Research Article

Behaviour of Weeds under Non - Chemical Methods of Weed Management in Maize

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Abstract

A Field experiment was conducted at Eastern Block Farm, Department of Farm Management, Tamil Nadu Agricultural University, Coimbatore during *kharif* 2015 (July - November) to study the behaviour of weeds under non – chemical methods of weed management in maize. The experiment was laid out in randomized block design and replicated thrice. The treatments comprised of eight weed management practices *viz*., stale seed bed followed by one hand weeding on 30 DAS (T_1), stale seed bed followed by twin wheel hoe weeder weeding on 30 DAS (T_2), mulching with crop residue @ 5 t ha^{-1} applied at sowing (T_3), intercropping with sunnhemp and incorporation on 40 DAS (T_4), intercropping with fodder cowpea (T_5), twin wheel hoe weeder weeding on 15 and 30 DAS (T_6), hand weeding on 15 and 30 DAS (T_7) and unweeded control (T_8). The result of this study was showed that *Trianthema portulacastrum* was the dominant weed followed by *Digera muricata* and *Cyperus rotundus*. Lower weed density, weed dry weight and higher weed control efficiency (91.36% at 30 DAS) were observed in mulching with crop residue @ 5 t ha^{-1} applied at sowing.

Keywords: Crop residue, Intercropping, Mulching, Weed control efficiency

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Introduction

Maize is the third most important cereal crop in the world agricultural economy next to wheat and rice. Among the different biotic factors, weeds are the most important one which have a significant influence on the performance of maize crop. Weeds are unwanted plants playing a very significant role in different agro-ecosystem and many of them cause direct and indirect losses. Weed cause huge reduction in crop yield but also increase cost of cultivation, reduce input use. In India, presence of weeds in general reduces crop yields by 37-45% [1]. Weed management takes nearly one third of total cost of production in field crops. Weeds are one of the obstacles that affect the crop productivity and quality of yield. Weed control in all agricultural crops is necessary to get a good yield and profit. The yield losses due to weeds vary depending on the type of weed flora and their intensity, stage, nature and duration of crop weed competition [2].

Maize plant is vigorous and tall in nature and it is very sensitive to weed competition at early stages of growth. Yield losses in maize crop due to weeds are estimated up to 35% [3]. Weeds are of negative values, which lower the input efficiency. Besides quantitative effects on yield, weeds deteriorate the quality of produce through the physical presence of their seeds and debris. Weed density, type of the weeds, their persistence and crop management practices determine the magnitude of yield loss. Understanding the ecological relationship in crop-weed competition, it is significantly important to develop an effective crop management technology and to prevent the huge loss due to weeds. Weeding has traditionally been a labour intensive operation in crop production. Different weed control practices like chemical, cultural, physical and biological are used to control the weeds. Herbicide used to be a key component in almost all weed management strategies, but indiscriminate use of same herbicides has resulted in serious ecological and environmental problems. A concern about the potential increase in weed population due to non-use of herbicides is rated as serious problem [4]. A strong need was felt to discover the alternative weed management options in order to reduce the ecological problems [5]. Keeping these aspects in background, the field experiment was laid out to study the behaviour of weeds under non – chemical methods of weed management in maize.

Materials and Methods

A Field experiment was conducted at Eastern Block Farm, Department of Farm Management, Tamil Nadu Agricultural University, Coimbatore during *kharif* 2015 (July - November). The experimental site is geographically located in the Western Agro Climatic Zone of Tamil Nadu at 11°N latitude, 77 °E longitude with an altitude of 426.7 m above mean sea level. The soil of the experimental site was sandy clay loam in texture having pH of 7.30 and low organic carbon (0.30%). With regard nutrient status, the soil was low in available nitrogen (191.60 kg ha^{-1}), medium in phosphorus (11.20 kg ha^{-1}) and high in potassium (449.80 kg ha^{-1}), respectively. Maize hybrid COH (M) 6 with the duration of 110 days was used as a test crop.

