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Effect of weeding regime on weed vegetation and yield performance of wheat in two locations of Mymensingh district

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Abstract

On-farm two experiments were carried out at the Fulbaria upazila under Mymensingh district and Agronomy Field Laboratory, Department of Agronomy, Bangladesh Agricultural University (BAU), Mymensingh during the period from November 2011 to March 2012. The experiment comprised ten fields for each of the locations which composed of three weeding regime treatments, namely, unweeded, farmers' weeded and weed free. The design was randomized complete block with ten replications. Data on weed density, yield contributing characters and yield of wheat were recorded. Except straw yield in Fulbaria all others yield contributing characters were affected significantly due to weeding regime treatment. The highest grain yield was recorded in weed-free treatment compared to farmers weeded and unweeded treatment in Fulbaria. Whereas, in Agronomy Field Laboratory at BAU, the highest grain yield was observed in weed-free treatment which was statistically identical to farmers' weeded treatment. Five dominant weed species were identified in Fulbaria naimly *Cynodon dactylon* L., *Cyperus rotundus* L., *Alternanthera sessilis* L., *Polygonum orientale* L. and *Chenopodium album* L. and in Agronomy Field Laboratory at BAU namely *Gnaphalium affine* L., *Cyperus rotundus* L., *Digitaria sanguinalis* L., *Cynodon dactylon* L. and *Panicum repens* L. Infestation of *Cynodon dactylon* L. was more in Fulbaria due to control difficulties and *Gnaphalium affine* L. was more in BAU due to weed seed bank year after year and poor cultural management. So there is scope to increase yield potential of wheat by improving existing weed control practices.

Key words: Productivity, weed vegetation, weeding regime, wheat

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Introduction

Wheat (*Triticum aestivum* L.) is the most important cereal crop all over the world in respect of high nutritional value *viz.*, protein 12%, fat 1.72%, carbohydrate 69.60% and minerals 27.2% (BARI, 1997) over rice. This crop ranks first in area 216.8 million hectares and third in production (651.4 million metric tons) among the grain crops during 2012-13 in the world (FAO, 2014). In Bangladesh, total area under wheat cultivation is 3.73 lac hectares with an annual production of 9.69 lac metric tons during 2012-2013 and average yield of 2.6 ton ha^{-1} (BBS, 2013). Though, wheat is an important cereal crops in Bangladesh, the average yield is lower than that of other wheat-growing countries around the world. On the other hand, total cultivable land in our country has been decreasing day by day due to increasing population. On the other hand, farmers have the tendency to cultivate *boro* rice during November - April. In this situation wheat cultivation can play an important role for maintaining the nutritional demand of these over population.

Weed is one of the the major constraints to wheat cultivation. Weeds can 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) and 33% in Bangladesh (Karim, 1987). The number of weed species reported to vary from country to country, where, 90 species from India (Rao, 2000), 73 from Bangladesh (Begum *et al*., 2003) and 30 from Nepal (Dangol and Chaudhary, 1993) were identified. Hossain *et al*. (2010) reported wheat fields are normally infested by 18 to 22 weed species belonging to 11-12 families. Among them, *Oxalis* species was the most dominant, accounting for 27-33% of the total. Most of the plant parameters of wheat including plant height, number of tiller, numbers of panicles, grain-weight etc. are affected by weed competition (Karim, 1987). Weeding treatments can produce higher yield attributes, grain and straw yields than weedy check treatment (Pandey *et al*. 2000). Weeding at 20 and 40 days after sowing (DAS) gave the highest grain and straw yields (Tariful *et al*., 1998).

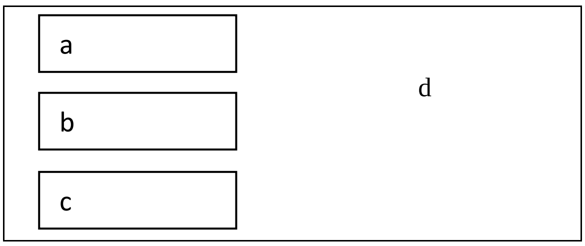
Weed control is a basic requirement and a major component of production systems (Hossain *et al*., 2009). Generally, weed-free condition is essential for obtaining optimum wheat yield. This can be achieved by removing the weeds through different weed control methods. Weeding regime can play important roles in reducing the early emergence of weed and crop weed competition. However, farmers' of Bangladesh are not interested in controlling weeds in wheat fields due to a labour crisis during the wheat-growing period (WRC, 2007). On the other hand, most of the annual weeds generally react very quickly to alternation of their environment. Thus, the weed flora in a field changes during the year, and from year to year in response to changing environment. Therefore, monitoring these temporal changes in weed species composition along with their existing control measure is important to reformulate appropriate weed control strategies to produce optimum wheat yield. So, the present study was undertaken to find out the effect of weeding regime on weed vegetation and yield components and yield of wheat in two locations of Mymensingh district.

