BARI Gom-30 having short duration, tolerant to leaf blight and heat.

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It is reported that weeds reduced wheat yield up to 25–30% in Pakistan (Nayyar *et al*., 1994), 20–40% in India (Mishra, 1997), up to 50% in Nepal (Ranjit, 2002). The number of weed species reported vary from country to country, 90 species from India (Rao, 2000), 73 species from Bangladesh (Begum *et al*., 2003) and 30 species from IAAS, Nepal (Dangol and Chaudhary, 1993). Hossain *et al*. (2010) noted that wheat fields are normally infested by 18 to 22 weed species belonging to 11-12 families. The most important weeds of wheat field in Bangladesh are *Polygonum orientale, Chenopodium album, Cynodon dactylon, Sonchus arvensis and Cyperus rotundus* (Huda *et al*., 2017). Karim (1987) estimated that weeds caused 33% yield loss of total wheat in Bangladesh, most of the plant parameters including plant height, number of tillers, number of grains spike^{-1}, grain weight etc. are affected by weed competition with wheat plant. It was found that weeding at 20 and 40 days after sowing (DAS) gave the highest grain and straw yields (Tariful *et al*., 1998). Weed control is a basic requirement and a major component of production systems (Hossain *et al*., 2009). However, Bangladesh farmers are not interested to control weeds in wheat fields due to labor crisis during the wheat-growing period (WRC, 2007). Most of the annual weeds generally react very quickly to alternate their environment. Thus the best weed management techniques need to be adopted by the farmers to reduce weed infestation and maximizing wheat yield. Therefore, the present study was undertaken (i) to find out the ability of cultivar on weed suppression and yield of wheat, (ii) to analyze the effect of weed management techniques on weed suppression and yield of wheat and (iii) to determine the influence of different weed management techniques on weed suppression and yield of wheat cultivars.

Materials and Methods

The experimental site belongs to the non-calcareous dark grey floodplain soil (Old Brahmaputra Alluvial Soil Tract) under the Old Brahmaputra Floodplain Agro Ecological Zone-9. The experimental field was medium high land with loamy soil having pH value 6.5 and 1.027% organic matter. The experiment comprised three wheat cultivars viz; BARI Gom-28, BARI Gom-29 and BARI Gom-30 and five weed management techniques namely no weeding (W_0), two HW at 20 DAS and 40 DAS (W_1), use of rice straw mulch @ 6 t ha^{-1} (W_2), use of pre emergence herbicide Panida @ 1 L ha^{-1} (W_3) and use of pre emergence herbicide + one HW at 40 DAS (W_4). The experiment was laid out in a split-plot design with three replications where wheat cultivar were assigned to the main plot and weed management practices were assigned to the sub-plots. The unit plot size was 10 m^2 (4 m × 2.5 m). The experimental land was opened with a tractor drawn disc plough 15 days before sowing and fertilized with 200, 160, 50 and 112 kg ha^{-1} urea, triple superphosphate, muriate of potash and gypsum, respectively. The entire amount of TSP, MoP and gypsum and one-third of urea were applied at the time of final land preparation. The rest amount of urea was top dressed at 20 and 40 DAS. Seeds were sown in line at the rate of 140 kg ha^{-1} in furrows made by tine on 21 November 2016. Weeding was done as per weed management treatment and other necessary intercultural operations were done to ensure and maintain the normal growth of the crop. Data on weed density and dry weight were collected at 30 60 and 90 DAS. For determining weed density and dry weight, weeds were collected by using 0.25 m × 0.25 m quadrate. The quadrate was placed in four spots at random in each plot and all weeds inside the quadrate were collected and the number of weeds was counted. The average values were converted to number m^{-2} multiplying by four. Then the weeds were dried first in the sun and thereafter in an electric oven maintaining a constant temperature of 80°C for 72. Oven dry weight was expressed in g m^{-2}. The importance value (I.V.) of weed was expressed based on the following equation:

$$\text{I.V.}(\%) = \frac{\text{Dry weight of each species in a community}}{\text{Dry weight of all species in a community}} \times 100$$

