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Effect of cultivar and seed rate on weed infestation and crop performance of wheat

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Abstract

An experiment was carried out at the Agronomy Field laboratory of Bangladesh Agricultural University, Mymensingh during the period from November 2014 to March 2015 to study the effect of cultivar and seed rate on weed infestation and crop performance of wheat. Three wheat cultivars viz. BARI Gam 24, BARI Gam 25 and BARI Gam 26 and five seed rates viz. 80, 90, 100, 110 and 120 kg ha^{-1} were considered as the experimental treatment. The experiment was carried out in Randomized Complete Block Design with three replications. The cultivar and seed rate were significantly influenced on weed infestation and crop performance of wheat. The dry weight of weeds in cultivar BARI Gam 26 was the lowest (9.24 g m^{-2}) compared to other cultivars. The lowest dry weight of weed was recorded in the seed rate of 120 kg ha^{-1} (7.57 g m^{-2}) and the highest one (16.14 g m^{-2}) was produced in seed rate of 80 kg ha^{-1}. The highest plant height (93.27 cm), number of effective tillers $plant^{-1}$ (3.69) and 1000-grain weight (44.51g) were produced in BARI Gam 25. The highest number of spikelet $spike^{-1}$ (18.12) and grains $spike^{-1}$ (34.51) were produced by BARI Gam 26. BARI Gam 26 produced the highest grain yield (2.51 t ha^{-1}) which was as good as BARI Gam 25 (2.48 t ha^{-1}). BARI Gam 26 produced the highest grain yield with 100 kg seed rate and also a good competitor against weeds. Seed rate was a reliable factor where increasing seed rate reduced the weed dry weight production. In conclusion, cultivation of BARI Gam 26 @100 kg ha^{-1} seeds may be cultivated for higher grain yield.

Key words: Cultivar, seed rate, weed infestation, crop performance, wheat

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Introduction

Wheat is one of the most nutritious cereals and its contribution to human diet puts it in the first rank of plant that feed the world. It ranks first in area (218.5 million hectares) and third in production (713 million metric tons) among the grain crops in the world (FAO, 2013). In Bangladesh, wheat ranks next to rice in respect of production (1.3 million metric tons) and total area of 0.43 million hectares (BBS, 2013). Though, wheat is an important cereal crop in Bangladesh its average yield is low compared to other wheat growing countries of the world.

Weeds are undesirable plants, which infest different crops and inflict negative effect on crop yield either competition for water or nutrients or space or light (Reddy and Reddi, 2011). Weeds are notorious yield reducers that are, in many situations, economically more important than insects, fungi or other pest organisms. It has been estimated that globally yield reduction of wheat due to weeds is 13% (Oerke *et al*., 1994). Generally weed-crop competition is complicated as weeds are competitor of crop plant by occupying space, light, moisture and nutrient.

High yield of wheat depends on many factors but variety is considered as the key factor among them, because different varieties respond differently to their input requirements. Wheat varieties differ significantly in producing various yield components and yield (Hasan, 1995). Gail *et al.* (2004) found that

total weed density was negatively correlated with the number of winter wheat stems /m^2.Seed rate influences the yield and yield contributing characteristics of wheat (Singh and Singh, 1987). Higher amount of seed rate generally increases plant population resulting intra-crop competition thereby affecting the yield. On the other hand, lower seed rate may reduce the yield drastically as the grain yield is positively correlated with plant population (Vukadinovic *et al*., 1986). With these end in view an attempt was undertaken to evaluate the effects of different cultivars and seed rates on weed infestation and crop performance of wheat.

Materials and Methods

The experiment was carried out at the Agronomy Field Laboratory of the Bangladesh Agricultural University, Mymensingh during the period from November 2014 to March 2015 to investigate the effect of cultivar and seed rate on weed infestation and crop performance of wheat. The experimental site is located at 24.75° N latitude and 90.50°E longitude at an elevation of 18 m above the mean sea and belongs to Old Brahmaputra Floodplain (AEZ-9) (UNDP and FAO, 1988). The experimental field was a medium high land with non-calcareous dark-grey floodplain soil and silty clay loam texture having pH 6.8.

