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INFLUENCE OF INTERCROPPING AND WEED MANAGEMENT PRACTICES ON WEED AND YIELDS OF MAIZE

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ABSTRACT
A field experiment was conducted on loamy sand soil at Anand to study the "Influence of intercropping and weed management practices on growth and yield of maize" during the year 2007 and 2008. Maize grain and straw yields were noted higher under the maize sole treatment, while, intercropping of maize + greengram recorded significantly the highest maize equivalent yield followed by maize + soybean intercropping system. In weed management practices, significantly higher grain and straw yields of maize as well as maize equivalent yield was recorded under the treatment of soil solarization and it was followed by pre-emergence application of pendimethalin 0.5 kg ha^{-1} + HW at 45 DAS and alachlor @ 1.0 kg ha^{-1} + HW (45 DAS). Weed smothering efficiency (%) calculated at 20 and 45 DAS and at harvest clearly indicated that intercropping of maize with soybean having higher WSE than the maize with greengram. The highest weed control efficiency (WCE) of 78.22 and 58.60% was obtained under the treatment of soil solarization (W_5) at 20 and 45 DAS, respectively. At harvest, WCE was higher with the pre-emergence application of pendimethalin @ 0.5 kg ha^{-1} coupled with HW at 45 DAS followed by pre-emergence application of alachlor @ 1.0 kg ha^{-1} coupled with HW at 45 DAS. Weed management practices soil solarization (W_5) recorded the zero weed index (0.00%) followed by pre-emergence application of pendimethalin @ 0.5 kg ha^{-1} along with HW at 45 DAS and pre-emergence application of alachlor @ 1.0 kg ha^{-1} coupled with HW at 45 DAS.

KEYWORDS: Intercropping, weed management, equivalent yield, soil solarization, weed smothering efficiency (WSE), weed control efficiency (WCE), weed index (WI), maize, soybean and greengram.

INTRODUCTION

Maize (*Zea mays* L.) being native of Mexico is one of the oldest and most productive cereal food crop. Intercropping is one of the most promising options for diversification of sustainable agricultural production system. Research on intercropping has indicated how niche differences in crop species can lead to resource capture and conversion leading to increased biological efficiency and yield advantage. Cereal and legume intercropping systems are one of the important agronomic practices, wherein usually the productivity of the system as a whole is higher in comparison with that of their performance individually. Intercropping of maize with soybean proved more effective (Jat, 1996) and intercropping of maize with green gram is traditional one. In the recent years however, a shift in research priorities has taken place and magnitude of crop weed competition in maize based intercropping system and evolving weed control practices are being made.

Maize being a rainy season and widely spaced crop gets infested with variety of weeds and subjected to heavy weed competition. The wider row spacing in maize can be used to grow short duration legumes which not only will act as smother crop, but will give additional yield. Weed control approach involving intercropping, herbicides and non- chemical method in maize and maize based intercropping system is very important to provide effective and acceptable weed control for realizing high production.

MATERIAL AND METHODS

A field experiment was conducted on loamy sand soil at the College Agronomy Farm, Anand Agricultural University, Anand during the year 2007 and 2008. Eighteen treatment combinations comprised of three intercropping [C_1 : Maize sole, C_2 : Maize + greengram (1:1) and C_3 : Maize + soybean (1:1)] and six weed management practices [W_0 : Weedy check, W_1 : Alachlor @ 1.0 kg/ha (PE), W_2 : Pendimethalin 0.5 kg/ha (PE), W_3 : Alachlor @ 1.0 kg/ha (PE) + HW (45 DAS), W_4 : Pendimethalin 0.5 kg/ha (PE) + HW (45 DAS) and W_5 : Soil Solarization (50 µm) (For 6 weeks)] were tested in a split plot design with three replications. The soils of the experimental field was loamy sand in texture (locally known as *Goradu* soil) having good drainage and fair moisture retention capacity with pH ranging from 7.8 to 8.0. The experimental soil was low in organic carbon (0.32 %) and total nitrogen (608 kg N ha^{-1}), medium in available phosphorus (42 kg P_2O_5 ha^{-1}) and high in available potassium (321 kg K_2O ha^{-1}).

