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Impact of Planting Time and Seedbed Conditions on Little Seed Canary Grass and Lambsquarters Dynamics in Wheat

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Abstract

This study was conducted to monitor the dynamics of most problematic weeds of wheat influenced by planting dates and planting methods, little seed canary grass and lambsquarters in a two years field experiment conducted at Agronomic Research Area, University of Agriculture, Faisalabad, Pakistan. Wheat was sown through drilling in lines, broadcasting and on raised beds at November 15, November 30 and December 15 during 2008-2009 and 2009-2010. Planting methods and planting times significantly influenced the abundance of these two challenging weeds. Wheat planted on raised beds at December 15 suffered least with these two weed species. Therefore, to avoid the damage caused by little seed canary grass and lambsquarters wheat should be planted on raised beds, while delay in sowing cause substantial reduction in the occurrence of these weeds. © 2013 Friends Science Publishers

Keywords: Lambsquarters; Little seed canary grass; Planting methods; Sowing dates; Wheat

Introduction

Weeds are an important obstacle to crop production, particularly in low-input and/or organic systems and are notorious yield reducers (Penfold *et al*., 1995; Clark *et al*., 1998; Saqib *et al.*, 2012) that are, in many situations, tax more yield than insects, fungi or other pest organisms (Savary *et al*., 1997; 2000). Up to 45 weeds species have been reported in wheat field in different wheat-growing areas of the Pakistan (Qureshi and Bhatti, 2001). Little seed canary grass (*Phalaris minor* Retz.) and lambsquarters (*Chenopodium album* L.) have been reported as the frequently occurring and densely populated weeds of wheat in the country among the other problematic weeds (Siddiqui and Bajwa, 2001). Lambsquarters is an annual weed of cultivated ground and is considered to be a very serious weed of many crops in the world (Randall, 2003). In Pakistan, lambsquarters is the most prevailing weed in the wheat fields (Siddiqui and Bajwa, 2001) and significantly reduced grain yield up to 65% through competition (Siddiqui, 2005). Little seed canary grass is distributed throughout the world. It commonly grows during the winter season in wheat and several other winter crops. It is one of the major constraints for increasing wheat crop productivity and about 28% of wheat fields are infested with little seed canary grass, causing about 40% losses in the yield of wheat (Byerlee *et al*., 1986). In an experiment, Siddiqui *et al.* (2010) conducted a field trial regarding the effect of some problematic weeds on the growth and yield of wheat crop and in the plots, where they maintain 1:1 weed-crop ratio, they observed a maximum yield reduction of 76% as compared to the plots, where weed management practice was used.

Wheat can be sown by different methods, line sowing by drilling, broadcasting and raised bed planting. Each of the sowing method has a fluctuating impact on weed antagonism (Ashrafi *et al.*, 2009). Crops sown on raised beds have less weed infestation than the flat/flood irrigation system. Weed dry biomass under raised beds was 31% lower than in basins for wheat crop (Hassan *et al*., 2005). Moreover, in comparison of different sowing methods, raised bed planting and drilling in lines suffered less weed population than the broadcast method (Ram *et al*., 2005; Aggarwal and Goswami, 2003; Tanveer *et al*., 2003). Similarly, planting date is of particular importance, which has a crucial impact on the periodicity of weed seed germination (Berzsenyi, 2000). In case of December 15 planting, Subhan *et al*. (2003) observed less weed density and dry weed biomass as compared to early and mid-plantings of October 15 and November 15.

Interaction between sowing dates and planting methods of wheat remained unknown and influence of this interaction on the dynamics of little seed canary grass and lambsquarters needed investigation. This experiment was conducted to investigate the occurrence and dry biomass of little seed canary grass and lambsquarters in wheat under different sowing methods planted at varying dates.