The crop of each plot was harvested at maturity on 21 March 2017. It was then carried to the threshing floor for processing. The crop was sun-dried for four days and then threshed and cleaned. Observations were made on plant height, number of total tillers hill^{-1}, number of effective tillers hill^{-1}, spike length, number of total spikelets spike^{-1}, number of grains spike^{-1}, 1000-grain weight, grain yield, straw yield, biological yield and harvest index. All the collected data were statistically analyzed and the mean differences were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results and Discussion

The experimental plots of Agronomy Field Laboratory of BAU were infested with 20 weed species belonging to 12 families. Five weed species belonging to the family Poaceae, three species belonging to the family Polygonaceae, two species belonging to the family Commelinaceae and Compositae and other 10 weed species belong to the family of Cyperaceae, Chenopodiaceae, Solanaceae, Leguminosae, Marsileaceae, Labiatae, Amaranthaceae and Asteraceae. Details of infested weed species are presented in Table 1. The hierarchy orders of five most widespread and abundant weed species of Agronomy Field Laboratory of BAU were *Gnaphalium affine*> *Cyperusrotundus*> *Digitaria sanguinalis*> *Cynodon dactylon*> *Panicum repens.*

Effect of cultivar, weeding regimes and their interaction on weed density and dry weight

Weed density was significantly influenced by different wheat cultivars. The highest weed density was recorded in BARI Gom-29 at 30 DAS (65.40 m^{-2}), BARI Gom-28 at 60 DAS (70.33 m^{-2}) and at 90 DAS (48.60 m^{-2}). The

lowest weed density was observed in BARI Gom-30 at 30 DAS (52.80 m^{-2}), at 60 DAS (56.67 m^{-2}) and at 90 DAS (34.13 m^{-2}) (Table 2). Different weed management treatment exerted significant effect on weed density was at different days after sowing (Table 3). The highest weed density (81.11 m^{-2}, 94.56 m^{-2} and 49.11 m^{-2}, respectively) was observed in the treatment W_0 (no weeding) at 30 DAS, 60 DAS, 90 DAS. The lowest weed density (44.00 m^{-2} and 42.67 m^{-2}) was recorded in the W_4 (use of pre emergence herbicide + one HW at 40 DAS) treatment at 30 DAS and at 60 DAS in W_2 (two HWs at 20 DAS and 40 DAS) and at 90 DAS (34.11 m^{-2}) in W_2 (use of straw mulch) treatment (Table 3). The probable reason for obtaining lowest weed population in use of pre emergence herbicide + and one HW at 40 DAS and in straw mulch treatments might be due to control of weed effectively in these two treatments. These results are in conformity with the observation made by Singh *et al.* (2010) who reported that application of pre-emergence herbicide followed by one hand weeding at 40 DAS reduced the weed population in wheat field. Weed density was significantly influenced by the interaction of different cultivars and weed management treatments (Table 4). The highest weed density (85.67 m^{-2}) was obtained in V_1W_0 (BARI Gom-28 × no weeding) at 30 DAS (112.00 m^{-2}), in V_2W_0 (BARI Gom-29 ×no weeding) at 60 DAS and (51.67 m^{-2}) in V_3W_0 (BARI Gom-30 ×no weeding) at 90 DAS. The lowest weed density (30.33 m^{-2}) was recorded in V_3W_4 (BARI Gom-30 × use of pre emergence herbicide Panida + one HW at 40 DAS), at 30 DAS (33.67 m^{-2}) in V_2W_4 (BARI Gom 29 × use of pre emergence herbicide Panida + one HW at 40 DAS) at 60 DAS and (22.33 m^{-2}) in V_3W_2 (BARI Gom-30 × use of rice straw mulch) at 90 DAS (Table 4).