Materials and Methods

The on-farm and site specific study was conducted in Fulbaria Upazila and Agronomy Field Laboratory, Bangladesh Agricultural University (BAU), under Mymensingh district during the period from November 2011 to March 2012 to study the weed vegetation and productivity of wheat as affected by weeding regime. Geographically the experimental site of Fulbaria is located at $24^{0}63'$ N latitude and $90^{0}27'$E longitude and BAU is located at $24^{0}04'$ N latitude and $90^{0}50'$ E longitude and at an elevation of 18 m above the sea level. The site of both location falls under the Old Bramaputra Floodplain Agroecological Zone (AEZ-9) (FAO and UNDP, 1988). Generally soil of this area belongs to the Sonatala series of non-calcareous dark grey floodplain with loamy soil. The area was medium high land with well-drained condition.

The wheat variety Shatabdi (BARI Gom 21) was used in the experiment. Three weeding regime treatments superimposed in the ten farmers' field were (i) Weed-free (ii) Farmers' weeded and (iii) Unweeded check. These on-farm experiments, each of the farmers bear three unit plots. In the weed-free treatment plots were kept weed-free throughout the life span of the crop by hand weeding when it was necessary (approximately 10 days interval) after broadcasting of wheat seeds. In unweeded treatment no weeding was done upto the harvest of the crop and in the farmers' weeded treatment farmers were allowed to control weeds in their conventional method. That means, the farmers were requested to perform the weeding operation when they do it in their fields. The superimposed position of plots in the farmers' field has been shown in Fig. 1.

a=Unweeded check, b=Farmers' weeded plot,



c=Weed-free, d=Farmers' crop

Figure1. Layout for superimposition of weeding regime in farmers' field

The experimental treatments of Fulbaria and Agronomy Field Laboratory, BAU both were same except farmers' weeded plot.

The experiment was laid out in a randomized complete block design with ten replications. The size of the unit plot was 4.0 m × 2.5 m having a plot to plot 0.5m distance for both locations. The numbers of unit plots became 30 for each location. The experimental plots were fertilized with urea, triple super phosphate, muriate of potash and gypsum at the rate of 220-180-50-120 kg ha^{-1}, respectively of both sites. Seeds were sown Fulbaria upazila and Agronomy Field Laboratory, BAU on 23 November and 24 November, 2011 respectively @ 120 kg ha^{-1}. Weeding was done as per treatment. Intercultural operations were done in order to ensure and maintain the normal growth of the crop. Data on weed species were recorded from unweeded plot by using 0.25m × 0.25m quadrate. The quadrate was placed in four spots at random in each plot. In each plot all weed species inside the quadrate were collected. The crop was harvested plot-wise at full maturity on 20 March 2012 in Fulbaria and on 21 March 2012 at Agronomy Field Laboratory, BAU from 1 m^2 area. Harvested crops were sun dried for four days. Then threshing, cleaning, drying and weighing of seeds were done and converted to t ha^{-1}. Five sample plants were selected at randomly and uprooted from each plot excluding boarder for collecting data on yield contributing characters of wheat. Data on yield and yield parameters were compiled, tabulated and analyzed statistically using the analysis of variance technique. Analysis of variance was done and the mean differences were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984) with the help of computer package program MSTAT-C.

Result and Discussion

Occurrence of weed species in wheat fields at Fulbaria upazila

The surveyed areas of Fulbaria upazilla were infested with 22 weed species belonging to 13 families (Table 1). Seven weed species were in the family Poaceae, three were in Amaranthaceae and two were in Polygonaceae. Rest of the weed species each belongs to the family Asteraceae, Borag-inaceae, Chenopodia-ceae, Commelin-aceae, Compositae, Crucife-rae, Cyperaceae, Labia-tae, Legumenosae, Scrophulariaceae and Portulacaceae. Annuals were dominant over perennials and broadleaves over grass and sedges.