Materials and Methods

Experimental Details

The field investigation was conducted during years 2008-2009 and 2009-2010 at the research area Department of Agronomy, University of Agriculture, Faisalabad (31.25°N,

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73.09°E with 184.8 m altitude). While the first year of study, more average rainfall was received during the whole crop season, while in second year average rainfall was less (Table 1). During 2008-2009, mean temperature was higher in early months of crop season (Nov-Feb), while it was higher in late crop season (Mar-Apr) during second year (Table 1). The soil of the experimental plot belongs to the Lyallpur soil series (Aridisol-fine-silty, mixed, hyperthermic Ustalfic, Haplargid in USDA classification and Haplic Yermosols in the FAO classification scheme). The preceding history of the field showed heavy infestation of little seed canary grass and lambsquarters. Before the sowing of crop, soil samples were collected to a depth of 0-15 cm and 15-30 cm with soil auger and analyzed for various physico-chemical properties like organic matter content (0.66-0.53%), EC (0.23-0.37 dS m^{-1}), Soil pH (8.4-8.3) and Exchangeable sodium (0.9-1.0 mmol 100 g^{-1}). Wheat cultivar Sehar-2006 was sown on raised bed, by drilling and by broadcast method on November 15, November 30 and December 15. Raised beds of 2 feet width were prepared with the help of spade with furrows of 1 foot width in between. There were 3 beds in one plot and 4 rows of wheat on each bed. In drill sowing, single row hand drill was used to sow the seed in 22.5 cm spaced lines and there were 12 lines in one plot. While in case of broadcasting, the same amount of seed was simply broadcasted in each plot.

Crop Husbandry

A basal dose of nitrogen, phosphorus and potash at 146 kg N, 85 kg P_2O_5 and 35 kg KCl ha^{-1} was applied in the respective plots in the form of urea and diammonium phosphate and sulphate of potash, respectively. The whole P, K and one third of N in the form of DAP (diammonium phosphate), SOP (sulphate of potash) and urea, respectively was broadcasted at the time of sowing, while remaining N was applied in two equal splits i.e., $1/3^{rd}$ with first irrigation and $1/3^{rd}$ with 2^{nd} irrigation. The first irrigation was done 20 days after crop emergence, and subsequent irrigations were done at different critical crop stages especially at tillering, booting, anthesis and grain development stage. Five irrigations were applied during the whole season.

Observations

A 1 m × 1 m quadrate was placed at two places in respective plots to record the density of little seed canary grass and lambsquarters. Weeds were cut from the ground level and brought to the laboratory to record their biomass. The dry weight of weeds was determined by drying in an oven at 70ºC until constant weight was achieved. After that their dry weight was measured with the help of electric balance. This was repeated at 40, 60 and 80 d after sowing.

Statistical Analysis

Experiment was laid out in randomized complete block design (RCBD) having split plot arrangements with three replications. Sowing dates were kept in the main plots, while sowing methods were placed in the sub plots. Analysis of the data was carried out by using Fisher's analysis of variance technique and least significance difference test (LSD test) at 5% was applied to compare the difference among treatment means (Steel *et al.*, 1997).

Results

Lambsquarters

Density and dry biomass of lambsquarters was significantly differed during both the year of experimentation (Table 2). All the sowing methods and planting times significantly affect the density and dry biomass of lambsquarters, recorded at 40, 60 and 80 days of sowing (DAS) during both the years 2008-2009 and 2009-2010. Interaction between sowing dates and planting methods was also significant during both years of experimentation (Table 2). Minimum density and dry biomass of lambsquarters was harvested where wheat was planted on beds at December 15 (D_3M_1) during both years and this was either statistically similar or followed by the treatments where wheat was drilled in lines at December 15 (D_3M_2) and sown on beds at November 30 (D_2M_1) during both the years (Table 2). However, maximum density and dry biomass of lambsquarters, where wheat was planted by broadcast method at November 15 (D_1M_3) at all recorded times during both years (Table 2). Among the different sowing dates minimum density and dry biomass of lambsquarters was observed where wheat was planted at December 15 and in comparison to November 15 planted wheat, reduction in density of lambsquarters by December 15 and November 30 planted wheat was 64 and 53%, while reduction in dry biomass of lambsquarters was 84 and 63%, respectively (Table 2). Similarly planting methods also differed significantly in their influence upon density and dry biomass of lambsquarters and minimum density and dry biomass of lambsquarters was recorded where wheat was planted on raised beds. In comparison to broadcasted wheat, density of lambsquarters recorded in bed planted and drilled wheat was 46 and 27% less while reduction in dry biomass of lambsquarters by bed planted and drilled wheat was 58 and 31%, respectively (Table 2).