The weed dry weight was significantly affected by different cultivars. The highest weed dry weight was recorded in BARI Gom-28 at all sampling dates (Table 2). The lowest weed dry weight was obtained in BARI Gom-29 at 30 DAS (21.89 g m^{-2}), in BARI Gom-30 at 60 DAS (26.46 g m^{-2}) and BARI Gom-29 at 90 DAS (26.62 g m^{-2}) (Table 2). The weed dry weight was significantly affected by different weed control treatments. The highest weed dry weight was recorded in the treatment W_0 (no weeding) at 30 DAS (28.80 g m^{-2}), at 60 DAS (40.92 g m^{-2}) and 90 DAS (44.49 g m^{-2}). The lowest weed dry weight was obtained in the treatment W_4 (use of pre emergence herbicide + one HW at 40 DAS) at 30 DAS (17.93 g m^{-2}), 60 DAS (17.33 g m^{-2}) and in W_2 (use of rice straw mulch) at 90 DAS (22.09 g m^{-2}) (Table 3). Weed dry weight was significantly influenced by the interaction of different cultivars and weeding treatments. The highest weed dry weight was recorded in V_1W_1 (BARI Gom-28 × two HW at 20 DAS and 40 DAS) at 30 DAS (36.57 g m^{-2}), in V_2W_0 (BARI Gom-29 × no weeding) at 60 DAS (49.77 g m^{-2}) and in V_3W_0 (BARI Gom-30 × no weeding) at 90 DAS (52.14). The lowest weed dry weight was recorded in V_2W_3 (BARI Gom-29 × use of pre emergence herbicide panida) at 30 DAS (11.97 g m^{-2}), V_2W_4 (BARI Gom-29 × use of pre emergence herbicide + two HW at 20 DAS and 40 DAS) at 60 DAS (13.62 g m^{-2}) and V_3W_4 (BARI Gom-30 × use of pre emergence herbicide + one HW at 20 DAS and 40 DAS) at 90 DAS (20.35 g m^{-2}) (Table 4).

Effect of cultivar, weeding regimes and their interaction on yield and yield attributes of wheat

Wheat cultivars did not show significant differences in all the plant characters measured at harvest except number of grains $spike^{-1}$, grain and straw yields. The number of grains $spike^{-2}$ of wheat was significantly influenced by different cultivars. The highest number of grains $spike^{-1}$ (34.63) was in BARI Gom-28. The lowest number of grains $spike^{-1}$ (29.64) was found in BARI Gom-30 (Table 5). Significant variation in grain yield due to different cultivars was found in this experiment. The highest grain yield (3.44 t ha^{-1}) was recorded in BARI Gom-29 and the lowest one (2.59 t ha^{-1}) was observed in BARI Gom-28. Straw yield of wheat was also significantly influenced by the different cultivars. The highest straw yield (7.58 t ha^{-1}) was obtained in BARI Gom-29 and the lowest one (5.30 t ha^{-1}) was obtained in BARI Gom-28 (Table 5).

Significant variation in grain yield was found due to different weeding treatments. The highest grain yield (3.29 t ha^{-1}) was obtained in the treatment W_3 (use of pre emergence herbicide) which was statistically similar with the application of rice straw mulch. The use of pre-emergence herbicide Panida produced highest grain yield due to the fact that this treatment reduced weed crop competition and vigorous growth was happened and yield increased. Statistically similar yield was obtained from the application of rice straw mulch. Similar results were observed by De *et al.* (1983), Chen (1996) and Upadhyay and Tiwari (1996) who reported that application of pre-emergence herbicide produced the highest grain yield in wheat than hand weeding. The authors opined that plant absorbed soil moisture as vaporized forms but there was no enough facilities to vaporize the soil moisture in control treatment (no mulch) whereas, mulching treatments suppressed the weed growth and conserved available soil moisture and vaporized the moisture for absorption by the plants. It might have enhanced all the growth stages which directly or indirectly increased the yield of wheat. The lowest yield (2.60 t ha^{-1}) was recorded from the treatment W_4 (use of pre emergence herbicide + one hand weeding at 40 DAS). The straw yield was influenced by different weeding treatments. The highest (7.27 t ha^{-1}) straw yield was obtained in W_3 (Use of pre emergence herbicide) and the lowest straw yield (5.39 t ha^{-1}) was in the treatment of W_0 (no weeding) (Table 6). Weed management treatments showed significant influence on harvest index. The highest value (33.57%) was in the treatment W_2 (Use of rice straw mulch). On the other hand, the lowest value was in the treatment W_4 (Use of pre emergence herbicide + one HW at 40) (29.62) (Table 6).

