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Weed Management in Spring Maize (*Zea mays*) through Cultural Practices in Punjab

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ABSTRACT

A field experiment to investigate the effect of different irrigation methods and live mulching on weed in spring maize was conducted at students' Research farm, Khalsa College, Amritsar during 2015. The experiment was laid out in a split plot design with four replications. The experiment comprised treatments viz., cowpea, moong and mash as live mulch with different irrigation methods i.e. conventional furrow irrigation method (CFI), alternate furrow irrigation method (AFI) and fixed furrow irrigation method (FFI). The data showed that live mulch of cowpea, moong and mash significantly reduced the weed density and weed dry matter than control. Higher weed control efficiency was recorded in cowpea mulching followed by moong and mash. Among different irrigation methods FFI and AFI significantly reduced the weed population than CFI. The higher WUE and less weed count were observed in FFI method and cowpea live mulch. All weed control treatments resulted in significant enhancement in maize yield.

Key Words: Alternate furrow, Irrigation method, Legumes, Live mulch, Maize, Weed control.

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INTRODUCTION

Weeds are one of the major problems in crop production around the world, and we are tending toward controlling these weeds with herbicides, which comes with an increased environmental impact. At present, weed control highly depends on chemical and mechanical practices that are very expensive, hazardous for the environment and consequently unsustainable as new and resistant species are emerging which are not controlled by existing chemicals. Further, herbicide contributes to soil and water pollution they are harmful to flora and fauna diversity. In addition the use of herbicide may result in human consumption of residues via contaminated water and food (Sankhla *et al,* 2010). The current emphasis on reduced herbicide use has led to increased interest in alternative weed management methods. In sustainable agriculture, for effective weed control different cultural practices like bed planting, live mulch, straw mulch and alternate furrow irrigation methods are used. Live mulches are crops grown simultaneously with the main crop that can suppress weed growth significantly without reducing main crop yield. Live mulch grows fast and covers the surface very quickly and has smothering potential. Live mulches can suppress weed growth by competing for light, water and nutrients (Sharma *et al,* 2010), and through the production of allelopathic compounds which may ultimately result in reduced herbicide applications. Many studies have confirmed the weed suppressing ability of living mulches in different cropping systems.

In alternate furrow irrigation less water is applied and furrows are irrigated alternatively and those un-irrigated furrow could obtain their water needs from the adjacent irrigated furrows through the horizontal movement of soil water (Mohamed *et al,* 2010) So water application is reduced by 25 to 35 per cent in alternate furrow irrigation as compared to every furrow irrigation. For conserving agricultural

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water, the fixed furrow irrigation is helpful. In this method, same furrows are fixed for irrigation, while adjacent furrows are not irrigated for the whole season. In general, these techniques are a trade off a lower yield for higher water use efficiency; water was saved mainly by reduced evaporation, from the soil surface. Weed infestation may also be less in the furrows which are not irrigated. So, weed intensity is low in dry furrow than in irrigated furrows. These new practices of irrigations reduced the volume of water used and improved the water use efficiency.

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MATERIALS AND METHODS

A field experiment was conducted at Students' Research Farm, Department of Agriculture, Khalsa College Amritsar during spring season 2015. The soil of the experimental site was sandy loam in texture having ph 7.6, low available nitrogen (154 kg/ha), low available phosphorus (28.9 kg/ha), high available potash (330 kg/ha). The experiment was laid out in split plot design, comprising three methods of irrigations (CFI, AFI and FFI) in main plot and four live mulch treatments (cowpea, moong, mash and control) in sub plot and replicated four times. The irrigation methods were alternate furrow irrigation (AFI), fixed furrow irrigation (FFI) and conventional furrow irrigation (CFI).The irrigation scheduling on the basis of soil moisture content. AFI means one of the two neighboring furrows was alternately irrigated throughout the growing season. FFI means that irrigation was fixed to one of the two neighboring furrows. CFI was the conventional way where all furrows irrigated during irrigation.

The field was ploughed and given pre-sowing irrigation. When the field reached at the optimum moisture conditions, it was ploughed four times with tractor drawn cultivator followed by planking each time. After the preparatory tillage, field was divided in four replications and each replication further divided into twelve different plots of same size. All treatment combinations were applied randomly in each replication. The pre treated seeds of variety Dragon 1247 were sown by *kera* method on 20th February 2015. On the same day live mulch crops such as cowpea, moong and mash were also sown in between the rows of spring maize as per treatment. All the treatments were watered on the same day. The weed count was recorded from two locations. Samples were taken randomly in each plot by a quadrate measuring 50cm × 50cm at 60, 90 days after sowing and at harvest. The weed plants were removed from ground surface from each plot and these samples were first sundried and then dried in oven at 65^{o}C. After weighing the samples, the dry matter accumulation was expressed as gm^{-2}.

Weed control efficiency (WCE)

Weed control efficiency of treatments was calculated by using following formula:

$$\frac{\text{Dry matter of weeds in control plots - Dry matter of weeds in treated plots}}{\text{Dry matter of weeds in control plots}} \times 100$$

Water use efficiency (WUE) (kg/m^3)

Water – use efficiency was calculated by dividing the economic yield by Irrigation water measured by gravimetric method.

WUE = Y (kg/ha)/ IW (mm)

RESULTS AND DISCUSION

Weed density

The impact of irrigation methods on weed population was significantly appeared. AFI and FFI were significantly better than CFI in smothering weed population might be due to the less water applied in AFI and FFI methods which help smothering weeds. At harvest the weed count in FFI and AFI was 33.3 and 14.9 percent less than CFI. Significant effects of live mulch on weed population were observed. The weed population reduced significantly under cowpea, moong and mash than control plots. The cowpea and moong mulching remained at par with each other. Further, moong and mash mulching were at par with each other but differed significantly from control plots with respect to reducing the weed population.