Little Seed Canary Grass

Data regarding density and dry biomass of little seed canary grass revealed that all the sowing dates and planting methods significantly affected the total weed dry biomass recorded at all harvests during both the years of experimentation (Table 3). Interaction between sowing dates and methods was significant for dry biomass of little seed canary grass, recorded at all thee harvests during the years 2008-2009 and 2009-2010, where minimum dry biomass of little seed canary grass was observed when

Table 1: Meteorological data during the crop growing season 2008-2009 and 2009-2010

Month	Temperature (°C)						Relative humidity (%)		Rainfall (mm)	
	Maximum		Minimum		Mean					
	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10	2008-09	2009-10
Nov	23.7	25.7	12.2	10.8	19.7	18.2	58.4	64.7	0.0	0.7
Dec	22.9	22.1	9.1	7.0	15.5	14.5	68.9	64.4	14.6	0.0
Jan	19.6	16.2	7.3	6.2	13.5	11.1	68.0	82.3	13.5	0.8
Feb	22.1	22.0	9.9	9.5	16.0	15.7	64.1	62.7	18.2	11.9
Mar	27.5	30.4	14.1	16.5	20.8	23.5	53.5	57.5	14.0	8.8
Apr	33.5	38.4	19.1	21.4	26.3	29.9	41.7	36.8	22.9	1.3

Source: Agri-Meteorology Cell, Department of Crop Physiology, University of Agriculture, Faisalabad

Table 2: Effect of sowing dates and sowing methods of wheat on the density and dry biomass of lambsquarters

