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WEED MANAGEMENT IN WHEAT-OILSEEDS INTER/RELAY CROPPING SYSTEM AND PLANTING PATTERNS

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ABSTRACT

A field experiment was conducted to assess the weed management in wheat-oilseed intercropping system and planting patterns at the Research Farm, Faculty of Agriculture, Gomal University, Dera Ismail Khan, Pakistan during Fall 2009 and was repeated in 2010. Randomized complete block design, with three replications, having sixteen treatments was used. Wheat variety "Sahar-06" was planted at seeding rate of 125 kg ha^{-1}. Statistical analysis of the data revealed that highly significant ($P \leq 0.01$) differences were found for biological yield, grain yield and weed density, weeds fresh and dry biomass. Among the planting geometries, single row sole wheat produced maximum biological yield (13.24 and 13.87 t ha^{-1}) and grain yield of 5.24 and 5.43 t ha^{-1} in both the cropping seasons, respectively. The highest reduction in weed density was recorded in treatment having 4 row strip wheat + 2 rows canola in both the years. Similarly dry weed biomass was also highly significantly ($P \leq 0.01$) reduced by 4 rows strip wheat + 2 rows canola. The instant results suggest that intercropping in wheat could be used as a viable weed management practice specially in the southern zone of Khyber Pakhtunkhwa.

Key words: intercropping, oilseeds, planting patterns, weed, wheat, yield.

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INTRODUCTION

Presence of weeds decline yield/production and quality of crop plants and leads to higher cost of food production. Therefore, weed control is one of the most important aspects of crop production in agricultural systems. Although appropriately selected herbicides may perform an important role in weed infestation, increasing weeds resistance to herbicides, high cost and, especially, negative effects of herbicides on environment have increased the need of non-chemical weed control in agro ecosystems (Augustin, 2003; Kropff, 1993; Spliid *et al*., 2004). Intercropping is one form of polyculture, using companion planting principles and is commonly used in tropical parts of the world and by various indigenous people (Altieri, 1991)

The purpose of intercropping is to generate beneficial biological interactions between the crops. Intercropping can increase grain yields and stability, more efficiently use of available resources, reduce weed pressure and sustain plant health (Hauggaard-Nielsen *et al*., 2003; Jensen *et al*., 2006, Kadziuliene *et al.,* 2009).

Intercropping is not a traditional farming in couthern region of Khyber Pakhtunkhwa as only a small fraction of farmers use this approach. Although intercopping provide more yield and insurance of crop production as compared to sole cropping. The need for increased production of vegetables can also be fulfilled through their intercropping in wheat. Besides, intercropping of compatible crops use resources very efficiently and provides yield advantage over sole crops. When a legume is grown in association with another crop (intercropping), commonly a cereal, the nitrogen nutrition of the associated crop may be improved by direct nitrogen transfer from the legume to cereal (Giller and Wilson, 1991). Khan *et al.* (2013) reported that wheat-pea was a successful intercropping and gave more yield as comapred to sole crops.

Presence of weeds in wheat severely affects the grain yield and biological yield of wheat (Khan and Marwat, 2006) therefore intercropping is one option for reducing weed problems through non-chemical methods (Khan *et al.,* 2013). Intercropping is encouraged throughout the world as higher number of effective nodules under intercropping system over pure stand of legume is an indication of more atmospheric nitrogen fixation in the crop mixture Maingi *et al.*, 2001). Weed suppression in intercropping through more efficient use of environmental resources by component crops has been earlier reported (Liebman and Dyck, 1993; Mashingaizde *et al*., 2000; Mashingaizde, 2004; Poggio, 2005). As farmers have small land holding in our country therefore intercropping is the only possible option for the farmers to grow more than one crop in a single season for getting higher net return.

In light of importance of intercropping, the present experiments were aimed to ascertain the potential of intercropping of sunflower and canola in wheat for environment friendly weed management in different planting geometries and intercropping systems under the agro-climatic conditions of Dera Ismail Khan.

MATERIALS AND METHODS

Field experiments were carried out to assess the response of different planting geometries and intercropping systems to weeds suppression in wheat-oilseed intercropping system at the Agronomic Research Area, Faculty of Agriculture, Gomal University, Dera Ismail Khan, Pakistan during winter season of 2009-10 and 2010-11. Randomized complete block design with three replications was used. Wheat variety "Sahar-06" was planted in rows at seed rate of 125 kg ha^{-1} with a plot size of 18 m^2. Sunflower and canola were intercropped. The different planting geometries/treatments included in the study were;

1. Single row sole wheat
2. 2 rows strip sole wheat
3. 3 rows strip sole wheat
4. 4 rows strip sole wheat
5. 2 rows strip wheat + 1 row canola
6. 3 rows strip wheat + 1 row canola
7. 4 rows strip wheat + 1 row canola
8. 2 rows strip wheat + 2 rows canola
9. 3 rows strip wheat + 2 rows canola
10. 4 rows strip wheat + 2 rows canola
11. 2 rows strip wheat + 1 row sunflower
12. 3 rows strip wheat + 1 row sunflower
13. 4 rows strip wheat + 1 row sunflower
14. 2 rows strip wheat + 2 rows sunflower
15. 3 rows strip wheat + 2 rows sunflower
16. 4 rows strip wheat + 2 rows sunflower