Three wheat cultivars viz. BARI Gam 24, BARI Gam 25 and BARI Gam 26 and five seed rates viz. 80, 90, 100, 110 and 120 kg ha^{-1} were considered as the experimental treatment. The experiment was carried out in Randomized Complete Block Design with three replications. The unit plot size was 4.0 m x 2.5 m. The land was opened in late November, 2014 with a tractor drawn plough. Later on, the land was ploughed and cross ploughed three times by a country plough followed by laddering to obtain the desirable tilth. The land was uniformly fertilized with urea, triple super phosphate (TSP), muriate of potash (MoP) and gypsum at the rate of 200, 160, 50 and 120 kg ha^{-1} respectively. The entire amount of TSP, MoP and gypsum and two third of urea were applied at the time of final land preparation. The rest one thirds of urea were top dressed at crown root initiation (CRI) stage i.e. 25 days after sowing (DAS). The crop received two irrigations, one at CRI stage on 25 December 2014 and the other at early booting stage on 1 February, 2015.

The weeds were found in each plot were identified and counted at 45 days after sowing. Weeds from each plot were collected by setting l m^2 quadrate. Dry weight of weeds were recorded after drying in an oven at 80°C for 72 hr. Five plants were selected randomly from each plot prior to harvest excluding boarder plants to collect the data on crop and yield contributing characters. The harvested crop of each plot was bundled separately and then carried to the threshing floor. Threshing, cleaning and drying the grain and straw of individual plot were done carefully. Grains were dried carefully up to 14% moisture content. Straws also sun dried properly. Grain and straw weights were recorded plot wise and converted to t ha^{-1}. The collected data were compiled and analyzed statistically by using the statistical package MSTAT and the mean values were adjudged as per Duncan's New Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

Weed Infestation

Effect of cultivar: The effect of cultivar on weed population and weed dry weight was statistically significant (Table 1). The maximum number of weed population was recorded in BARI Gam 24 (21.90) followed by BARI Gam 26 (19.76) which was statistically significant to BARI Gam 25 (19.57).

Table 1. Effect of wheat cultivar on the weed population and weed dry weight

Cultivar	Weed population (no.)	Weed dry weight (g m^{-2})
BARI Gam 24	21.90a	10.76a
BARI Gam 25	19.57b	10.70a
BARI Gam 26	19.76b	9.24b
CV (%)	1.29	2.59
Level of significance	**	**

** = Significant at 1% level of probability

The highest dry matter accumulation of weeds was in BARI Gam 24 (10.76 g m^{-2}) which was statistically identical with BARI Gam 25 (10.70 g m^{-2}) while dry matter accumulation of weeds in BARI Gam 26 was the lowest (9.24 g m^{-2}). It might be due to genetical characteristics of the variety. The variety BARI Gam 26 produced the highest grain yield. Contrarily, BARI Gam 24 was the shortest variety with the least production of grain and straw yield. Therefore, it rendered least competition effects on weed growth. From the correlation study, it was evident that the grain yield was negatively related to weed dry weight. This relationship between grain yield and weed dry weight supports the fact that the highly competitive variety lead to greater yield of wheat (Figure 1). This result is in agreement with that of Rashid and Khan (2000).

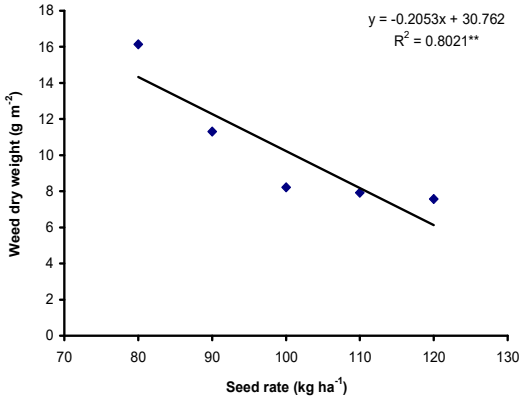

Figure 1. Functional relationship between seed rate of wheat and weed dry weight (g m^{-2})