Sources of variation	Density (m^{-2})						Dry biomass (g m^{-2})					
	40 DAS		60 DAS		80 DAS		40 DAS		60 DAS		80 DAS	
Sowing dates	2008-09	2009-10	2008-09	2008-09	2009-10	2008-09	2008-09	2009-10	2008-09	2008-09	2009-10	2008-09
D_1 = November 15	71.32 a†	64.88 a	53.32 a	63.56 a	72.00 a	60.00 a	8.56 a†	3.56 a	10.56 a	6.32 a	11.56 a	11.88 a
D_2 = November 30	36.88 b	36.24 b	20.24 b	39.56 b	33.8 b	17.56 b	0.8 b	0.8 b	2.96 b	3.68 b	7.08 b	5.08 b
	(-48)	(-44)	(-62)	(-38)	(-53)	(-71)	(-91)	(-78)	(-72)	(-42)	(-39)	(-57)
D_3 = December 15	25.12 c	20.68 c	6.44 c	65.76 a	3.56 c	21.12 b	0.24 c	0.28 c	0.72 c	2.04 c	2.2 c	3.48 c
	(-65)	(-68)	(-88)	(3)	(-95)	(-65)	(-97)	(-92)	(-93)	(-68)	(-81)	(-71)
LSD (p) 0.05	1.96	9.8	7.96	8.16	6.72	11.40	0.12	0.36	0.64	0.52	1.16	0.76
Sowing methods												
M_1 =Bed Sowing	31.32 c	16.24 c	24.44 c	31.32 c	31.32 b	25.56 b	2.68 c	0.52 c	3.68 c	1.64 c	4.24 c	3.00 c
	(-47)	(-74)	(-24)	(-63)	(-25)	(-42)	(-29)	(-79)	(-39)	(-74)	(-54)	(-75)
M_2 = Drill Sowing	42.68 b	42.24 b	27.32 b	54.00 b	36.24 ab	28.68 b	3.2 b	1.6 b	4.52 b	4.2 b	7.4 b	5.44 b
	(-28)	(-33)	(-15)	(-35)	(-13)	(-35)	(-15)	(-37)	(-25)	(-32)	(-20)	(-55)
M_3 = Broadcasting	59.32 a	63.32 a	32.24 a	83.56 a	41.80 a	44.44 a	3.76 a	2.52 a	6.04 a	6.2 a	9.2 a	12.00 a
LSD (p) 0.05	4.92	4.48	2.4	3.24	6.08	7.28	0.16	0.20	0.48	0.40	1.36	0.56
Interactions												
D_1M_1	56.00 c	28.68 de	50.68 b	48.00 e	61.32	46.68 bc	7.72 b	1.36 d	9.44 b	2.48 ef	9.36 bc	4.04 e
D_1M_2	69.32 b	69.32 c	54.00 ab	54.68 d	73.32	50.00 b	8.92 a	4.12 c	9.96 d	7.4 b	12.48 a	9.76 b
D_1M_3	88.68 a	96.68 a	55.32 a	97.32 a	81.32	83.32 a	9.04 a	5.2 a	12.32 a	9.08 a	12.92 a	21.8 a
D_2M_1	20.68 f	13.32 fg	18.68 d	18.00 h	29.32	11.32 d	0.12 e	0.16 e	1.24 ef	1.96 f	2.56 de	4.24 e
D_2M_2	33.32 d	40.00 d	22.00 d	37.32 f	32.00	14.00 d	0.44 d	0.32 e	3.2 d	3.08 de	7.36 c	4.48 e
D_2M_3	56.68 c	55.32 c	32.00 c	63.32 cd	40.08	27.32 cd	1.84 c	2.00 d	4.48 c	6.04 c	11.36 ab	6.52 d
D_3M_1	17.32 f	06.68 g	4.00 f	28.00 g	3.32	18.68 d	0.12 e	0.08 e	0.36 f	0.52 g	0.88 e	0.76 g
D_3M_2	25.32 ef	17.32 ef	6.00 ef	70.00 c	3.32	22.00 d	0.28 de	0.36 e	0.4 f	2.12 f	2.32 de	2.04 f
D_3M_3	32.68 de	38.00 d	9.32 e	88.00 b	4.00	22.68 d	0.36 de	0.36 e	1.36 e	3.52 d	3.36 d	7.68 c
LSD (p) 0.05	8.52	7.76	4.12	5.64	10.56	17.56	0.28	0.32	0.84	0.68	2.36	0.96

†Means not sharing a letter in common differ significantly at 0.05 p; Figures in parenthesis show percent decrease over November 15 and Broadcasting; NS*= Non-Significant

wheat was planted on raised beds at December 15 (D_3M_1) and this was either statistically similar or followed by the treatments where wheat was drilled in lines at December 15 (D_3M_2) and sown on beds at November 30 (D_2M_1) during both the years (Table 3), but this interaction was non-significant at 40 DAS during first year. Regarding density of little seed canary grass, interaction between sowing dates and methods was non-significant recorded at all harvests except at 80 DAS during second year where in a similar way, minimum density of little seed canary grass was observed in wheat planted on raised beds at December 15 (D_3M_1), which was statistically similar to the wheat drilled in lines at December 15 (D_3M_2) and sown on beds at November 30 (D_2M_1) (Table 3). Among the different sowing dates minimum density and dry biomass of little seed canary grass was recorded, where wheat was planted at December 15 and in comparison to November 15 planted wheat, density of little seed canary grass recorded at December 15 and November 30 planted wheat was 69 and 54% less respectively, while reduction in dry biomass of little seed canary grass at December 15 and November 30 planted wheat was 79 and 64% in comparison to wheat planted at November 15, respectively (Table 3). Likewise planting methods also differed significantly in their affect upon density and dry biomass of little seed canary grass and minimum attributes of little seed canary grass were recorded where wheat was planted on raised beds. While in comparison to broadcasted wheat, density of little seed canary grass recorded in bed planted and drilled wheat was 71 and 42% less respectively and dry weight of little seed canary grass was 78 and 47% lower under bed and drill planted wheat respectively (Table 3).