Land was ploughed, leveled and then recommended dose (20-25 t ha^{-1}) of farm yard manure (FYM) was incorporated into the soil. Nitrogen, phosphorus and potassium (NPK) were applied @ 120-60-60 kg ha^{-1} using urea, single super phosphate (SSP) and sulphate of potach (SOP), respectively. Full doses of phosphorus and potassium and half dose of nitrogen were applied before sowing, while remaining dose of nitrogen was added to the experimental plot after a month (Baloch, 2008). The field was irrigated as per need and all other agronomic practices were applied uniformly.

Data collection and analysis

To record biological yield, wheat was harvested, bundled, sun dried and were weighed. The data was then converted into t ha^{-1} by using the following formula:

$$\text{Biological yield (t ha}^{-1}) = \frac{\text{Weight of sample (kg) x 10000}}{\text{Area harvested (m}^2\text{) x 1000}}$$

Grain yield was recorded after threshing of wheat of each treatment separately and then was converted to t ha^{-1} by using the following formula:

$$\text{Grain yield (t ha}^{-1}) = \frac{\text{Weight of sample (kg) x 10000}}{\text{Area harvested (m}^2\text{) x 1000}}$$

For recording fresh and dry weed biomass, the weeds in individual plots were removed at the crop maturity/harvested stage, whereas, for dry weed biomass, weeds were kept in electric oven (set at 70°C) for 72 hours and then dry biomass was recorded with Sartorius balance. The data recorded was subsequently converted into g m^2.

All the data recorded were statistically analyzed by using MSTATC software. The purpose of analysis of variance was to determine the significant effect of treatments on weeds management and wheat yield. Duncan Multiple Range test was applied when analysis of variance showed significant effects for treatments (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Weed density (m^{-2})

The mean values of weed density for both the cropping seasons is shown in Table-1. Data showed that various cropping patterns highly significantly ($P \leq 0.01$) affected the weed density. In both cropping seasons, highest weed density was found in blocks where pure stands of wheat were sown as compared to the rest of the treatments which might be attributed to open space for weeds to germinate and establish in sole crop. Increasing number of rows of intercrops (Canola and Sunflower) in wheat decreased the weed density by increasing the weed suppression capabilities. Two rows of intercrop were more effective in suppressing the weeds. In a similar studies Khan *et al.* (2013) reported that intercropping in wheat was profitable to suppress the weeds and make the farming more profitable.

Fresh weed biomass (g m^{-2})

Data analysis revealed highly significant ($P \leq 0.01$) differences for fresh weed biomass in various cropping patterns in both the cropping seasons (Table-1). Maximum fresh weed biomass was recorded in treatment having single row sole wheat followed by 2 rows sole wheat in both the years. Minimum fresh weed biomass was noted in treatment having 4 row strip wheat + 2 row canola. All the other treatments produced statistically comparable fresh weed biomass. It was found that all the intercropping treatments decreased the fresh weed biomass probably due to effective utilization of resources and severe inter-specific competition. As dense stands prevent the sunlight to reach to the ground therefore the weeds were effectively suppressed.

Dry weed biomass (g m^{-2})

Table-1 depicted highly significant (*P≤0.01*) differences among different means with respect to dry weed biomass in both the cropping seasons. Maximum dry weed biomass was recorded in single row sole wheat in both the years. The intercropped treatments depicted the decreasing trend of dry weed biomass explaining that weeds could be successfully suppressed through canola and sunflower intercropping with wheat. However more studies are suggested to ensure the possibility of weed suppression in wheat in combination with other methods of weed control.

Biological yield (t ha^{-1})

The crop growth and overall development is expressed by the total biomass. The mean values of biological yield presented in Table-2 demonstrate that maximum biological yield was obtained in single row sole wheat followed by 2 rows sole wheat. Similar response for biological yield was also observed in next crop growing season. Whereas, minimum biological yield was exhibited by the treatment having 2 rows strip wheat + 2 rows sunflower. Higher biological yield suggests that intercropping has no negative effect on biological yield because besides grain yield, in our country biological yield is also equally important for the farmers. Rashid *et al.* (2011) reported that intercropping was profitable by giving more yield under higher fertility status of the soil. Thus nutrients regimes may provide more encouraging results.

Grain yield (t ha^{-1})

The data pertaining to grain yield is presented in Table-2 which clearly demonstrated that highly significant (*P≤0.01*) differences were observed in different planting geometries for grain yield. Maximum grain yield was obtained in single row sole wheat followed by 2 rows sole wheat. The response for grain yield in second cropping season was also the same. Whereas minimum grain yield was obtained by 3 rows strip wheat + 2 rows sunflower and 2 rows strip wheat + 2 rows sunflower. It has been reported that the competitive ability and interactions of different plant species in intercropping may vary due to time and environmental conditions (Andersen *et al*., 2007). Therefore more studies are required to fully explore the possibilities of intercropping oilseed in wheat for getting higher yield.