Table 1. Occurrence of weed species (according to alphabetically of local name) in the experimental plots of wheat

SL No.	Local name	Scientific name	Family	Importance value (%)
1	Biskatali	*Polygonum orientale* L.	Polygonaceae	18.65
2	Mutha	*Cyperus rotundus* L.	Cyperaceae	14.38
3	Bathua	*Chenopodium album* L.	Chenopodiaceae	13.02
4	Dubra	*Cynodon dactylon* L.	Poaceae	10.95
5	Angta	*Panicum repens* L.	Poaceae	9.52
6	Bankafi	*Gnaphalium affine* L.	Compositae	7.51
7	Anguli	*Digitaria sanguinalis* L.	Poaceae	7.24
8	Ban masur	*Vicia sativa* L.	Leguminosae	7.14
9	Faskabegun	*Physalis heterophylla*	Solsnaceae	1.71
10	Arail	*Leersia hexandra* Sw.	Poaceae	1.68
11	Ban tula	*Soncus arvensis*	Compositae	1.36
12	Susnishak	*Marsilea crenata L.*	Marsileaceae	1.26
13	Kanainala	*Murdannia nudiflora* L.	Commelinaceae	1.23
14	Chala gas	*Hemarthria compressa* L.	Poaceae	1.1
15	Ketpapri	*Polygonum plebeium* R. Br.	Polygonaceae	1.1
16	Setodron	*Leucas aspera*	Labiatae	0.97
17	Chanchi	*Alternanthera sessilis* L.	Amaranthaceae	0.49
18	Gangpalong	*Rumex maritimus* L.	Polygonaceae	0.37
19	Haludnakful	*Spilanthesi abadicensis* A.H. Moore	Asteraceae	0.19
20	Kanaibashi	*Commelina diffusa* Burn. F	Commelinaceae	0.13

Table 2. Effect of cultivar on weed density and dry weight

Cultivar	Weed density (no. m^{-2})			Weed dry weight (g m^{-2})		
	30	60	90	30	60	90
BARI Gom-28	60.33b*	70.33a	48.60a	26.35a	28.30a	27.31b
BARI Gom-29	65.40a	64.13b	36.00b	21.89c	27.41b	26.62b
BARI Gom-30	52.80c	56.67c	34.13b	24.10b	26.46c	29.53a
Level of Significance	0.01	0.01	0.01	0.01	0.01	0.01
CV (%)	3.26	6.50	5.90	6.43	3.11	3.68

*In a column, figures with the same letter(s) or without letter do not differ significantly whereas figures with dissimilar letter differ significant at 1% level of probability.

Table 3. Effect of different weed management techniques on weed density and dry weight

Weed management techniques	Weed density (no. m^{-2})			Weed dry weight (g. m^{-2})		
	30	60	90	30	60	90
W_0	81.11 a*	94.56 a	49.11 a	28.80 a	40.92 a	44.49 a
W_1	51.11 d	59.00 c	36.78 c	28.02 a	24.66 c	22.32 c
W_2	54.44 c	66.89 b	34.11 d	25.52 b	28.32 b	22.09 c
W_3	66.89 b	55.44 d	39.89 b	20.30 c	25.73 c	27.58 b
W_4	44.00 e	42.67 e	38.00 bc	17.93 d	17.33 d	22.60 c
Level of Significance	0.01	0.01	0.01	0.01	0.01	0.01
CV (%)	3.26	6.50	5.90	6.43	3.11	3.68

* = In a column, figures with the same letter (s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT) **=Significant at 1% level of probability,

W_0 = No weeding, W_1 = Two HW at 20 DAS and 40 DAS, W_2 = Use of rice straw mulch @ 6 t ha^{-1}, W_3 = Use of pre emergence herbicide Panida @ 1L ha^{-1} and W_4 = Use of pre emergence herbicide Panida @ 1L ha^{-1} + one HW at 40 DAS