Table 1. Occurrence of weed species based on family affiliation, life cycle and weed type in wheat fields at Fulbaria upazilla

Local name	English name	Scientific name	Family	Life cycle	Weed type
Chanchi	Sessile joy weed	*Alternanthera sessilis* L.	Amaranthaceae	Annual	Broad-leaved
Shaknotey	Pig weed	*Amaranthus viridis* L.	Amaranthaceae	Annual	Broad-leaved
Katanotey	Spiny pig weed	*A. spinosus* L.	Amaranthaceae	Annual	Broad-leaved
Halud nakful	Toothache plant	*Spilanthes iabadicensis* A.	Asteraceae	Annual	Broad-leaved
Hatisur	Wild clary	*Heliotropium indicum* L.	Boraginaceae	Annual	Broad-leaved
Bathua	Lambs quarter	*Chenopodium album* L.	Chenopodiaceae	Annual	Broad-leaved
Kanaibashi	Spider wort	*Commelina diffusa* Burn. F	Commelinaceae	Annual	Broad-leaved
Keshuti	False daisy	*Eclipta alba* L.	Compositae	Annual	Broad-leaved
Ban sarisha	Wild mustard	*Rorippa indica* L.	Cruciferae	Annual	Broad-leaved
Mutha	Purple nut sedge	*Cyperus rotundus* L.	Cyperaceae	Perennial	Sedge
Durba	Bermuda grass	*Cynodon dactylon* L.	Poaceae	Perennial	Grass
Angta	Joint grass	*Panicum repens* L.	Poaceae	Perennial	Grass
Anguli	Crab grass	*Digitaria sanguinalis* L.	Poaceae	Annual	Grass
Chapra	Goose grass	*Eleusine indica* (L.) Gaertn.	Poaceae	Annual	Grass
Arail	Swamp rice grass	*Leersia hexandra* Sw.	Poaceae	Annual	Grass
Khude shama	Jungle rice	*Echinochloa colonum* L.	Poaceae	Annual	Grass
Shama	Barnyard grass	*E. crus-galli* L.	Poaceae	Annual	Grass
Setodron	White verticilla	*Leucas aspera* (Willd.) Linn.	Labiatae	Annual	Broad-leaved
Ban masur	Wild lentil	*Vicia sativa* L.	Leguminosae	Annual	Broad-leaved
Khet papri	Prostate false pimpernel	*Lindernia procumbens* (Krock.) Philcox	Scrophulariaceae	Annual	Broad-leaved
Bishkatali	Smart weed	*Polygonum orientale* L.	Polygonaceae	Annual	Broad-leaved
Nunia shak	Common purslane	*Portulaca oleracea* L.	Portulacaceae	Annual	Broad-leaved

Occurrence of weed species in wheat fields at Agronomy Field Laboratory of BAU

The Agronomy Field Laboratory at BAU were infested with 20 weed species belonging to 12 families (Table 2). Five weed species belong to in the family Poaceae, three to polygonaceae, two to Commelinaceae and compositae and remaining eight weed species belong to the family Amaranthaceae, Asteraceae, Chenopodiaceae, Cyperaceae, Labiatae, Leguminosae, Marsileaceae, Scrophulariaceae and Solanaceae. Yasmin (2012) observed less number of infesting weed species of which 11 were annuals and two were perennials in wheat at Agronomy Field Laboratory. The family Poaceae contributed to the highest number of weed species than other family. Broadleaves were dominant over grasses and sedges. In contrast to, Rahman (1985) observed the most abundant weed species is *Chenopodium album* which constituted 56.5% of the total weed vegetation in wheat field at Agronomy Field Laboratory. Similarly Islam (1987) and Gaffar (1987) also observed that the most important weed in wheat field was *Chenopodium album* in wheat field at Agronomy Field Laboratory. It is interesting to observe here that long time ago *Chenopodium album* was the most dominant species but now-a-days it is shifted by other weed species due to changes of agricultural management practices. Agronomic management also changes the seed bank storage and it's above ground weed flora in associated crops.

Table 2. Occurrence of weed species based on family affiliation, life cycle and weed type in wheat fields at Agronomy Field Laboratory of BAU