CONCLUSION

It is concluded that all intercropped treatments had a significant effect on grain yields of wheat along with great influence on the weed density, fresh weed biomass and dry weed biomass. As the farmers in southern part of KPK are poor and they are totally or partially dependent on farming therefore the instant findings suggest that intercropping should be popularized.

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Table-1. Effect of wheat-oilseeds intercropping system on weeds.

Treatments	Weed density (m^{-2})		Fresh weeds biomass ($g\ m^{-2}$)		Dry weeds biomass ($g\ m^{-2}$)	
	2009-2010	2010-2011	2009-2010	2010-2011	2009-2010	2010-2011
Single row sole wheat	39 ad	42 abc	85 a	92 a	37 a	38 a
2 row strip sole wheat	43 ab	45 a	80 ab	83 bc	34 ab	37 ab
3 row strip sole wheat	45 a	44 a	73 bcdef	79 cde	31 bc	34 abc
4 row strip sole wheat	44 a	43	72 bcdef	80 cd	29 cd	32 bcd
2 row strip wheat + 1 row canola	39 abcd	39 abcd	74 bcdef	88 ab	24 e	27 def
3 row strip wheat + 1 row canola	34 de	36 cde	69 cdefg	73 ef	22 efg	21 gh
4 row strip wheat + 1 row canola	30 ef	32 ef	68 defg	76 def	26 de	29 cdef
2 row strip wheat + 2 row canola	27 fg	26 fg	66 fg	71 fg	23 ef	24 fgh
3 row strip wheat + 2 row canola	26 fg	25 g	67 efg	66 gh	19 fg	26 efg
4 row strip wheat + 2 row canola	23 g	24 g	63 g	61 h	18 g	25 efgh
2 row strip wheat + 1 row sunflower	41 abc	43 ab	77 bc	80 cd	23 ef	14 i
3 row strip wheat + 1 row sunflower	37 bcd	37 bcde	75 bcde	79 cde	25 de	15 i
4 row strip wheat + 1 row sunflower	36 cde	35 de	73 bcdef	79 cde	23 ef	20 h

2 row strip wheat + 2 row sunflower	36 cde	37 bcde	76 bcd	77 cdef	27cde cd	28 def
3 row strip wheat + 2 row sunflower	35 cde	34 de	72 bcdef	74 def	27 cde	30 cde
4 row strip wheat + 2 row sunflower	33 de	32 ef	69 cdefg	73 ef	24 e	26 efg
LSD $_{0.01}$	5.553	5.953	7.280	6.058	4.444	4.807

Means not sharing common letters are significantly different at 1% α

Table-2. Effect of wheat-oilseeds intercropping system on wheat.

Treatments	Biological yield (t ha $^{-1}$)		Grain yield (t ha^{-1})	
	2009-2010	2010-2011	2009-2010	2010-2011
Single row sole wheat	13.24 a	13.87 a	5.24 a	5.43 a
2 row strip sole wheat	12.92ab	13.21ab	4.56 ab	4.78 b
3 row strip sole wheat	12.2abc	12.6abc	4.11 bc	4.32 bc
4 row strip sole wheat	12.00 abcd	12.23 abc	4.06 bc	4.00 cd
2 row strip wheat + 1 row canola	11.13 abcde	11.00 cde	3.89 bcd	4.06 cd
3 row strip wheat + 1 row canola	11.65 abcd	12.00 abcd	3.78 cde	3.89 cde
4 row strip wheat + 1 row canola	11.87 abcd	12.00 abcd	3.62 cde	3.56 def
2 row strip wheat + 2 row canola	10.05 cde	10.77 cde	3.45 cde	3.43 ef
3 row strip wheat + 2 row canola	10.00 cde	9.88 de	3.87 bcde	3.54 def
4 row strip wheat + 2 row canola	11.12 abc	11.56 bcd	3.32 cde	3.22 f
2 row strip wheat + 1 row sunflower	9.80 de	10.00 de	3.19 de	3.40 ef
3 row strip wheat + 1 row sunflower	9.85 de	10.54 cde	3.21 de	3.07 f
4 row strip wheat + 1 row sunflower	10.34 cde	11.00 cde	3.89 bcd	4.00 cd
2 row strip wheat + 2 row sunflower	9.06 e	8.89 e	3.33 cde	3.55 def
3 row strip wheat + 2 row sunflower	11.11 abcde	10.94 cde	3.08 e	3.00 f
4 row strip wheat + 2 row sunflower	10.78 bcde	10.00 de	3.11 de	3.21 f
LSD $_{0.01}$	1.964	1.864	0.6884	0.5021

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