In both the years, white transparent plastic sheet of 50 µm was placed after giving light irrigation as soon as possible to avoid water loss on 1st May. The plastic sheets are anchored to the soil by burying the edges in a trench around the treated area. The plastic should be left in place for six weeks to allow the soil to heat the greatest depth possible. During the *Kharif* season, seeds were dibbled evenly in each plot of 3.6 x 4.4 m manually at 60 x 20 cm for maize(GM-6) and at 30 x 10 cm distance for

greengram (GM-4) and soybean(GS-2) at a depth of 3-4 cm in 2nd week of June during both the years and harvested at the physiological maturity stage. Recommended doses of fertilizers, i.e. 100 kg N + 40 kg P_2O_5 ha^{-1} in maize, 10 kg N + 20 kg P_2O_5 ha^{-1} in greengram and 15 kg N + 30 kg P_2O_5 ha^{-1} in soybean (half of RD for intercrop) were applied through urea and single super phosphate. Half the N and full quantities of phosphorus in maize and full N and phosphorus in greengram and soybean were applied at the time of sowing. The remaining N was top dressed at knew high stage of maize. Alachlor @ 1.0 kg ha^{-1} and pendimethalin 0.5 kg ha^{-1} were applied as pre emergence in respective treatments on next day of sowing. The quantity of water used was 500 lit. ha^{-1}. The required quantity of these herbicides was applied on respective plots with the help of 'Knapsack sprayer' (Sikar-59) with flat fan nozzle and followed hand weeding in respective treatments at 45 DAS. Maize grain equivalent yield and economics were calculated considering the prevailing market prices of inputs and crop produces. Total rainfall received during the year 2007 and 2008 were 1144 and 961 mm, respectively

RESULTS AND DISCUSSION

Effect on weeds

Weeds dry weight recorded at all the stages of crop growth was significantly influenced by different intercropping systems and it was reduced under the intercropping of maize with soybean and greengram, while it was higher with maize sown as sole crop (Table 1). Weed smothering efficiency (%) calculated at 20 and 45 DAS and at harvest clearly indicated that intercropping of maize with soybean having higher WSE than the maize with greengram (Table 2). This is only due to the fact that the lower availability of space and light leads to lower down the density of weeds and ultimately recorded lower weeds dry weight in intercropping and also suppress the weed species by more canopy cover. These findings are in conformity with those reported by Haque *et al*. (2008) and Tripathi *et al.* (2008)

Soil solarization treatments showed its superiority over rest of the treatments in reduction of dry weight of weeds and higher weed control efficiency (WCE) at 20 and 45 DAS. At harvest, pre-emergence application of pendimethalin 0.5 kg ha^{-1} + HW at 45 DAS recorded significantly lower weed dry weight and higher WCE but did not differ from pre- emergence application of alachlor @ 1.0 kg ha^{-1} coupled with HW at 45 DAS. Similar trend was observed for weed index recorded at harvest (Table 3). In general, inclusion of post emergence weed control measures along with any pre-emergence herbicide markedly enhanced the weed control efficiency. The results are in accordance with those of Singh *et al*. (2005).

Effect on growth, yield attributes and yield

Significantly taller plants and highest test weight were observed with maize sole sowing treatment. The lowest plant height and lower test weight was recorded under intercropping maize + soybean. Increase in plant height under maize sole treatment was due to the fact that the wider space available in sole maize reduced the competition of light and nutrients, which probably provided favourable physical environment and must be ensure for plant to grow taller. Increase in plant height under sole maize sowing was observed by Hugar and Palled (2008).

Grain and straw yields were noted higher under the treatment sole maize and the magnitude of increase in grain and straw yields under C_1 was 15.07 and 13.43 % over C_2 and 18.72 and 19.49 % over C_3, respectively. The yield difference in intercropping of maize with greengram and soybean is non significant, while, intercropping of maize + greengram recorded significantly the highest maize equivalent yield followed by maize + soybean intercropping system. The yield increment in sole maize is only due to less competition for sunlight, space, water and nutrients as it was in intercrops having shading effect curtail efficient utilization of natural resources and restrict growth of maize from initial stages to harvest resulted in yield competition in intercrop. Similar findings were obtained by Hussain *et al.* (2003) and Haque *et al.* (2008).

Application of different weed management practices significantly influenced the growth, yield attributes and yields of maize (Table 1). The plant height at harvest and test weight were found significantly higher under the treatment of soil solarization which was not differed significantly with pre-emergence application of pendimethalin 0.5 kg ha^{-1} + HW (45 DAS) and alachlor @ 1.0 kg ha^{-1} + HW (45 DAS). The grain and straw yields of maize as well as maize equivalent yield was significantly higher under the treatment of soil solarization. This treatment was followed by pre-emergence application of pendimethalin 0.5 kg ha^{-1} + HW at 45 DAS and alachlor @ 1.0 kg ha^{-1} + HW (45 DAS). The improvement in grain and straw yields of maize as well as maize equivalent yield under the treatment of soil solarization was in a tune of 82.07, 70.09 and 58.85 % over the treatment weedy check. The higher maize equivalent grain yield in intercrops was also noticed by Padhi and Panigrahi (2006) and Sharma and Behera (2009)

Economics

The highest net return of Rs 20482 ha^{-1} was recorded in maize + greengram intercropping system, followed by Rs 18691 ha^{-1} with maize + soybean. In case of weed management practices, the highest net return of Rs 24903 ha^{-1} was incurred with the application of pendimethalin @ 0.5 kg ha^{-1} + HW at 45 DAS, followed by treatment alachlor @ 1.0 kg ha^{-1} + HW at 45 DAS with net returns of Rs 24497 ha^{-1}. The lowest net return of Rs 13690 ha^{-1} was recorded with the control treatment.