Local name	English Name	Scientific name	Family	Life cycle	Weed type
Chanchi	Sessile joyweed	*Alternanthera sessilis* L.	Amaranthaceae	Annual	Broad-leaved
Halud nakful	Toothache plant	*Spilanthes iabadicensis* A.	Asteraceae	Annual	Broad-leaved
Bathua	Lambsquarter	*Chenopodium album* L.	Chenopodiaceae	Annual	Broad-leaved
Kanainala	Spreading day flower	*Murdannia nudiflora* L.	Commelinaceae	Annual	Broad-leaved
Kanaibashi	Spider wort	*Commelina diffusa* Burn. F.	Commelinaceae	Annual	Broad-leaved
Bankafi	Jersey cudweed	*Gnaphalium affine* L.	Compositae	Annual	Broad-leaved
Ban tula	Gut weed/field thistle	*Soncus arvensis* L.	Compositae	Annual	Broad-leaved
Mutha	Purple nut sedge	*Cyperus rotundus* L.	Cyperaceae	Perennial	Sedge
Durba	Bermuda grass	*Cynodon dactylon* L.	Poaceae	Perennial	Grass
Angta	Joint grass	*Panicum repens* L.	Poaceae	Perennial	Grass
Anguli	Crab grass	*Digitaria sanguinalis* L.	Poaceae	Annual	Grass
Chela ghash	Sheand grass	*Hemarthria compressa* L.	Poaceae	Annual	Grass
Arail	Swamp rice grass	*Leersia hexandra* Sw.	Poaceae	Annual	Grass
Ban masur	Wild lentil	*Vicia sativa* L.	Leguminosae	Annual	Broad-leaved
Setodron	White verticilla	*Leucas aspera* (Willd.) Linn.	Labiatae	Annual	Broad-leaved
Susni shak	4-leaved water clover	*Marsilea crenata* L.	Marsileaceae	Annual	Broad-leaved
Khetpapri	Prostate false pimpernel	*Lindernia procumbens* (Krock.) Philcox	Scrophulariaceae	Annual	Broad-leaved
Bishkatali	Smart weed	*Polygonum orientale* L.	Polygonaceae	Annual	Broad-leaved
Gang palong	Bitter dock	*Rumex maritimus* L.	Polygonaceae	Annual	Broad-leaved
Faska begun	Clammy ground cherry	*Physalis heterophylla* Nees	Solanaceae	Annual	Broad-leaved

Yield and yield contributing characters of wheat as affected by weeding regime in Fulbaria upazila

Weeding regime exerted significant effect on all yield and yield contributing characters of wheat except straw yield (Table 3). The tallest plant was found in weed-free treatment followed by farmers' weeded plot and unweeded treatments. It was observed that plant height was increased by 14.24 and 6.16% in weed-free and farmers' weeding respectively over unweeded treatment. The highest number of total tillers plant^{-1} were recorded in weed-free treatment followed by farmers' weeded plots and unweeded treatments. It was observed that number of total tillers plant^{-1} was increased by 54.59 and 12.24% in weed-free and farmers' weeding, respectively over unweeded treatment. The highest number of effective tillers plant^{-1} was in weed-free treatment. The lowest number of effective tillers plant^{-1} was found in unweeded treatment. Similar results were reported by Karim and Mamun (1988) who observed that including other parameters total number of effective tillers was affected by weed competition. In case of spike length the weed-free treatment produced longest spike which was statistically identical to farmers' weeding practice. The shortest spike was obtained from unweeded treatments (Table 3). Spike length reduced due to weed competition and it might be resulted from reduced flag leaf which ultimately caused less photosynthesis and supplied less assimilates than that required for production of normal spike length. The result was also in conformity with Karim and Mamun (1988) and Okafor (1987) who reported that spike length was reduced due to competitive stress of weeds. The highest number of spikelets spike^{-1} and 1000-grain weight was recorded in weed-free treatment followed by farmers' weeded and unweeded treatment (Table 3). Islam (1987), Mamun and Salim (1989) and Singh and Singh (1996) also recorded reduction in 1000-grain weight in wheat due to weed competition by 7.22, 29.44 and 5.00%, respectively. It was observed that number of grains spike^{-1} was increased by 48.50 and 16.83% in weed-free and farmers' weeding, respectively over unweeded treatment. The highest grain yield was recorded in the weed-free condition and the lowest grain yield was produced by unweeded treatment which was statistically identical to farmers' weeded plot. It was observed that grain yield was increased 47.74% in weed free treatment and only 0.97% in farmers weeding treatment over unweeded treatment. The highest grain yield obtained in weed-free condition was mainly due to higher number of total effective tillers plant^{-1} and heaviest 1000-grain weight. Hossain *et al*. (2001) reported that weed-free condition gave higher grain yield of wheat than unweeded treatment.