Table 4. Interaction effect of cultivar and different weed management techniques on weed density and dry weight at different DATs

Cultivar × Weed management technique	Weed density (no. m^{-2}) at different DATs			Weed dry weight (g. m^{-2}) at Different DATs		
	30	60	90	30	60	90
V_1W_0	85.67a*	86.00b	45.67b	33.37b	40.64b	37.90c
V_1W_1	56.00ef	67.00d	46.00b	36.57a	28.07f	23.55f
V_1W_2	51.00fg	78.67c	50.00ab	24.93cd	29.50ef	24.00f
V_1W_3	55.67ef	64.67d	49.00ab	22.67de	24.37g	27.35e
V_1W_4	53.33efg	55.33ef	51.33a	14.23fg	18.93i	23.74f
V_2W_0	83.33a	112.0a	50.00ab	20.63e	49.77a	43.45b
V_2W_1	62.67d	66.00d	30.67e	31.40b	29.37ef	22.44fg
V_2W_2	56.67e	57.67e	30.00e	21.00e	22.00h	22.44fg
V_2W_3	76.00b	51.33f	33.00de	11.97g	22.28gh	21.04fg
V_2W_4	48.33g	33.67i	36.33cd	24.47cd	13.62k	23.71f
V_3W_0	74.33b	85.67b	51.67a	32.40b	32.36cd	52.14a
V_3W_1	34.67h	44.00g	33.67cde	16.10f	16.55j	20.97fg
V_3W_2	55.67ef	64.33d	22.33f	30.63b	33.45c	19.84g
V_3W_3	69.00c	50.33f	37.67c	26.27c	30.53de	34.35d
V_3W_4	30.33h	39.00h	25.33f	15.10f	19.43i	20.35g
CV (%)	3.26	6.50	5.90	6.43	3.11	3.68
Level of Significance	0.01	0.01	0.01	0.01	0.01	0.01

*In a column, figures with the same letter (s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT) **=Significant at 1% level of probability, W_0 = No weeding, W_1 = Two HW at 20 DAS and 40 DAS, W_2 = Use of rice straw mulch @ 6 t ha^{-1}, W_3 = Use of pre emergence herbicide Panida @ 1L ha^{-1} and W_4 = Use of pre emergence herbicide Panida @ 1L ha^{-1} + one HW at 40 DAS, V_1 =BARI Gom-28, V_2 = BARI Gom-29 and V_3 = BARI Gom-30

Table 5. Effect of cultivar on the yield and yield characters and yield of wheat

Cultivar	Plant height (cm)	Total tillers $hill^{-1}$ (no.)	Effective tillers $hill^{-1}$ (no.)	Grains $spike^{-1}$ (no.)	1000- grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
BARI Gom-28	92.28	5.00	3.93	29.64b*	49.09	2.81b	6.03	32.98
BARI Gom-29	91.44	4.93	3.93	34.63a	47.70	2.59b	5.30c	30.80
BARI Gom-30	90.08	4.93	3.93	33.18ab	48.01	3.44a	7.58a	31.32
CV (%)	4.02	4.77	8.04	2.37	3.88	**	**	8.06
Level of Significance	NS	NS	NS	0.05	NS	0.01	0.01	NS

* In a column, figures the with same letter (s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT). NS = Not significant

Table 6. Yield and yield contributing characters of wheat as affected by different weed management practices

Weed management techniques	Plant height (cm)	Total tillers $hill^{-1}$ (no.)	Effective tillers $hill^{-1}$ (no.)	Grains $spike^{-1}$ (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
W_0	91.80	4.78	3.78	32.72	46.48	2.68c	5.39d	33.00a
W_1	92.69	5.22	4.11	30.03	48.56	2.99b	6.38b	31.84ab
W_2	92.09	4.67	3.67	32.93	49.79	3.20ab	6.38b	33.57a
W_3	91.58	4.89	3.89	33.38	47.14	3.29a	7.27a	30.47b
W_4	88.18	5.22	4.22	33.36	49.38	2.60c	6.09c	29.62b
Level of Significance	NS	NS	NS	0.94	NS	0.01	0.01	0.01
CV (%)	7.01	12.31	14.43	12.62	7.34	7.64	3.61	7.73