Effect of seed rate: The seed rate also affect significantly on weed population and weed dry weight. The maximum weed population was observed at seed rate 80 kg ha^{-1} (37.11) followed by 90 kg ha^{-1} (26.38) and lowest number was recorded in 120 kg ha^{-1} (11.82). Similarly, the highest weed dry weight accumulation was noted under the seed rate of 80 kg ha^{-1} (16.14 g m^{-2}) and the lowest weed growth (7.57 g m^{-2}) was found under at seed rate of 120 kg ha^{-1}. There was vice-versa relationship was found between seed rate of 120 kg ha^{-1} and seed rate of 60 kg ha^{-1} (Table 2).

Table 2. Effect of seed rate on the weed population and weed dry weight

Seed rate (kg ha^{-1})	Weed population (no.)	Weed dry weight (g m^{-2})
80	37.11a	16.14a
90	26.38b	11.31b
100	13.74c	8.22c
110	13.00c	7.92c
120	11.82c	7.57c
CV (%)	1.29	2.59
Level of significance	**	**

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

Effect of interaction between cultivar and seed rate: The interaction effect of cultivar and seed rate on weed population and dry weight of weed was significant. The maximum number of weeds were recorded in BARI Gam 24 × seed rate of 80 kg ha^{-1} (44.67) followed by BARI Gam 26 × seed rate of 80 kg ha^{-1} (38.93) and minimum population of weeds were found in (6.25). The highest accumulation of weed dry matter (18.68 g m^{-2}) was noted in BARI Gam 24 and seed rate 80 kg ha^{-1} followed by BARI Gam 25 and seed rate 80 kg ha^{-1}. The lowest weed growth (4.56 g m^{-2}) was marked in BARI Gam 24 grown at the rate of 100 kg ha^{-1} which was statistically identical to BARI Gam 26 at 120 kg ha^{-1} seed rate (Table 3).

Effect on yield contributing characters and yield of wheat

Effect of cultivar: The variety had significant influenced crop characters, yield contributing characters and yield of wheat. The highest plant height (93.27 cm) was recorded in BARI Gam 25 which was statistically identical with BARI Gam 26 and the lowest height (87.93cm) was found in BARI Gam 24. The highest number of total tillers was obtained (5.01) from BARI Gam 24 followed by BARI Gam 25 (4.83) and lowest one was BARI Gam 26 (3.99). The highest number of effective tillers $plant^{-1}$ (3.69) was found in the variety BARI Gam 25 which was statistically identical to BARI Gam 24

(3.59) and the lowest one in BARI Gam 26. The highest number of grains spike^{-1} (34.51) was obtained in BARI Gam 26 and the lowest grains spike^{-1} (30.38) was found in BARI Gam 25. BARI Gam 25 gave the heaviest grain weight (44.51g), which was statistically identical with the variety BARI Gam 24 (44.01g) and the lowest grain weight was observed in BARI Gam 26 (42.22g) (Table 4).

Table 3. Effect of interaction of wheat cultivar and seed rate on the weed population and weed dry weight

Cultivar × Seed rate	Weed population (no.)	Weed dry weight (g m^{-2})
$V_1 \times S_1$	44.67a	18.68a
$V_1 \times S_2$	33.22c	13.86b
$V_1 \times S_3$	6.25i	4.56i
$V_1 \times S_4$	12.90gh	9.00def
$V_1 \times S_5$	12.47gh	7.68fg
$V_2 \times S_1$	27.73d	15.47b
$V_2 \times S_2$	25.77d	10.77c
$V_2 \times S_3$	18.00ef	9.81cde
$V_2 \times S_4$	13.37fgh	8.21ef
$V_2 \times S_5$	13.00gh	9.24c-f
$V_3 \times S_1$	38.93b	14.28b
$V_3 \times S_2$	20.17e	9.30c-f
$V_3 \times S_3$	16.97efg	10.30cd
$V_3 \times S_4$	12.73gh	6.53gh
$V_3 \times S_5$	10.00hi	5.79hi
CV (%)	1.29	2.59
Level of significance	**	**