Table 3. Effect of weeding regime on yield and yield contributing characters of wheat in Fulbaria upazilla

Weeding regime	**Plant height (cm)**	**Total tillers plant^{-1} (no)**	**Effective tillers plant^{-1} (no)**	**Spike length (cm)**	**Spikelets spike^{-1} (no)**	**1000-grain wt. (g)**	**Grain yield (t ha^{-1})**	**Straw yield (t ha^{-1})**
Unweeded	83.38c	3.92c	3.16b	9.36b	33.40c	54.96c	3.10b	6.00
Farmers' weeded	88.52b	4.40b	3.52ab	10.26ab	39.02b	57.71b	3.13b	6.28
Weed-free	95.25a	6.06a	4.70a	11.14a	49.60a	60.53a	4.58a	7.03
CV (%)	2.38	15.58	17.26	7.01	11.01	1.19	12.43	17.9
Level of significance	**	**	**	**	**	**	**	NS

Figure in a column with common letter (s) do not differ significantly as per DMRT. **= Significant at 1% level of probability, NS = Non significant

Yield and yield contributing characters of wheat as affected by weeding regime at in Agronomy Field Laboratory of BAU

Weeding regime exerted significant effect on all yield and yield contributing characters of wheat except straw yield (Table 4). The tallest plant was found in weed-free treatment followed by farmers' weeded plot and unweeded treatments (Table 4). It was observed that plant height was increased by 12.70 and 4.75% in weed-free and farmers' weeding respectively over unweeded treatment. The highest number of total tillers plant^{-1} was recorded in weed-free treatment and the lowest was recorded in unweeded treatment while the intermediate result was observed in farmers' weeded treatment (Table 4). It was observed that number of total tillers plant^{-1} was increased by 45.68 and 11.73% in weed-free and farmers' weeding respectively, over unweed. Similar results were reported by Okafor (1987), and Karim and Mamun (1988). The highest number of effective tillers plant^{-1}, the longest spike, the highest number of spikelets spike^{-1} and the maximum 1000 grain weight was observed in weed-free treatment followed by farmers' weeded and unweeded treatment (Table 4). Singh and Singh (1996) observed a reduction in spike length and number of spikelets per spike of wheat by 9.76% and 40%, respectively due to weed competition. Rahman (1985) also recorded reduction in 1000-grain weight in wheat due to weed competition by 10.65%. The weed-free condition produced the maximum grain yield which was statistically identical to the farmers' weeded plot. The lowest grain yield was produced by unweeded treatment (Table 4) which was statistically identical to farmers' weeded plot. It was observed that grain yield was increased by 39.24 and 29.75% in weed-free and farmers' weeding respectively over unweeded. The highest grain yield obtained in weed-free condition was mainly due to higher number of total and effective tillers plant^{-1}, higher number of spikelets spike^{-1} and 1000-grain weight. The highest straw yield was recorded from weed-free condition followed by the farmers weeded practice. The lowest value of straw yield was obtained from unweeded treatment (Table 4). It was observed that straw yield was increased by 39.31 and 27.36% in weed-free and farmers weeding respectively over unweeded treatment. Rahaman (1985), Mamun and Salim (1989) and Singh and Singh (1996) observed reduction in straw yield in wheat due to weed competition by 31.90, 45.45 and 44.10%, respectively.

Table 4. Effect of weeding regime on yield and yield contributing characters of wheat at Agronomy Field Laboratory of BAU

Weeding regime	Plant height (cm)	Total tillers plant^{-1} (no)	Effective tillers plant^{-1} (no)	Spike length (cm)	Spikelets spike^{-1} (no)	1000-grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
Unweeded	86.06c	3.24b	2.52c	9.64c	34.18c	49.43c	1.58b	3.18c
Farmers' weeded	90.15b	3.62ab	3.04b	10.28b	41.12b	51.81b	2.05ab	4.05b
Weed-free	96.99a	4.72a	3.78a	11.10a	52.26a	55.03a	2.20a	4.43a
CV (%)	2.57	12.4	12.1	6.58	13.3	1.76	20.72	16.32
Level of significance	**	**	**	**	**	**	**	**

Figure in a column with common letter (s) do not differ significantly as per DMRT.

**= Significant at 1% level of probability, NS = Non- significant

This study reveals that, in Fulbaria upazila, farmers' weeding practices produced yield around 1% higher and 31.66% lower than unweeded and weed-free condition, respectively. This result indicates that farmers' weeding practices is not enough to produce optimum yield of wheat. On the other hand, at Agronomy Field Laboratory of BAU, although, existing weed management practice produced the significantly similar yield of weed-free condition but overall yield was very low compared to Fulbaria upazila. This result indicates that there is a scope to increase yield potentiality by improving other management practices along with weed control measures at Agronomy Field Laboratory of BAU.

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