From the results, it is concluded that maize variety "Gujarat Maize 6" gave higher grain yield and net profit in *kharif* season when follow the practices of intercropping of maize with greengram alongwith pre-emergence application of pendimethalin 0.5 kg ha^{-1} or alachlor 1.0 kg ha^{-1} followed by hand weeding at 45 DAS in middle Gujarat conditions.

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TABLE 1. Weed, growth and yield parameters of maize as influenced by various treatments

Treatment	Dry weight of weeds at (√x)			Plant height at harvest (cm)	Test weight (g)	Grain yield of maize (kg ha^{-1})	Straw yield of maize (kg ha^{-1})	Maize equivalent grain yield (kg ha^{-1})	Net realization (Rs ha^{-1})
	20 DAS (g)	45 DAS (g)	Harvest (kg ha^{-1})						
Intercropping (C)									
C_1 : Maize (sole)	4.41 (20.59)	5.86 (35.27)	30.55 (964)	167.71	22.97	3000	6113	3000	17469
C_2 : Maize + Greengram (1:1)	3.90 (16.34)	4.75 (23.20)	25.92 (698)	125.28	20.33	2607	5389	3655	20482
C_3 : Maize + Soybean (1:1)	3.64 (14.34)	3.88 (15.79)	20.86 (471)	101.25	19.45	2527	5116	3526	18691
C.D. (P= 0.05)	0.40	0.36	2.32	9.65	1.34	155	349	159	
Weed Management (W)									
W_0 : Weedy check	5.81 (33.89)	6.14 (38.97)	33.50 (1161)	103.74	17.90	1818	3782	2274	13690
W_1 : Alachlor @ 1.0 kg ha^{-1} (PE)	4.17 (17.73)	4.98 (25.91)	28.52 (847)	127.52	20.03	2610	5467	3277	22212
W_2 : Pendimethalin 0.5 kg ha^{-1} (PE)	3.54 (12.84)	4.43 (20.47)	27.85 (793)	128.11	20.08	2655	5612	3336	22609
W_3 : Alachlor @ 1.0 kg ha^{-1} (PE) + HW (45 DAS)	4.09 (17.72)	5.06 (26.52)	20.72 (451)	141.57	22.16	2907	5949	3642	24497
W_4 : Pendimethalin 0.5 kg ha^{-1} (PE) + HW (45 DAS)	3.56 (12.86)	4.45 (20.53)	20.20 (430)	142.49	22.35	2968	5993	3708	24903
W_5 : Soil Solarization (50 µm)	2.72 (7.50)	3.91 (16.13)	23.88 (584)	145.03	22.99	3310	6433	4127	18157
C.D. (P= 0.05)	0.34	0.33	2.14	8.86	1.38	160	256	160	

Figures in parentheses indicates original values

TABLE 2. Weed smothering efficiency (%) as influenced by different treatments

Treatment	Weed smothering efficiency (%)		
	20 DAS	45 DAS	Harvest
Intercropping (C)			
C_1 : Maize (sole)	-	-	-
C_2 : Maize + Greengram (1:1)	20.62	34.21	27.55
C_3 : Maize + Soybean (1:1)	30.37	55.21	51.16

TABLE 3. Weed control efficiency (%) as influenced by different treatments

Treatment	Weed Control Efficiency (%)			Weed Index (%)
	20 DAS	45 DAS	Harvest	
Weed Management (W)				
W_0 : Weedy check	-	-	-	45.09
W_1 : Alachlor @ 1.0 kg ha^{-1} (PE)	48.93	33.51	27.09	21.14
W_2 : Pendimethalin 0.5 kg ha^{-1} (PE)	62.46	47.48	31.72	19.79
W_3 : Alachlor @ 1.0 kg ha^{-1} (PE) + HW (45 DAS)	48.55	31.94	61.19	12.18
W_4 : Pendimethalin 0.5 kg ha^{-1} (PE) + HW (45 DAS)	61.55	47.32	62.99	10.33
W_5 : Soil Solarization (50 µm)	78.22	58.60	49.71	0.00