In a column, figures with same letter(s) or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT.
V_1 = BARI Gam 24, V_2 = BARI Gam 25, V_3 = BARI Gam 26, S_1 = 80 kg ha^{-1}, S_2 = 90 kg ha^{-1}, S_3 = 100 kg ha^{-1}, S_4 = 110 kg ha^{-1}, S_5 = 120 kg ha^{-1}
** = Significant at 1% level of probability

The highest grain yield (2.51 t ha^{-1}) was obtained in BARI Gam 26 which was statistically identical to BARI Gam 25 (2.48 t ha^{-1}) and the lowest grain yield (1.78 t ha^{-1}) was obtained from BARI Gam 24. The effects of variety on the number of grains spike^{-1} have been reflected on the grain yield of the variety. BARI Gam 25 produced the highest straw yield (3.43) which was as good as BARI Gam 26 (3.42). The highest harvest index (42.30%) was obtained from BARI Gam 25 and the lowest one (38.10%) was obtained from BARI Gam 24 (Table 4).

Effect of seed rate: The effect of seed rate on plant height, no. of total tillers plant^{-1}, no. of effective tillers plant^{-1}, no. of grains spike^{-1}, 1000-grain weight (g), grain yield (t ha^{-1}), straw yield (t ha^{-1}) and harvest index (%) was also statistically significant . The tallest plant (93.37 cm) was obtained at 110 kg ha^{-1} which was statistically identical to 100 kg ha^{-1} and the lowest height (88.11 cm) at 90 kg ha^{-1}. The highest number of tillers plant^{-1} (6.03) was obtained in the seed rate of 100 kg ha^{-1} followed by seed rate of 100 kg ha^{-1} (5.67) and the lowest number of tillers (2.85) was found in case of seed rate 80 kg ha^{-1} (Table 5). Optimum seed rate (100 kg ha^{-1}) can fulfill the demand of crop plants which positively affect the total tillers plant^{-1}. The highest number of effective tiller plant^{-1} (4.91) was noted at seed rate 100 kg ha^{-1} and the lowest number of effective tiller (2.03) was at seed rate 80 kg ha^{-1}. The highest number of grains spike^{-1} (41.06) was in 100 kg ha^{-1} seed rate which was statistically identical with 110 kg ha^{-1} and the lowest number of grain was at seed rate 80 kg ha^{-1}. The heaviest grain weight (45.36 g) was noted in 110 kg ha^{-1} seed rate. The lowest grain weight (40.44 g) was obtained at the seed rate 90 kg ha^{-1}. The highest grain yield (2.99 t ha^{-1}) was obtained by the seed rate of 100 kg ha^{-1} followed by 100 kg ha^{-1} seed rate and the lowest grain yield (1.39 t ha^{-1}) was produced at of 80 kg ha^{-1} seed rate. Maximum plant population was produced in 120 kg ha^{-1} of seed rate which lead to higher intra-plant competition and the production of grain yield was affected accordingly. Talukder *et al.* (2004) reported that the highest grain yield (4.16 t ha^{-1}) was obtained from 100 kg ha^{-1} of seed rate in wheat. The highest straw yield (3.93 t ha^{-1}) was produced by the seed rate of 110 kg ha^{-1} and the lowest (2.31 t ha^{-1}) at the seed rate of 80 kg ha^{-1}. The highest harvest index (43.48%) was found at 100 kg ha^{-1} seed rate and the lowest one (37.98%) was at 80 kg ha^{-1} seed rate.

