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Agronomic Management for Enhancing Control of Malva neglecta Wallr. and Wheat (*Triticum aestivum* L.) Productivity

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A B S T R A C T

Field study was conducted at experimental farm of Punjab Agricultural University, Ludhiana (India) during *rabi* season of 2004-05 and 2005-06 in split plot design and treatments were replicated four times. The main plots comprised of three dates of sowing viz., end October, mid November and 1st week of December. Sub plots comprised of eight combinations of three treatments viz., two spacings (15 cm and 22.5 cm), two seed rates (100 and 120 kg/ha) and two weed control treatments (hand weedings twice at 30 & 45 DAS and unweeded). The results of study revealed that early sown wheat crop (end Oct.) recorded significantly higher population, plant height, branches/plant and dry matter accumulation of *Malva neglecta* as well as higher growth parameters, yield attributes and grain as well as straw yields of wheat crop than mid Nov. and 1st week of Dec. sown crop. Closer spacing (15 cm) registered significant superiority over wider spacing (22.5 cm) in respect of *M. neglecta* control, crop growth parameters, yield attributes and grain yield of wheat. Different seed rates did not exhibit any significant difference on *M. neglecta* and wheat crop. Hand weeding twice was significantly better in controlling *M. neglecta* and registered better growth parameters, yield attributes and grain yield of wheat crop.

Introduction

Wheat (*Triticum aestivum* L.) is one of the most important and widely cultivated cereal crop of India and occupies a prime position among the food crops in terms of production and consumption. It is the premier *rabi* crop of Punjab, Haryana, Uttaranchal and Madhya Pradesh. With the introduction of short statured, high yielding and input responsive Mexican wheat varieties, the cultivation of crop has gained a special significance in the state of Punjab. The Punjab state being "the wheat bowl of the country", covers 3.52 m ha producing 17.98 m tonnes of wheat grains with an average yield of 5097 kg/ha (Anonymous, 2011). Thus, wheat plays an important role in the agricultural economy of Punjab.

Among the various factors responsible for low yield of wheat crop, weed infestation is

the major one. With the adoption of dwarf genotypes of wheat over an extensive area under the intensive cropping system in Punjab, grass and broadleaf weeds are flourishing luxuriantly. Weeds compete with crop plants for essential growth factors such as light, space, nutrients, soil moisture, CO_2 etc. and cause heavy reduction in yield. Among the dicot weeds in wheat crop, *Malva neglecta* Wallr. is a new emerging problematic weed.

Malva neglecta Wallr. commonly known as common mallow/ button weed/cheese plant/cheese weed and belongs to mallow family (Malvaceae). It is a broadleaf winter annual weed. It propagates through seed. It was introduced from Europe and found throughout in the United States in waste areas, gardens and cultivated land. During 1997 and 1998, it was intercepted and identified in wheat grain consignments imported through 10 major ports of India (Singh, 2001).

Several selective herbicides most commonly used for the control of broad leaf weeds have been tried against *M. neglecta* but none have provided a consistently high degree of control at the rates tested (Maurice and Cole, 1986). So to formulate any effective weed control strategy by following agronomic management is of paramount importance to knock it out at the most vulnerable stage. Hence, in the light of such complexities, the present investigation was carried out to study the effect of different agronomic practices for the management of *M. neglecta* and their effect on wheat yield.

Materials and Methods

The field experiment was conducted at the Student's Research Farm of the Department of Agronomy, Punjab Agricultural University, Ludhiana, during rabi season of 2004-05 and 2005-06. Soil of the experimental field was sandy loam in texture, normal in soil reaction and electrical conductivity, low in organic carbon and available nitrogen, medium in available phosphorus and potassium. The experiment was laid out in split plot design and treatments were replicated four times. The main plots comprised of three dates of sowing viz., end October, mid November and 1st week of December. Sub plots comprised of eight combinations of two spacings (15 cm and 22.5 cm), two seed rates (100 and 120 kg/ha) and two weed control treatments (Hand weedings twice at 30 & 45 DAS and unweeded)

After the harvesting of previous crop, two cultivations were given with a tractor-drawn cultivator followed by planking. The crop was manually sown with hand drill by kera method on October 27, November 15 and December 7 during 2004 and on October 28, November 16 and December 7 during 2005, respectively keeping row to row spacing of 22.5 cm and 15 cm each with a seed rate of 100 kg and 120 kg/ha. In two hand weedings treatment, first and second hand weeding was done with khurpa 4 and 6 weeks after sowing, respectively. Wheat was raised with recommended package of practices. The crop was harvested on April 7, 2005 and April 14, 2006, during the first and second year, respectively. Data on population, plant height, branches/plant and dry matter accumulation of *M. neglecta*, growth parameters, yield attributes and yield of wheat were recorded at harvest to draw valuable conclusions.