The experiment was laid out in randomized block design and replicated thrice. The treatments comprised of eight weed management practices *viz*., stale seed bed (flushing out of germinable weed seeds prior to the planting of the maize crop) followed by one hand weeding on 30 DAS (T_1), stale seed bed followed by twin wheel hoe weeder weeding on 30 DAS (T_2), mulching with crop residue @ 5 t ha^{-1} applied at sowing of previous crop residue was cut into two to three pieces and applied next day of sowing in the entire plot as a dense covering except where the seeds are placed (T_3), intercropping with sunnhemp and incorporation on 40 DAS (Sunnhemp was sown along with main crop as solid row planting) (T_4), intercropping with fodder cowpea, which was sown along with main crop and harvested at 50 per cent of flowering (T_5), twin wheel hoe weeder weeding given twice on 15 and 30 DAS (T_6), two hand weeding given on 15 and 30 DAS (T_7) and unweeded control (T_8). To study the behaviour of weeds under non - chemical methods of weed management in maize. The observed data on weeds were statistically analysed based on the standard procedure [6] to find out the treatment differences. The data on weed count and weed dry weight having higher variation were subjected to square root transformation ($\sqrt{X + 0.5}$) and analysed statistically. Critical differences were worked out at five per cent probability level wherever the treatment differences were significant. Weed characters like weed flora, relative density, weed density, weed dry weight and weed control efficiency were calculated as per the standard procedure.

Weed flora

Weed species in unweeded control plot were observed, identified and grouped as grasses, sedges and broad-leaved weeds and presented as weed flora of the experimental field.

Relative weed density

Relative density of individual weed species and group wise weeds were worked out and expressed as percentage.

$$\text{Relative density (\%)} = \frac{\text{Absolute density of a given species (No. m}^{-2})}{\text{Total absolute density of all species (No. m}^{-2})} \text{ X 100}$$

Weed density

Weed density of grasses, sedge and broad-leaved weeds in each plot was recorded by using quadrate (0.25 m x 0.25 m) in four places at random and expressed as number m^{-2}.

Weed dry weight

The weeds removed from each treatment plot from the sampling area of the plot were separated into groups of grass, sedge and broad leaved weeds and were air dried and then oven dried at 80±2°C to obtain a constant weight and expressed as g m^{-2}. Group wise dry weight was summed up to arrive total dry weight.

Weed control efficiency

Weed control efficiency (WCE) was calculated on the basis of weed dry weight recorded in control and treated plot [7]. It is expressed as percentage.

$$\text{Weed control efficiency (\%)} = \frac{\text{Weed dry weight in unweeded control plot (kg ha}^{-1})}{\text{Weed dry weight in treated plot (kg ha}^{-1})} \text{ X 100}$$

Result and Discussion

Weed flora of the experimental field

Weed flora of the experimental field consisted of five, one and eleven species of grass, sedge and broad leaved weeds, respectively. *Cynodon dactylon, Dactyloctenium aegyptium, Digitaria longiflora, Dinebra retroflexa, Echinochloa colonum* under grasses, *Cyperus rotundus* under sedge and *Abutilon hirtum, Trianthema portulacastrum, Portulaca oleracea, Parthenium hysterophorus, Amaranthus viridis, Euphorbia prostrata, Convolvulus arvensis, Cleome gynandra, Boerhaavia erecta, Digera muricata, Corchorus olitorius* under broad leaved weeds were observed irrigated maize field. These results are in line with the findings of [8].

Absolute and relative weed density

Among the group of weeds, broad leaved weeds registered higher absolute and relative weed density at 15 and 30 DAS (**Table 1**). Among the broad leaved weeds, *Trianthema portulacastrum* registered higher absolute and relative density, because experimental field contain higher weed seed bank of broad leaved weeds particularly *Trianthema portulacastrum* in nature. On the other hand, *Cynodon dactylon* among grasses and *Cyperus rotundus* was the only sedge weed observed higher absolute and relative weed density. Among the weed species, *Trianthema portulacastrum* (BLW) was the dominant weed and was followed by *Digera muricata* (BLW) and *Cyperus rotundus* (sedge) [9].