* In a column, figures with the same letter (s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT). NS = Not significant

W_1 = Two HW at 20 DAS and 40 DAS, W_2 = Use of rice straw mulch @ 6 t ha^{-1}, W_3 = Use of pre emergence herbicide Panida @ 1L ha^{-1} and W_4 = Use of pre emergence herbicide Panida @ 1L ha^{-1} + one HW at 40 DAS

Though plant height total tillers and effective tillers hill^{-1} were not significantly influenced by the interaction of cultivar and weed management practices but the number of grains spike^{-1} of wheat was significantly influenced by different cultivars and weed management treatment interactions. The highest number of grains spike^{-1} (37.42) was obtained in the interaction of V_1W_3 (BARI Gom-28 × application of pre-emergence herbicide Panida) which was statistically identical with other interactions except V_3W_1 interaction (BARI Gom-30 × two HW at 20 DAS and 40 DAS) in which the lowest number of grains spike^{-1} (21.52) was obtained (Table 7). The highest grain yield (4.36 t ha^{-1}) was recorded in V_2W_2 (BARI Gom-29 × use of straw mulch). This might be due to the fact that mulching treatments suppressed the weed growth and conserved available soil moisture and vaporized the moisture for absorption by the plants. The lowest grain yield (2.21 t ha^{-1}) was obtained in V_1W_4 (BARI Gom-28 × use of pre emergence herbicide + one HW at 40 DAS) (Table 7). Straw yield of wheat was also significantly influenced by the interaction of cultivar and weed management treatment. The highest (8.99 t ha^{-1}) straw yield was recorded in V_2W_3 (BARI Gom-29 × use of pre emergence herbicide) and the lowest one (4.37 t ha^{-1}) was observed in V_1W_0 (BARI Gom-28 × no weeding) treatment (Table 7). Interaction between cultivar and weed management treatment showed significant influence on harvest index. The highest harvest index (39.91%) was recorded in V_1W_0 (BARI Gom-28 × no weeding). On the other hand, the lowest value of harvest index (25.27%) was found in V_2W_0 (BARI Gom-29 × no weeding) treatment (Table 7). From the results of the study it may be concluded that BARI Gom-29 with use of straw mulch or BARI Gom-29 with application pre-emergence herbicide Panida @ 1 L ha^{-1} might be used for obtaining higher yield as well as controlling weed in an effective manner. But further studies are required in different regions of the country to confirm the present results.

Table 7. Effect of interaction between cultivar and treatment on the yield and yield characters of wheat

Cultivar × Weed management techniques	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Grains spike^{-1} (no.)	1000- grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
V_1W_0	92.73	5.00	4.00	33.51a*	48.68	2.90cde	4.37h	39.91a
V_1W_1	93.40	5.00	4.00	34.40a	48.83	2.93cd	6.14def	32.29b-e
V_1W_2	92.13	4.67	3.33	34.40a	49.83	2.38f	4.14h	36.48ab
V_1W_3	92.53	5.00	4.00	37.42a	48.24	2.56def	6.93c	25.38f
V_1W_4	90.60	5.33	4.33	33.40a	49.90	2.21f	4.91g	30.82c-e
V_2W_0	92.80	4.67	3.67	31.85a	44.09	2.27f	6.54d	25.27f
V_2W_1	91.27	5.00	4.00	34.18a	48.03	3.44b	7.25c	32.22b-e
V_2W_2	96.00	4.67	3.67	31.71a	50.17	4.36a	7.98b	35.35bc
V_2W_3	92.80	5.00	4.00	33.15a	47.30	4.06a	8.99a	30.82c-e
V_2W_4	84.33	5.33	4.33	35.00a	48.92	3.09bc	7.16c	30.36de
V_3W_0	89.87	4.67	3.67	32.80a	46.67	2.86cde	5.26g	33.82b-d
V_3W_1	93.40	5.67	4.33	21.52b	48.82	2.59def	5.76f	30.99cde
V_3W_2	88.13	4.67	4.00	32.67a	49.36	2.86cde	7.04c	28.89ef
V_3W_3	89.40	4.67	3.67	29.56a	45.87	3.25bc	5.89ef	35.22bc
V_3W_4	89.60	5.00	4.00	31.67a	49.32	2.49ef	6.19de	27.69ef
Level of Significance	NS	NS	NS	NS	NS	0.01	0.01	0.01
CV (%)	7.01	12.31	14.43	12.62	7.34	7.64	3.61	7.73

