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Influence of Intercropping and Weed Management Practices on Weed Parameters and Yield of Maize

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A B S T R A C T

A field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore during *kharif* 2015 to investigate the influence of intercropping systems and weed management practices on weed density, dry weight and weed control efficiency in maize under irrigated condition. The experiment was laid out in split plot design and replicated thrice. Three intercropping systems *viz.*, maize alone (I_1), maize + blackgram (1:1 ratio) (I_2) and maize + blackgram (2:2 ratio) (I_3) were evaluated under main plot and four weed management practices *viz.*, unweeded check (Control) 9 (W_1), Pendimethalin 0.75 kg ha^{-1} as pre emergence (PE) 3 DAS + one hand weeding at 25 DAS (W_2), Imazethapyr 75 g ha^{-1} as post emergence (POE) 25 DAS (W_3) and Pendimethalin 0.75 kg ha^{-1} as PE 3 DAS + Imazethapyr 75 g ha^{-1} as POE 25 DAS (W_4) were accommodated under subplot. Observations on weed parameters *viz.*, weed density, weed dry weight and weed control efficiency were recorded. The results of the experiment revealed that among the intercropping systems, maize + blackgram (1:1) intercropping and among weed management practices, pendimethalin 0.75 kg ha^{-1} as PE 3 DAS + one HW 25 DAS recorded lesser total weed density and weed dry weight. Maize + blackgram intercropping along with pendimethalin 0.75 kg ha^{-1} as PE 3 DAS + one HW 25 DAS recorded higher weed control efficiency. The sole crop of maize recorded higher yield than maize under intercropping systems followed maize + blackgram intercropping at 1:1 ratio.

Introduction

Maize (*Zea mays* L.) is the third most important cereal next to rice and wheat, in the world as well in India. It is a versatile crop and can be grown in diverse environmental conditions and has multiple uses. Many factors are responsible for the low yields of maize in India. Of the several factors, most critical for the low yield appears to be the weed growth that competes with the crop for nutrients, water, sunlight and space. They cause yield losses worldwide with an average of 12.8 per cent despite weed control practices and 29.2% in case of unchecked weed growth (Dogan *et al.*, 2004). Although maize plant is vigorous and tall in nature, yet it is very sensitive to weed competition at early stages of growth. Hence, it is necessary that maize should be kept free of weeds for the first 30 days after crop emergence.

Weeding has traditionally been a labour intensive operation in crop production. Manual weeding is seldom possible, because of greater demand and high cost of human labour. Intercropping has potential as a means of weed control because it offers the possibility of a mixture of crops capturing a great share of available resources than in monocropping. 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 (Shah *et al.,* 2011). Besides, intercropping also reduces weeding cost and realizes higher total productivity of the system and monetary returns (Pandey and Prakash, 2002). But this system alone is not sufficient to ensure adequate weed control because of varied canopy coverage by the intercrops. Hence, an integrated approach is needed to control weeds through manual and chemical weeding in an intercropping system. Hence, the present study was taken up to find out suitable weed management practice in maize - blackgram intercropping system and to study the ability of intercrop to compete with weeds.

Materials and Methods

A field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore during *kharif* 2013 to investigate the influence of intercropping systems and weed management practices on weed density, dry weight and weed control efficiency of maize under irrigated condition. The experiment was laid out in split plot design replicated thrice. The popular maize hybrid CO6 was used as test variety. Three intercropping systems *viz.*, maize alone (I_1), maize + blackgram (1:1 ratio) (I_2)and maize + blackgram (2:2 ratio) (I_3)were evaluated under main plot and four weed management practices *viz.*, unweeded check (Control) (W_1), Pendimethalin 0.75 kg ha^{-1} as pre emergence (PE) 3 DAS + one hand weeding 25 DAS (W_2), Imazethapyr 75 g ha^{-1} as post emergence (POE) 25 DAS (W_3) and Pendimethalin 0.75 kg ha^{-1} as PE 3 DAS + Imazethapyr 75 g ha^{-1} as POE 25 DAS (W_4) were accommodated under subplot treatments. Observations on weed parameters *viz*., weed density, weed dry weight and weed control efficiency were recorded. Weed count was recorded by placing four quadrats of size 0.5 m x 0.5 m in each plot and the weeds falling within the frames of the quadrat were counted, recorded and the mean values expressed in number m^{-2}. The weeds falling within the frames of the quadrats were collected and dried in hot-air oven at 80^0C for 72 hrs. Weed control efficiency (WCE) was calculated as per the procedure given by Mani *et al.*, (1973) and expressed in percentage.