Results and Discussion

Effect on weeds

The perusal of data presented in Table 1 shows that wheat crop sown during end Oct.

registered significantly higher population, plant height, branches/plant and dry matter accumulation of *Malva neglecta* as compared to mid Nov. and 1st week of Dec. sown crop. Further, mid Nov sown crop recorded significantly higher plant height, branches/plant and dry matter accumulation by *M. neglecta* as compared to 1st week of Dec. sown crop during both the years. The more infestation of *M. neglecta* under end Oct. and mid Nov. sown crops might be due to availability of conducive temperature and other weather conditions for growth of weed plants. *M. neglecta* can germinate between 5°C to 30°C but maximum seeds germination was recorded between 15°C to 20°C (Makowski, 1987). Among the row spacing, wider spacing of 22.5 cm registered significantly higher population, plant height, branches/plant and dry matter accumulation of *M. neglecta* as compared to closer spacing of 15 cm for wheat sowing during both the years.

This might be due to availability of more space, nutrients, water and light etc. for weed plants to grow in 22.5 cm spacing. Seed rate of wheat did not exhibit any significant difference on *M. neglecta* infestation. Regarding weed control treatments, hand weeding twice treatment showed significantly lower poulation, plant height, branches/plant and dry matter accumulation of *M. neglecta* as compared to control (unweeded) treatment during both the years. This might be due to suppressing of weed plants by the crop growing in partial weed free conditions.

Effect on wheat crop

Among the dates of sowing, end Oct. sown wheat crop recorded significantly higher growth parameters (plant height, tiller count, dry matter accumulation), yield attributes (spike length, grains/spike and test weight), grain and straw yield than mid Nov. and 1st week of Dec. sown crop during both the years (Table 2 & 3). Further, mid Nov. sown wheat crop registered significantly higher crop growth parameters except plant height, yield attributes and grain as well as straw yield than 1st week of Dec. sown crop during both the years.

The higher growth parameters, yield attributes and grain yield of wheat in the earlier date of sowing might be due to conducive temperature during this period of crop growth and longer duration of crop growth despite higher infestation of *M. neglecta*. However, with delay in sowing, there was significant reduction in grain yield of wheat crop. Similar findings were also reported by Nainwal and Singh (2000) and Shivani *et al.* (2001).

Regarding spacing, closer spacing of 15 cm showed significantly higher growth parameters, yield attributes and yields (grain and straw) than wider spacing of 22.5 cm during both the years. The increase in grain yield in closer spacing in comparison to wider spacing might be attributed to the more number of effective tillers/m^2, spike length, grains/spike, 1000-grain weight and less infestation of *M. neglecta*. These findings confirm the results of Behera (1995) and Jena and Behera (1998).

However, seed rate treatments did not exhibit any significant difference regarding growth parameters, yield attributes and grain as well as straw yield of wheat crop during both the years. Among the two weed control treatments, hand weeding twice recorded significantly higher values for growth parameters, yield attributes, grain and straw yield of wheat than control (unweeded) during both the years.

Table 1. Effect of dates of sowing, row spacings, seed rates and weed control treatments on population, plant height, number of branches and dry matter accumulation of *M. neglecta* at harvest