*In a column, figures with the same letter(s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT).

**=Significant at 1% level of probability, W_0 = No weeding, W_1 = Two HW at 20 DAS and 40 DAS, W_2 = Use of rice straw mulch @ 6 t ha^{-1}, W_3 = Use of pre emergence herbicide Panida @ 1L ha^{-1} and W_4 = Use of pre emergence herbicide Panida @ 1L ha^{-1} + one HW at 40 DAS,

V_1 =BARI Gom-28, V_2 = BARI Gom-29 and V_3 = BARI Gom-30

References

BBS (Bangladesh Bureau of Statistics) 2016. Statistical Yearbook of Bangladesh. Statistics Division, Ministry of Planning. Govt. Peoples' Repub, Bangladesh.

BBS (Bangladesh Bureau of Statistics) 2017.Statistical Yearbook of Bangladesh. Statistics Division, Ministry of Planning. Govt. Peoples' Repub, Bangladesh.

Begum, M., Iqbal, M.Z., Rezaul, K.S.M. and Mamun, A.A. 2003. Weed flora of wheat, mustard and lentil grown in old Brahmaputra floodplain soils of Bangladesh. Bangladesh Journal of Agricultural Sciences 30(1): 129–134

Bertholdsson, N.O. 2005. Early vigour and allelopathy – two useful traits for enhanced barley and wheat competitiveness against weeds. Weed Research. 45: 94–102. https://doi.org/10.1111/j.1365-3180.2004.00442.x

Bond, W. and Grundy, A.C. 2001. Non-chemical weed management in organic farming systems. Weed Research. 41: 383–405. https://doi.org/10.1046/j.1365-3180.2001.00246.x

Chen, L.X., Xia, S.F. and Xu, S.L. 1996. Effect of straw mulching under wheat- maize rotation system on soil fertility and crop yields. Soils. 28(3): 156–159.

Christensen, S. 1995. Weed suppression ability of spring barley varieties. Weed Research. 1995;35:241–247. https://doi.org/10.1111/j.1365-3180.1995.tb01786.x

Cosser, N.D., Gooding, J.M., Tompson, A.J. and Froud-Williams, R.J. 1997. Competitive ability and tolerance of organically grown wheat cultivars to natural weed infestations. Annals

of Applied. Biology. 130(3): 523–535. https://doi.org/10.1111/j.1744-7348.1997.tb07679.x

Dangol, D.R. and Chaudhary, N.K. 1993. Wheat-weed interactions at Rampur, Chitwan. In: Neupane,F. P. (ed.). IAAS Research Reports 1992-1993. pp. 19–37.

De, R., Rao, D.V.S.B., Rao, Y.Y., Rao, L.G.G. and Ikramuls, M. (1983). Modification of irrigation requirement of wheat through mulching and foliar application of transpiration suppressants. Irrigation Science. 4(3): 215–223. https://doi.org/10.1007/BF00285527

Didon, U.M.E. 2002. Variation between barley cultivars in early response to weed competition. Journal of Agronomy and. Crop Science. 188: 176–184. https://doi.org/10.1046/j.1439-037X.2002.00566.x

Feledyn-Szewczyk, B. 2013. The influence of morphological features of spelt wheat (Triticum aestivum ssp. spelta) and common wheat (Triticum aestivum ssp. vulgare) varieties on the competitiveness against weeds in organic farming system. Journal of Food, Agriculture and Environment. 11(1):416–421.