Discussion

There are several studies showing that the competitive ability of weeds largely depends upon their time of emergence relative to the crop (Ross and Harper, 1972;

Table 3: Effect of sowing dates and sowing methods on the density and dry biomass of little seed canary grass

Sources of variation	Density (m^{-2})						Dry biomass ($g\ m^{-2}$)					
	40 DAS		60 DAS		80 DAS		40 DAS		60 DAS		80 DAS	
Sowing dates	2008-09	2009-10	2008-09	2008-09	2009-10	2008-09	2008-09	2009-10	2008-09	2008-09	2009-10	2008-09
D_1 = November 15	5.76	13.32 a	12.00 a	24.2 a	7.76 a	22.24 a	0.44 a	0.8 a	4.88 a	7.64 a	11.56 a	31.2 a
D_2 = November 30	5.56	2.88 b	2.44 b	8.88 b	5.56 a	18.00 a	0.12 b	0.12 b	0.04 b	5.00 b	4.60 b	22.16 b
		(-78)	(-80)	(-63)	(-28)	(-19)	(-73)	(-85)	(-99)	(-35)	(-60)	(-29)
D_3 = December 15	2.88	7.32 ab	0.44 b	6.68 b	2.00 b	9.12 b	0.12 b	0.12 b	1.24 b	0.96 c	0.72 c	11.92 c
		(-45)	(-96)	(-72)	(-74)	(-59)	(-73)	(-85)	(-75)	(-87)	(-94)	(-62)
LSD (p) 0.05	4.52	6.40	3.32	4.6	2.48	6.24	0.12	0.28	1.32	1.24	0.72	3.8
Sowing methods												
M_1 =Bed Sowing	2.24 b	2.00 c	2.88 b	6.88 c	2.68 c	6.24 c	0.12 b	0.04 b	1.0 b	0.88 c	3.64 c	4.00 c
	(-72)	(-85)	(-58)	(-69)	(-65)	(-78)	(-70)	(-92)	(-74)	(-90)	(-52)	(-91)
M_2 = Drill Sowing	4.00 b	7.76 b	5.12 a	10.44 b	5.12 b	14.68 b	0.16 b	0.48 a	1.28 b	3.88 b	5.68 b	16.08 b
	(-50)	(-44)	(-26)	(-53)	(-32)	(-48)	(-60)	(-8)	(-66)	(-56)	(-25)	(-64)
M_3 = Broadcasting	8.00 a	13.76 a	6.88 a	22.44 a	7.56 a	28.44 a	0.4 a	0.52 a	3.8 a	8.84 a	7.6 a	45.16 a
LSD (p) 0.05	2.72	3.2	1.88	3.12	1.96	2.56	0.12	0.12	0.67	0.80	0.68	2.08
Interactions												
D_1M_1	4.00	6.68	8.00	15.32	4.68	4.68 e	0.28 NS*	0.08 bcd	2.2 bc	2.08 cd	8.24 c	1.64 f
D_1M_2	6.00	14.00	12.00	23.32	8.00	24.68 b	0.44	1.24 a	2.6 b	9.12 b	10.96 b	22.08 c
D_1M_3	7.32	21.32	16.00	34.00	10.68	37.32 a	0.64	1.08 a	9.8 a	11.68 a	15.52 a	69.88 a
D_2M_1	2.68	0.00	0.00	2.68	3.32	9.32 cde	0.04	0.00 d	0.00 e	0.4 de	2.72 f	9.28 e
D_2M_2	4.68	3.32	0.68	5.32	5.32	12.68 cd	0.04	0.08 bcd	0.01 e	2.16 c	4.84 e	10.88 de
D_2M_3	9.32	5.32	0.68	18.68	8.00	32.00 a	0.20	0.24 b	0.08 e	12.48 a	6.28 d	46.28 b
D_3M_1	0.00	1.32	0.68	2.68	0.00	4.68 e	0.00	0.028 cd	0.8 de	0.12 e	0.00 h	1.12 f
D_3M_2	1.32	6.00	2.68	2.68	2.00	6.68 de	0.028	0.08 bcd	1.28 bcd	0.4 de	1.24 g	15.28 d
D_3M_3	7.32	14.68	4.00	14.68	4.00	16.00 c	0.32	0.24 bc	1.6 cd	2.36 c	0.96 gh	19.32c
LSD (p) 0.05	4.76	5.52	3.28	5.44	3.4	4.48	0.24	0.24	1.16	1.44	1.16	3.64