Treatment	Population/m^2*		Plant height (cm)		Branches/plant		Dry matter accumulation (q/ha)*	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
Dates of sowing								
End Oct.	6.8 (50.0)	7.2 (55.0)	109.5	107.0	19.6	19.4	3.8 (13.9)	4.2 (17.5)
Mid Nov.	4.1 (18.0)	4.5 (21.0)	94.5	92.0	16.0	15.3	2.8 (7.2)	3.2 (9.3)
1st wk of Dec.	3.8 (15.0)	4.2 (18.0)	88.0	86.0	13.0	12.6	2.6 (5.9)	2.9 (7.7)
LSD (P = 0.05)	0.39	0.37	4.7	3.3	2.1	1.3	0.18	0.19
Row spacing (cm)								
22.5	5.3 (31.0)	5.6 (35.0)	98.7	96.2	16.5	16.1	3.3 (10.2)	3.7 (12.8)
15.0	4.5 (24.0)	4.9 (28.0)	96.0	93.8	15.9	15.5	2.9 (7.7)	3.2 (10.1)
LSD (P = 0.05)	0.21	0.19	2.4	1.4	0.48	0.41	0.12	0.13
Seed rates (kg/ha)								
100	5.0 (27.0)	5.4 (32.0)	97.7	95.4	16.3	15.9	3.1 (9.3)	3.5 (11.8)
120	4.8 (27.0)	5.2 (30.0)	96.9	94.6	16.1	15.6	3.0 (8.6)	3.4 (11.1)
LSD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Weed control treatments								
Hand weeding twice	3.6 (14.0)	4.1 (17.0)	92.5	90.8	15.2	14.6	2.8 (7.2)	3.3 (9.7)
Unweeded	6.2 (42.0)	6.5 (45.0)	102.1	99.2	17.2	16.9	3.3 (10.7)	3.7 (13.2)
LSD (P = 0.05)	0.21	0.19	2.4	1.4	0.48	0.41	0.12	0.13

*Values in parentheses are original values, data is transformed to $\sqrt{x+1}$ transformation (sq. root)

Table.2 Effect of dates of sowing, row spacing, seed rates and weed control treatments on growth parameters of wheat at harvest

Treatment	Plant height (cm)		Tiller count (No./m^2)		Dry matter accumulation (q/ha)	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
Dates of sowing						
End Oct.	88.7	86.1	511	492	120.8	114.4
Mid Nov.	84.2	83.3	418	404	105.4	99.0
1st wk. of Dec.	82.4	81.8	382	368	85.3	82.5
LSD (P = 0.05)	1.8	1.5	35.7	29.7	10.9	15.3
Row spacing (cm)						
22.5	83.7	82.3	394	382	99.0	93.8
15	86.4	85.2	480	462	108.6	103.4
LSD (P = 0.05)	0.85	0.78	18.8	18.4	5.8	6.5
Seed rates (kg/ha)						
100	84.6	83.6	430	415	101.4	96.2
120	85.5	83.9	444	429	106.3	101.1
LSD (P = 0.05)	NS	NS	NS	NS	NS	NS
Weed control treatments						
Hand weeding twice	86.4	85.2	455	439	108.3	103.1
Unweeded	83.7	82.2	419	405	99.3	94.1
LSD (P = 0.05)	0.85	0.78	18.8	18.4	5.8	6.5

Table.3 Effect of dates of sowing, row spacing, seed rates and weed control treatments on yield attributes and yield of wheat

Treatment	Spike length (cm)		Grains/spike		Test weight(g)		Grain yield		Straw yield	
	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06	2004-05	2005-06
Dates of sowing										
End Oct.	10.7	10.1	45.9	40.6	43.3	40.2	49.4	46.2	77.8	71.5
Mid Nov.	9.5	9.2	41.6	38.5	38.8	36.8	44.2	41.1	67.3	63.4
1st wk. of Dec.	8.1	8.0	38.1	36.4	35.0	34.0	38.0	34.6	52.3	51.7
LSD (P = 0.05)	0.21	0.35	3.2	2.0	3.5	2.7	3.8	3.9	8.8	5.6
Row spacing (cm)										
22.5	9.2	8.9	41.2	37.9	38.4	36.6	42.0	38.6	64.4	60.2
15	9.5	9.3	42.6	39.2	39.7	37.4	45.6	42.6	67.2	64.2
LSD (P = 0.05)	0.17	0.20	1.2	1.2	1.2	0.74	1.0	1.2	2.6	1.7
Seed rates (kg/ha)										
100	9.4	9.1	41.5	39.1	39.1	37.4	43.4	40.1	65.0	61.6
120	9.3	9.1	42.3	38.0	38.9	36.6	44.3	41.2	66.6	62.8
LSD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Weed control treatments										
Hand weeding twice	9.5	9.3	43.8	40.7	42.2	38.5	46.9	43.0	69.8	64.8
Unweeded	9.2	8.9	40.0	36.4	37.9	35.5	40.8	38.2	61.9	59.5
LSD (P = 0.05)	0.17	0.20	1.2	1.2	1.2	0.74	1.0	1.2	2.6	1.7
Interactions	NS	NS	NS	NS	NS	NS	Sig.	Sig.	NS	NS