Effect of interaction between variety and seed rate: Different yield contributing characters and yield of wheat were significantly affected by interaction between variety and seed rate (Table 6). The highest

plant height was noticed in interaction between the variety BARI Gam 25 and the seed rate of 100 kg ha^{-1} followed by BARI Gam 26 and the seed rate of 100 and 110 kg ha^{-1}, respectively. The lowest plant height was found in BARI Gam 24 at 90 kg ha^{-1} seed rate (Table 6). The highest number of total tillers plant^{-1} (6.53) was obtained in BARI Gam 25 at seed rate of 100 kg ha^{-1} which was statistically identical with BARI Gam 24 and seed rate 110 kg ha^{-1} and the lowest number of total tillers plant^{-1} (3.26) was obtained in BARI Gam 24 with the seed rates 80 kg ha^{-1} which was statistically identical with BARI Gam 25 with at seed rate 90 kg ha^{-1} (Table 6).

Table 4. Effect of cultivar on the crop performance of wheat

Cultivar	Plant height (cm)	Total tillers plant^{-1}	No. of effective tillers hill^{-1}	No. of grains spike^{-1}	1000-grain weight (g)	Straw yield (t ha^{-1})	Harvest index (%)
BARI Gam 24	87.93b	5.01a	3.59ab	33.56b	44.01ab	2.88b	38.10b
BARI Gam 25	93.27a	4.83b	3.69a	30.38c	44.51a	3.43a	42.30a
BARI Gam 26	93.03ab	3.99c	3.09b	34.51a	42.22b	3.42a	41.94a
CV (%)	3.17	5.69	6.65	4.13	3.09	4.48	3.78
Level of significance	**	**	**	**	**	**	**

** = Significant at 1% level of probability

Table 5. Effect of seed rate on the crop performance of wheat

Seed rate (kg ha^{-1})	Plant height (cm)	Total tillers plant^{-1}	No. of effective tillers hill^{-1}	No. of grains spike^{-1}	1000-grain weight (g)	Straw yield (t ha^{-1})	Harvest index (%)
80	90.48bc	2.85e	2.03d	21.00c	42.68b	2.31b	37.98b
90	88.11c	3.19d	2.14d	23.44c	40.44c	2.37b	42.66a
100	93.35a	6.03a	4.91a	41.06a	44.60a	3.87a	43.48a
110	93.37a	5.67b	4.69b	40.34ab	45.36a	3.93a	41.22ab
120	91.74ab	5.31c	3.52c	38.26b	44.82a	3.72a	38.57b
CV (%)	3.17	5.69	6.65	4.13	3.09	4.48	3.78
Level of significance	**	**	**	**	**	**	**

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

The highest number of effective tiller (5.35) was noted due to interaction effect of variety BARI Gam 24 and the seed rate 100 kg ha^{-1} which was followed by BARI Gam 25 (5.14) and the seed rate 110 kg ha^{-1} (Table 6). The lowest number of effective tillers plant^{-1} (1.83) was recorded from the interaction of seed rate 80 kg ha^{-1} with the variety BARI Gam 24. In case of no. of grains spike^{-1} the highest value (43.77) was obtained in the combination of BARI Gam 24 with 110 kg seed ha^{-1}. The lowest grain number (19.83) was marked in combination of BARI Gam 25 under seed rate 80 kgha^{-1} (Table 6). The highest grain weight (47.61g) was noted in BARI Gam 25 at seed rate of 110 kg ha^{-1} and the lowest weight was in BARI Gam 24 at 90 kg ha^{-1} seed rate (37.96g). The highest grain yield (3.45 t ha^{-1}) was observed from the variety BARI Gam 26 with the seed rate of 100 kg ha^{-1} followed by (3.08 t ha^{-1}) BARI Gam 25 at 100 kg ha^{-1} seed rate and the lowest yield (0.96 t ha^{-1}) was obtained in BARI Gam 24 where the crop was sown with the seed rate of 80 kg ha^{-1} (Table 6). There were a good number of variations in different combination of the factors, which indicates the grain production of wheat varieties varied with different seed rates. The highest straw yield (4.27 t ha^{-1}) was produced in BARI Gam 25 at 100 kg ha^{-1}