†Means not sharing a letter in common differ significantly at 0.05 p; Figures in parenthesis show percent decrease over November 15 and Broadcasting; NS*= Non-Significant

Hawton and Drennen, 1980). In this study, lambsquarters and little seed canary grass infestation was much higher in case of early planted wheat while delay in sowing not only decreased the density but also the dry weight of both these weeds species (Tables 2, 3). It may be due to the favorable temperature during mid-November, which was suitable for the emergence and establishment of associated weeds (lambsquarters and little seed canary grass) of wheat crop, as temperature during late planting was lower which do not allow the weed seeds to germinate hence, reduce the dynamics of weeds (Table 1). Previously, in comparison of different planting times of wheat, much higher weed density was recorded in early plantation rather in delayed sowing (Subhan *et al*., 2003). While low temperature during December inhibits the germination of lambsquarters and little seed canary grass. Another field study indicated that delay in sowing of wheat past November reduced weed population to a significant level with simultaneous reduction in wheat yield (Bhan, 1987). However, weed flora differed significantly between the years; possibly due to the difference in precipitation received and temperature between the two experimental years, as more precipitation was received during 2008-2009 and mean temperature was also more favorable for germinating weeds during 2008-2009 (Table I). The manipulation of sowing date of wheat plays an important role in the management of associated weeds. Since wheat crop is being sown over a period of two months, the emergence and growth of associated weeds in relation to planting time may influence the antagonism of weeds (Chester, 1993).

Different wheat sowing methods significantly influenced the density and dry biomass lambsquarters and little seed canary grass during both the years of experimentation (Tables 2, 3). Possible reason of the low weed pressure in bed sowing is weed seeds are usually present in the upper soil layer and are buried to deeper depth during bed preparation and may not germinate well. Higher weed population in broadcasted wheat was possibly due to the poor stand establishment of wheat, which allow the weeds species to dominate, as seeds are not placed at proper depth by broadcasting. Whereas in case of drilled and bed planted wheat seeds were placed at proper depth and there was better and uniform wheat germination, which suppressed the germination and growth of lambsquarters and little seed canary grass (Tables 2, 3). In comparison of different sowing methods of wheat, 30-40% less weed infestation was recorded in raised beds than the traditional flat sowing in line and broadcasting (Ram *et al*., 2005; Ghani and Zahid, 2006; Mollah *et al*., 2009). Similarly, in comparison between drill sowing and broadcasting of wheat, more lambsquarters and little seed canary grass density and dry biomass was recorded in broadcasted wheat and this was probably due to low wheat plant population achieved from broadcasting (Hassan *et al*., 2003). Greater competitive ability of plants has often been linked to rapid emergence, early canopy cover, and anticipation of limited resources. However, a number of studies have shown that species with delayed emergence or slow initial growth rates may later come to dominate a mixture (Lutman, 1989; Regnier and Soller, 1989; Wilson and Wright, 1990).

In conclusion, delay in sowing caused substantial reduction in the infestation of lambsquarters and little seed canary grass. Similarly selection of appropriate sowing method is also very necessary for minimum problem of said weed species and raised bed planting is best method to avoid influx of lambsquarters and little seed canary grass.

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