$$WCE = \frac{WDC - WDT}{WDC} \times 100$$

where

WDC – weed dry weight in unweeded control plot (kg ha^{-1})

WDT – weed dry weight in treated plot (kg ha^{-1})

Results and Discussion

Total weed density and total weed dry weight varied markedly due to intercropping systems and different weed management practices (Table 1). Among the intercropping systems, maize + blackgram intercropping (1:1) recorded lower density of total weeds (4.89 m^{-2}) followed by maize + blackgram intercropping (2:2). Sole maize recorded the

highest density of total weeds. The possible reason for this might be due to complete crop coverage and high plant density existed in intercropping system which had competitive advantage over the weeds and reduced the weed growth and development. Lower density and dry weight in intercropped plots indicated that sole crop cannot suppress the weed growth as compared to intercropped plots. Similar results are reported by Moody and Shetty (1981). Velayutham *et al.,* (2002) also opined that intercrops provide efficient coverage of land resulting in suppression of weed growth.

Among the weed management practices, pendimethalin 0.75 kg ha^{-1} + one HW 25 DAS recorded significantly lesser density and dry weight of total weeds. This was followed by application of pendimethalin 0.75 kg ha^{-1} + imazethapyr 75 g ha^{-1} as POE 25 DAS. This might be due to effective control of weeds at the germination phase through pre emergence application of soil applied herbicides and significant reduction at later growth stages as late germinating weeds were removed by hand weeding. Hand weeding or pre emergence herbicide could reduce the weed stand at early stages of crop growth was reported by Leela (2002) is in support of the present findings.

Weed control efficiency (WCE) indicates the magnitude of effective reduction of weed dry weight by weed control treatments over weedy check. The treatment combination involving maize + intercropping blackgram along with pre emergence application of pendimethalin 0.75 kg ha^{-1} + one hand weeding on 25 DAS (W_2) and PE application of pendimethalin 0.75 kg ha^{-1}+ Imazethapyr 75g ha^{-1} as POE 25 DAS (W_4) recorded higher WCE (Table 2). More reduction of weed dry weight by reducing the weed density in these treatments resulted in higher WCE. Such reduction in weed dry weight and increase in WCE due to intercropping blackgram was reported by Ananthi (2013) is concomitant to the present result. Mynavathi (2007) also reported higher WCE of 94.69 per cent under pre emergence application of pendimethalin followed by one hand weeding in maize.

The maize grain yield was significantly influenced by intercropping systems and weed management practices. Sole maize recorded the highest grain yield of 5543 kg $ha^{-1}$and was comparable with maize + blackgram intercropping (1:1) which recorded an yield of 5383 kg ha^{-1}(Table 3). Maize + blackgram intercropping (2:2) recorded lower grain yield. The yield reduction due to intercropping blackgram (1:1) was less (3.52 per cent) comparing the sole maize yield, whereas the yield reduction due to maize + blackgram intercropping (2:2) was 7.57 per cent, indicating least effect of planting pattern of intercrops on the grain yield of maize. The yield increment in sole maize was only due to least competition for sunlight, space, water and nutrients while it was in intercrops having shading effect which curtailed efficient utilization of natural resources and restricted the growth of maize from initial stages to harvest resulted in yield competition in intercrop as reported by Yilmaz *et al.,* (2008). Similar findings were also reported by Dwivedi *et al.,* (2012). With regard to weed management practices, pendimethalin 0.75 kg ha^{-1} as PE + one HW 25 DAS recorded higher grain yield (6546 kg ha^{-1}) followed by pendimethalin 0.75 kg ha^{-1} + imazethapyr 75g ha^{-1} as POE 25 DAS (6085 kg ha^{-1}).