seed rate while the lowest straw yield (1.67 t ha^{-1}) was obtained in BARI Gam 24 with 80 kg ha^{-1} seed rate which is statically identical to BARI Gam 24 under the seed rate of 90 kg h^{-1}. The highest plant height and higher number of total tillers $plant^{-1}$were led the highest straw yield in BARI Gam 25 at 100 kg ha^{-1} seed rate. Harvest index was the highest (48.62%) in BARI Gam 26 under seed rate 90 kg ha^{-1} which was statistically identical (48.05%) with BARI Gam 26 at 100 kg ha^{-1} seed rate and the lowest harvest index (31.41%) was found in BARI Gam 26 with 80 kg ha^{-1} seed rate.

Table 6. Effect of interaction between cultivar and seed rate on the crop performance of wheat

Cultivar × Seed rate	Plant height (cm)	Total tillers $plant^{-1}$ (no.)	Effective tillers $plant^{-1}$ (no.)	Grains $spike^{-1}$ (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
V_1× S_1	88.06d	3.26e	1.83h	20.16e	42.83bcd	0.96i	1.67h	36.12de
V_1× S_2	80.73e	3.13ef	1.92gh	20.30e	37.96e	1.17i	1.85h	39.01cd
V_1× S_3	89.81bcd	6.27ab	5.35a	40.27a	45.58ab	2.43cd	3.60cde	40.49bcd
V_1× S_4	92.66a-d	6.44a	5.13a	43.77a	46.86a	2.27de	3.87abc	36.98de
V_1× S_5	88.40cd	5.96b	3.74d	43.30a	46.83a	2.07ef	3.40de	37.93d
V_2× S_1	92.67a-d	2.77fg	2.14fg	19.83e	43.28bcd	1.74gh	2.01gh	46.42ab
V_2× S_2	90.86a-d	3.33e	2.17fg	25.52d	41.10d	1.92fg	2.86f	40.36bcd
V_2× S_3	95.52a	6.53a	4.79b	39.93a	45.15abc	3.08b	4.27a	41.90bcd
V_2× S_4	93.69ab	5.97b	5.14a	35.53b	47.61a	2.99b	4.13ab	42.00bcd
V_2× S_5	93.60ab	5.53c	4.19c	31.11c	45.44ab	2.67c	3.87abc	40.84bcd
V_3× S_1	90.71a-d	2.53g	2.11fgh	23.00de	41.95d	1.48h	3.24ef	31.41e
V_3× S_2	92.75a-d	3.11ef	2.33f	24.50de	42.25cd	2.28de	2.41g	48.62a
V_3× S_3	94.71ab	5.27c	4.59b	42.98a	43.07bcd	3.45a	3.73bcd	48.05a
V_3× S_4	93.76ab	4.60d	3.80d	41.71a	41.63d	3.06b	3.79bcd	44.69abc
V_3× S_5	93.22abc	4.44d	2.63e	40.36a	42.19cd	2.29de	3.90abc	36.95de
CV (%)	3.17	5.69	6.65	4.13	3.09	3.94	4.48	3.78
Level of significance	**	**	**	**	**	**	**	**

In a column, figures with same letter(s) or without letter do not differ significantly whereas figures with dissimilar letters differ significantly as per DMRT. V_1 = BARI Gam 24, V_2 = BARI Gam 25, V_3 = BARI Gam 26, S_1 = 80 kg ha^{-1}, S_2 = 90 kg ha^{-1}, S_3 = 100 kg ha^{-1}, S_4 = 110 kg ha^{-1}, S_5 = 120 kg ha^{-1}, ** = Significant at 1% level of probability

Conclusion

Results of the present study indicated that variety BARI Gam 26 was better than other two varieties. Seed rate 100 kg ha^{-1} was optimum in case of highest grain yield of wheat. So it can be concluded that variety BARI Gam 26 at 100 kg ha^{-1} seed rate could be the promising combination to obtain maximum grain yield of wheat.

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