Table 1 Absolute and relative density of weeds under non – chemical methods of weed management in maize at 15 DAS and 30 DAS

Weed species	Absolute density (No. m^{-2})		Relative density (%)	
	15 DAS	30 DAS	15 DAS	30 DAS
Grasses				
Cynodon dactylon (L.)	10.35	11.98	5.67	5.67
Dactyloctenium aegyptium	4.73	2.29	2.59	1.08
Digitaria longiflora	5.85	8.62	3.20	4.08
Dinebra retroflexa	7.39	8.78	4.05	4.16
Echinochloa colonum (L.)	2.68	3.00	1.47	1.42
Total grasses	31.00	34.67	16.97	16.42
Sedges				
Cyperus rotundus (L.)	21.00	30.50	11.50	14.44
Total sedge	21.00	30.50	11.50	14.44
Broad leaved weeds				
Abutilon hirtum	6.17	5.56	3.38	2.63
Amaranthus viridis (L.)	18.32	20.45	10.03	9.68
Boerhaavia erecta (L.)	10.45	11.98	5.72	5.67
Cleome gynandra	5.78	4.45	3.16	2.11
Convolvulus arvensis	8.55	10.78	4.68	5.10
Corchorus olitorius	3.78	2.33	2.07	1.10
Digera muricata	22.45	24.33	12.29	11.52
Euphorbia prostrate	14.50	15.66	7.94	7.42
Parthenium hysterophorus	3.67	4.66	2.01	2.21
Portulaca oleracea (L.)	2.13	3.60	1.17	1.70
Trianthema portulacastrum	34.87	42.20	19.09	19.98
Total broad leaved weeds	130.6	146.0	71.53	69.14
Total weeds	182.6	211.1	-	

Weed density

At 15 and 30 DAS, mulching with crop residue @ 5 t ha^{-1} applied at sowing (T_3) recorded remarkably lower total weed density (**Figure 1**) due to application of organic mulching as a thick layer next day to sowing which can prevent weed seed germination from the top soil. It can control pre – germinated as well as at early establishment of weeds in the crop especially broad leaved weeds which dominated the experimental field [10]. Straw mulches suppressed the weed growth greatly by inducing higher growth rate of maize plants. At 15 DAS, total weed density was significantly higher in T_6, T_7 and T_8 which were comparable with each other because the treatment was imposed at 15 DAS. At 30

DAS, higher total weed density was recorded in intercropping with sunnhemp and incorporation on 40 DAS (T_4) barring unweeded control. Obviously unweeded control resulted in higher grasses, sedges and broad leaved weeds density due to unchecked and increased weed growth [11].