The interaction between intercropping systems and weed management practices on maize grain yield was significant. The highest grain yield (5755 kg ha^{-1}) was recorded under the treatment combination sole maize with pendimethalin 0.75 kg ha^{-1} as PE + one HW 25 DAS followed by the treatment

combination maize + blackgram intercropping at 1:1 ratio with pendimethalin 0.75 kg ha^{-1} as PE + one HW 25 DAS. The least grain yield (2943 kg ha^{-1}) was obtained under maize + blackgram intercropped at 2:2 ratio without weeding. The yield increase could be attributed to the reason that herbicide application might have killed the weeds at germination phase devoiding competition for crop growth from the inception of germination of the crop and hand weeding on 25 DAS lasting its efficiency at later growth stages. The results are in accordance with the findings of Singh and Singh (2009) who have observed that pre emergence application of pendimethalin 250 g ha^{-1} followed by one hand weeding on 45 DAS produced maximum pod and haulm yield of groundnut when compared to farmers' practice of hand weeding twice.

Table.1 Effect of intercropping and weed management practices on total weed density, weed dry weight and weed control efficiency in maize hybrid at 40 DAS

Treatment	Total weed density(No. m^{-2})	Total weed dry weight(g m^{-2})
Intercropping system		
I_1 - Sole maize	5.64 (29.8)	4.82 (21.22)
I_2 - Maize + Black gram (1:1) (60 x25 cm)	5.12 (24.24)	4.62 (19.30)
I_3 - Maize + Black gram (2:2) (30/90 cm)	4.89 (21.95)	4.49 (18.20)
SEd	**0.05**	**0.03**
CD (P=0.05)	**0.15**	**0.09**
Weed management practices		
W_1-Weedy check	10.04 (98.87)	7.64 (56.42)
W_2 -Pendimethalin 0.75 kg ha^{-1} + one HW 25 DAS	3.89 (13.11)	2.45 (4.02)
W3 -Imazethapyr 75 g ha^{-1} as POE 25 DAS	4.74 (20.47)	3.37 (9.33)
W4 -Pendimethalin 0.75 kg ha^{-1} + Imazethapyr 75 g ha^{-1} as POE 25 DAS	4.35 (16.94)	3.24 (8.50)
SEd	**0.06**	**0.04**
CD (P=0.05)	**0.15**	**0.08**
Interaction	**NS**	**NS**

Figures in the parentheses are original values; values are transformed into square root transformation

Table.2 Effect of intercropping and weed management practices on weed control efficiency in maize hybrid

Treatment	40 DAS	60 DAS
I_1W_1	-	-
I_1W_2	90.1	89.7
I_1W_3	79.0	82.7
I_1W_4	81.4	87.6
I_2W_1	-	-
I_2W_2	92.9	92.8
I_2W_3	82.7	84.1
I_2W_4	85.2	91.8
I_3W_1	-	-
I_3W_2	92.8	93.8
I_3W_3	84.8	86.5
I_3W_4	85.3	92.0

Data not analyzed statistically

Table.3 Effect of intercropping and weed management practices on grain yield (kg ha^{-1}) of maize hybrid

Treatment	I_1	I_2	I_3	Mean
W_1-Weedy check	3038	3039	2943	**3007**
W_2 -Pendimethalin 0.75 kg ha^{-1} + one HW 25 DAS	6755	6737	6147	**6546**
W3 -Imazethapyr 75 g ha^{-1} as POE 25 DAS	6051	5798	5740	**5863**
W4 -Pendimethalin 0.75 kg ha^{-1} + Imazethapyr 75 g ha^{-1} as POE 25 DAS	6330	5960	5965	**6085**
Mean	**5543**	**5383**	**5199**	
	SEd	**CD (P=0.05)**		
I	**60**	**175**		
W	**78**	**183**		
I at W	**131**	**319**		
W at I	**117**	**227**		

In conclusion, the results of the experiment revealed that maize + blackgram intercropping along with pendimethalin 0.75 kg ha^{-1} as PE 3 DAS + one HW 25 DAS can lower the weed density and dry weight during critical stage of the crop growth sole maize with pendimethalin 0.75 kg ha^{-1} as PE 3 DAS + one HW25 DAS recorded higher grain yield followed by maize + blackgram intercropping at 1:1 ratio along with pendimethalin @0.75kg ha^{-1} as PE on 3 DAS + one hand weeding on 25 DAS and both were comparable with each other.

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