Table1. Effect of irrigation methods and live mulching on weed population per meter square of spring maize.

Treatment	Weed population (Number/m2)		
	30 DAS	60DAS	At harvest
Irrigation methods			
CFI	56.1	85.1	80.0
AFI	40.6	75.6	69.6
FFI	39.0	69.0	60.0
CD (p = 0.05)	5.68	7.20	8.72
Live mulching			
Control	95.8	150.2	139.6
Mash	42.0	64.0	58.8
Moong	28.2	52.1	44.2
Cowpea	15.1	40.1	36.4
CD (p = 0.05)	14.8	13.6	16.8
Interaction	NS	NS	NS

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The less weed count in cowpea mulching was because of the reason that it had a large effect on weed suppression due to its spreading growth habit, which occupied the inter row spaces and restricted the germination and growth of weeds. The similar results were found by the Singh *et al* (2015).

Weed dry matter accumulation

The FFI method significantly reduced the weed dry matter accumulation in comparison with CFI method at all observational periods. AFI and FFI methods remained at par with each other but significantly reduced the weed dry matter than the CFI method. FFI and AFI methods reduced the weed dry matter accumulation by 24.8 and 14.1 per cent in comparison with CFI method.

Live mulch also had a pronounced effect on

Table2. Effect of irrigation methods and live mulching on weed dry matter accumulation (g/m^2) of spring maize.

Treatment	Weed dry matter accumulation (g/m^2)		
	60 DAS	90 DAS	At harvest
Irrigation methods			
CFI	68.3	258	291
AFI	44.2	214	266
FFI	40.0	204	233
CD(p = 0.05)	19.8	24.2	21.0
Live mulching			
Control	109	601	642
Mash	40.5	122	151
Moong	31.0	101	142
Cowpea	22.0	80.0	115
CD (p = 0.05)	28.9	60.5	56.8

dry matter accumulation. Weed dry matter was significantly less in plots where live mulch with cowpea, moong and mash was done over control (no mulch). Among different types of mulching, highest weed dry matter reduction in cowpea mulching was noticed followed by moong and mash. Similarly, moong and mash mulched plots were at par with each other but significantly different from control plots. The general trend seen was control > mash > moong> cowpea at all observational periods. In cowpea mulching, the lack of availability of uncovered inter- row spaces for weed establishment resulted in severe reduction in the weed biomass. The lower dry matter weight of weeds in a system that uses cover crops by covering the inter – row spaces causes ultimately suppression of weed emergence (Talebbeigi *et al* 2012).

Weed control efficiency

Weed control efficiency is a measure of the ability of a technique to control weeds. Among the different irrigation methods FFI method gave the highest weed control efficiency and lower value was observed under CFI method.

Cowpea mulching resulted in the highest weed control efficiency followed by moong and mash mulching. The order of weed control efficiency was observed as cowpea > moong > mash with values 82.1, 77.8 and 76.4 per cent, respectively.

Grain Yield

The maize grain yield was significantly affected by different irrigation methods. The highest grain yield of maize was obtained with conventional furrow irrigation (36.9 q/ha) which was statistically higher than fixed furrow irrigation method (33.3q/ha) but was at par with AFI method. In fixed furrow irrigation the reduction of yield is due to the small amount of applied irrigation water. The percent increase in grain yield was 10.8 and 9.9 in CFI and AFI method, respectively over FFI method. Increase in yield by CFI over FFI may be due to more water availability in CFI than FFI. Similar type results were noticed by Ahmad *et al* (2002).

Effect of legume live mulch on maize grain yield was also significant. Maize grain yield was significantly higher in plots where live mulch with cowpea, moong and mash was done over control (no mulch) plot. Among different types of mulching cowpea produced highest yield followed by moong and mash. Yield of maize in cowpea and moong mulched plots was at par with each other. Higher

Table3. Effect of irrigation methods and live mulching on Grain yield, Water use efficiency and weed control efficiency (%) of spring maize.

Treatments	Grain yield (q/ha)	Irrigation water (mm)	Water use efficiency (WUE)	Weed control efficiency (%)
Irrigation methods				
CFI	36.9	280	1.31	54.6
AFI	36.6	224	1.63	58.6
FFI	33.3	189	1.76	63.8
CD (p = 0.05)	2.09	-	-	-
Live mulching				
Control	30.6	212	1.41	-
Mash	35.4	232	1.52	76.4
Moong	37.9	235	1.61	77.8
Cowpea	38.6	230	1.67	82.1
CD (p = 0.05)	2.93			-

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grain yield of maize in cowpea mulched plots over other may be due to preserving soil moisture through reducing evaporation, less weeds count and more biomass of live mulch crop which may be due to better efficiency of nitrogen fixation in cowpea than moong and mash mulching. Similar results were observed by Caamal- Maldonado *et al* (2001).

Water use efficiency

Among the different irrigation methods FFI had higher WUE due to less amount of water used than CFI. In the live mulch treatments all had higher WUE as compared to control. More land area covered by cowpea due to more biomass as compared to moong and mash by which evapotranspiration losses decreased that is lead to less amount of water required. So under this treatment grain yield and WUE were higher as compared to other treatment.

CONCLUSION

Irrigation management and live mulch can play a large role in the control of weeds in spring maize. It is concluded that highest maize grain yield and less weed intensity was observed under fixed furrow irrigation (FFI) and live mulch cowpea. Due to higher WUE and WCE under FFI irrigation method and cowpea live mulch recommended as a step toward sustainable agriculture.

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