Feledyn-Szewczyk, B., Kuś, J., Jończyk, K., Stalenga, J. 2014. Suitability of different winter and spring varieties for cultivation in organic farming. In: Pilipavičius, V., editor. Organic agriculture towards sustainability. Rijeka: Intech. pp. 197–225. https://doi.org/10.5772/58351

Gomez, K.A. and Gomez, A.A. 1984 Statistical Procedures for Agricultural Research.John Willey and Sons. New York, Chichester, Brisbane, Toronto. pp. 97-129, 207–215.

Hoad, S., Topp, C. and Davies, K. 2008 Selection of cereals for weed suppression in organic agriculture: a method based on cultivar sensitivity to weed growth. Euphytica. 163(3): 355–366. https://doi.org/10.1007/s10681-008-9710-9

Hossain, A, Sarker, M.A.Z, Mowlick, S., Kabir, M.R. and Bazzaz, M.M. 2009. Effect of herbicides on weed control in wheat. Journal of Bioresearch. 6(1): 1–6.

Hossain, A. Chowdhury, M.A.S., Jahan, T. Sarker, M.A.I. and Akhter, M.M. 2010.Competitive ability of wheat cultivars against weeds. Bangladesh J. Weed Sci. 1(1): 65–72.

Huda, M., Begum, M., Rahman, M.M. and Akter, F. 2017. Weed composition study on wheat and boro rice in research and farmers' fields. J. Bangladesh Agril. Univ. 15(2): 148–157. https://doi.org/10.3329/jbau.v15i2.35056

Karim, S.M.R. 1987. Estimate of crop losses due to weeds in Bangladesh. Abs. 2ndAnnual Conf. Bangladesh Soc. Agron., BARI, Joydebpur. pp. 13–20.

Lemerle, D., Smith, A., Verbeek, B., Koetz, E., Lockley, P. and Martin, P. 2006. Incremental crop tolerance to weeds: a measure for selecting competitive ability in Australian wheat. Euphytica. 149: 85–95. https://doi.org/10.1007/s10681-005-9056-5

Liatukas, Ž. and Leistrumite, A. 2009. Selection of winter wheat for organic growing. Agron. Res. 7(1):381–386.

Mishra, J.S. 1997. Critical period of weed competition and losses due to weeds in major field crops. Farmers and Parliament. 23: 19–20.

Nayyar, M.M., Shafi, M., Shah, M.M., and Mahmood, T. 1994. Weed eradication studies in wheat. Abstract. 4th Pakistan Weed Science., Conference. UAF.

O'Donovan, J.T., Blackshaw, R.E., Harker, K.N., Clayton, G.W., McKenzie, R. 2005. Variable plant establishment contributes to differences in competitiveness with wild oat among wheat and barley varieties. Canadian Journal of Plant Science. 85(4): 771–776. https://doi.org/10.4141/P04-190

Rao, V.S. 2000. Principles of Weed Science (2nded.). Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, India.

Ranjit, J.D. 2002. Response of wheat weeds to straw mulch in mid plants. Proceedings of International Seminar on Mountains-Kathmandu, March 6-8, 2002. pp. 372–377.

Singh, G. Singh, O.P., Singh, S., and Prasad, K. 2010. Weed movement in late grown wheat after rice in rice-wheat system in rainfed lowland. Indian Journal of Agronomy. 55(2): 83–85.

Tariful, M.L. Emran, A.K. and Gailer, M.A. 1998. Influence of crop density and weeding frequency on crop growth and grain yield in wheat. Pertanika Journal of Tropical Agricultural. Sciences. 21(2): 123–128.

Upadhyay, V.B. and Tiwari, J.P. (1996). Influence of nitrogen, seed rate and mulch on wheat varieties under late sown conditions. Indian Journal of Agronomy. 41(4): 562-565.

WRC (Wheat Research Centre). 2007. Annual Report, 2006–07, WRC, BARI, Joydebpur, Gazipur, Bangladesh. pp. 26–51.