Table.4 Interaction between dates of sowing, row spacing and seed rates for wheat grain yield (q/ha)

Seed rate (kg/ha)	End Oct.		Mid Nov.		1st wk. of Dec.		Mean
	22.5 cm	15 cm	22.5 cm	15 cm	22.5 cm	15 cm	
				2005			
100	47.1	51.0	42.8	45.0	35.0	39.7	43.4
120	47.7	51.8	43.5	45.7	36.2	40.8	44.3
Mean (spacing)	47.4	51.4	43.1	45.3	35.6	40.2	
Mean (sowing date)	49.4		44.2		38.0		
			LSD (P = 0.05)) : 1.2				
				2006			
100	44.1	47.3	38.6	42.4	31.5	36.7	40.1
120	45.2	48.2	39.7	43.7	32.8	37.3	41.1
Mean (spacing)	44.6	47.7	39.1	43.0	32.1	37.0	
Mean (sowing date)	46.2		41.1		34.6		
			LSD (P = 0.05)) : 2.7				

Table.5 Interaction between dates of sowing and weed control treatments for grain yield (q/ha)

Weed control treatments	Dates of sowing			Mean
	End Oct.	Mid Nov.	1st wk. of Dec.	
		2005		
Hand weeding twice	53.1	47.0	40.7	46.9
Unweeded	45.7	41.4	35.2	40.8
Mean	49.4	44.2	38.0	
		LSD (P = 0.05) : 1.0		
		2006		
Hand weeding twice	49.3	43.4	36.4	43.0
Unweeded	43.1	38.8	32.8	38.2
Mean	46.2	41.1	34.6	
		LSD (P = 0.05) : 2.4		

It might be due to the fact that weeds competed with crop and suppressed the growth and hence reduced the growth parameters, yield attributing characters and yield of wheat in control (unweeded) treatment. Similar findings were also reported by Solie *et al.* (1991).

Interactions

The interaction effects due to sowing dates, spacings and seed rates in respect of grain yield were significant (Table 4). On mean basis, wheat crop sown in end Oct. at wider spacing with 100 kg/ha seed rate recorded statistically similar grain yield when crop was sown at a closer spacing with 120 kg/ha seed rate under second date of sowing (mid Nov.), but crop sown in mid Nov. at 22.5 cm row to row spacing with 100 kg/ha seed rate produced significantly higher grain yield as compared with delay sowing of crop in first

week of Dec. at 15 cm row to row spacing with 120 kg/ha seed rate.A maximum of 50.0 q/ha grain yield was obtained in closer row spacing with higher seed rate in the first date of sowing which was at par with 100 kg/ha seed rate under same row spacing, however, it was significantly more than the wider row spacing at the same seed rates. Similar observations were also recorded for second and third date of sowing.

Interaction between sowing dates and weed control treatments in respect of grain yield was also found to be significant (Table.5).Two hand weedings given at four and six weeks after sowing produced significantly higher grain yield as compared with unweeded treatment in end Oct., mid Nov. and first week of Dec. sowing respectively. Non-significant differences were observed in grain yield between unweeded treatment in first date of sowing and weeded treatment of second date of sowing. It means unweeded treatment of end Oct. sown crop resulted in similar grain yield, when crop was sown in mid Nov. with two hand weedings. Mid Nov. sown wheat crop under control (unweeded) conditions produced significantly higher grain yield as compared with weeded treatment of 1st week of Dec. sown crop.

Among the different treatments, early sown wheat crop (end Oct.) recorded significantly higher weed infestation, at the same time higher growth parameters, yield attributes and yields of wheat crop than late sown treatments. Closer spacing (15 cm) showed significant superiority over wider spacing (22.5 cm) in respect of weed control, crop growth parameters, yield attributes and grain yield of wheat. Different seed rates did not exhibit any significant difference on weeds and crop. Hand weeding twice was significantly better in controlling weeds and registered better growth parameters, yield attributes and grain yield of wheat crop.

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