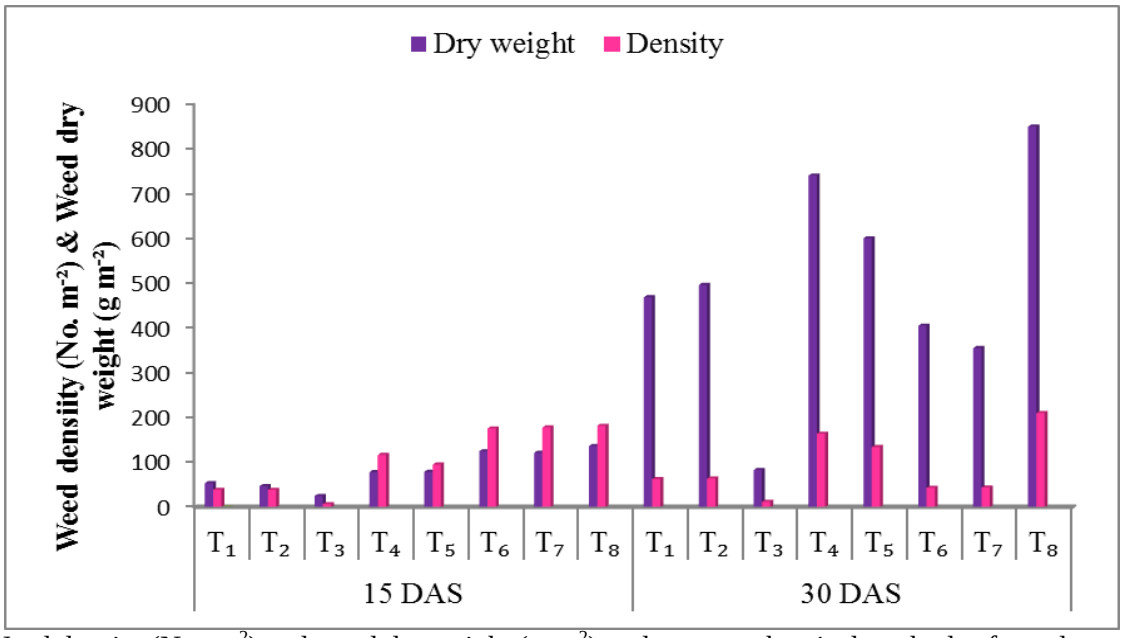

Figure 1 Weed density (No. m^{-2}) and weed dry weight (g m^{-2}) under non – chemical methods of weed management in maize

Weed dry weight

Mulching with crop residue @ 5 t ha^{-1} applied at sowing (T_3) recorded remarkably lower total weed dry weight (Figure 1) at both 15 and 30 DAS might be attributed to considerable reduction in total weed density with lesser biomass in the cropping period and reduction in dry mass of weeds increased as the covering of the soil increased with mulching [12]. Weed dry weight reduced due to the efficient weed control and lesser weed density compared to other weed treatments practiced [13]. T_6, T_7 and T_8 recorded higher and comparable total weed dry weight at 15 DAS. Total weed dry weight was higher in intercropping with sunnhemp and incorporation on 40 DAS (T_4) at 30 DAS barring unweeded control.

Weed control efficiency

Weed control efficiency (WCE) indicates the magnitude of effective reduction of weed dry weight by weed management treatments over unweeded control. At 15 & 30 DAS, higher WCE of 82.27 & 91.36 per cent, respectively in mulching with crop residue @ 5 t ha^{-1} applied at sowing (T_3) (**Table 2**) was due to reduced weed dry weight by covering the entire plot with mulch which prevented the germination of weed seeds at initial stage itself [14]. At 15 DAS, WCE was less than 15 per cent in T_6 and T_7. At 30 DAS, intercropping with sunnhemp and incorporation on 40 DAS (T_4) registered lower WCE of 15.33 per cent.

Table 2 Weed control efficiency (%) under non – chemical methods of weed management in maize

Treatment	15 DAS	30 DAS
T_1 : Stale seed bed followed by one hand weeding on 30 DAS	61.24	52.97
T_2 : Stale seed bed followed by twin wheel hoe weeder weeding on 30 DAS	66.56	50.38
T_3 : Mulching with crop residues @ 5 t ha^{-1} applied at sowing	82.27	91.36
T_4 : Intercropping with sunnhemp and incorporation on 40 DAS	42.20	15.33
T_5 : Intercropping with fodder cowpea	45.27	32.51
T_6 : Twin wheel hoe weeder weeding on 15 and 30 DAS	10.71	64.87
T_7 : Hand weeding on 15 and 30 DAS	14.28	65.19
T_8 : Unweeded control	-	-
Data not statistically analysed		

Conclusion

Mulching with crop residue @ 5 t ha^{-1} applied at sowing was very effectively reduce the weed density, weed dry weight and in turn increases the weed control efficiency. These findings are useful for improving productivity of maize through selection of suitable non chemical weed management method.

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