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STUDIES ON INTEGRATED WEED MANAGEMENT PRACTICES IN IRRIGATED HYBRID MAIZE

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ABSTRACT

Field experiments were conducted during Kharif 2018 to evolve a suitable weed management practices for irrigated hybrid maize. The experiments were laid out in randomized block design, replicated thrice with fifteen treatments *viz.*, T_1-Atrazine @0.25 kg a.i /ha as pre-emergence + hand weeding on 30 DAS, T_2-Pendimethalin @0.75 kg a.i/ha as pre-emergence + hand weeding on 30 DAS, T_3- Alachlor @ 0.2kg a.i/ha as pre-emergence + hand weeding on 30 DAS, T_4- Atrazine @0.25 kg a.i /ha as pre-emergence + early post emergence tembotrione 100g ha^{-1} on 21 DAS, T_5-Pendimethalin @0.75 kg a.i/ha pre-emergence + early post emergence tembotrione 100g ha^{-1} on 21 DAS, T_6-Alachlor @ 0.2 kg a.i/ha as pre-emergence + early post emergence tembotrione 100g ha^{-1} on 21 DAS, T_7- Atrazine @0.25 kg a.i /ha as pre-emergence + twin wheel hoe weeding on 30 DAS, T_8- Pendimethalin @0.75 kg a.i/ha pre-emergence + twin wheel hoe weeding on 30 DAS, T_9- Alachlor @ 0.2 kg a.i/ha pre-emergence + twin wheel hoe weeding on 30 DAS, T_{10}-Maize + cowpea without weeding, T_{11}-Maize + cowpea + hand weeding on 30 DAS, T12-Maize+cowpea + pendimethalin @0.75 kg a.i/ha as pre-emergence, T_{13}-Hand weeding on 15 and 30 DAS, T_{14}-Weed free, T_{15}-Weedy check. From the results, its concluded that atrazine @ 1.5 kg a.i / ha + twin wheel hoe at 30 DAS proved most effective in controlling weeds followed by alachlor @ 0.2 kg a.i/ha pre-emergence +twin wheel hoe on 30 DAS and they reduce the weed density and increased weed control efficiency significantly, which in turn increased yield compared with unweeded control. Significantly highest grain yield were recorded under atrazine @ 1.5 kg a.i / ha + twin wheel hoe at 30 DAS followed by alachlor @ 0.2 kg a.i/ha as pre-emergence + twin wheel hoe on 21 DAS. The highest net returns and highest benefit: cost ratio were obtained under atrazine @ 1.5 kg a.i / ha + twin wheel hoe on 30 DAS followed by alachlor @ 0.2 kg a.i/ha pre-emergence + twin wheel hoe on 30 DAS.

Keywords: Economics, Herbicides, Integrated weed management, Maize

Introduction

Maize (*Zea mays* L.) is the third most important cereal crop next to the wheat and rice in the world. Maize production is high compared to any other cereal crop sand it s adaptability has been wide range to the environments. The crop has very high genetic yield potential, and hence it is also called as the "Queen of cereals". The maize crops can be used as consumer purpose for human being, feed for the poultry, cattle, sheep, and production of lactic acid, alcohol for the industries. It is a resourceful, to convert the solar energy into dry matter accumulation. In the Indian economy, the maize occupies an important place as like the rice, wheat and millets. Recently, with the release of improved cultivars and hybrids, the grain yield has been increased but still the maize crop faces many problems. Farmers usually give prime importance to few cultural practices and neglect other factors like seed rate and weed control. Maize crop gets infested with variety of weeds and subjected to heavy weed competition, which often inflicts huge losses ranging from 28 to 100 % (Patel *et al*., 2006). Weed management strategies attempt to limit the deleterious effects of weeds growing with crop plants. These effects could be quite variable, but the most common is competition for available resources. The quantities of growth factors used by weeds are thus unavailable to the crop. Atrazine, alachlor and pendimethalin are widely used for control of weeds in maize. But their continuous use for long time may lead development of herbicide resistance in weeds (Pandey *et al*., 2000). Hence, there is a need to develop integrated weed management strategies for effective weed control and to realize higher maize productivity.

Materials and Methods

The field experiment was conducted during Kharif season of 2018 at ICAR Krishi Vigyan Kendra Farm, Perambalur. The experimental field is geographically located in Tamil Nadu at 11° 31 'North latitude and 73° 38' East longitude at an altitude of 40 meters above mean sea level. The experimental site was sandy clay loam, 0.35% organic carbon, neutral in reaction (pH 7.19), low in available N (195 kg ha-1), low in available P (10.3 kg ha^{-1}) and medium in available K (133 kg ha^{-1}). The experiment was laid out in a randomized block design with three replications. The net plot size was 5 x 4 m. A set of fifteen treatments comprising T_1-Atrazine @0.25 kg a.i /ha as pre-emergence + hand weeding on 30 DAS, T_2-Pendimethalin @0.75 kg a.i/ha as pre-emergence + hand weeding on 30 DAS, T_3- Alachlor @ 0.2kg a.i/ha as pre-emergence + hand weeding on 30 DAS, T_4- Atrazine @0.25 kg a.i /ha as pre-emergence + early post emergence tembotrione 100g ha^{-1}on 21 DAS, T_5-Pendimethalin @0.75 kg a.i/ha pre-emergence + early post

emergence tembotrione 100g ha^{-1} on 21 DAS, T_6-Alachlor @ 0.2 kg a.i/ha as pre-emergence + early post emergence tembotrione 100g ha^{-1} on 21 DAS, T_7- Atrazine @0.25 kg a.i /ha as pre-emergence + twin wheel hoe weeding on 30 DAS, T_8- Pendimethalin @0.75 kg a.i/ha pre-emergence + twin wheel hoe weeding on 30 DAS, T_9-Alachlor @ 0.2 kg a.i/ha pre-emergence + twin wheel hoe weeding on 30 DAS, T_{10}-Maize + cowpea without weeding, T_{11}-Maize + cowpea + hand weeding on 30 DAS, T_{12}-Maize+cowpea + pendimethalin @0.75 kg a.i/ha as pre-emergence, T_{13}-Hand weeding on 15 and 30 DAS, T_{14}-Weed free, T_{15}-Weedy check. Maize hybrid COH (M) 6 sown with a spacing of 60 x 25 cm. Crop was fertilized with 250:75:75 Kg NPK ha^{-1} through urea, single super phosphate and muriate of potash respectively. Thinning was done at 15 DAS to maintain plant to plant distance of 25 cm. Thinning was done at 10 DAS to maintain plant to plant distance of 25 cm.

Biometric observations on weeds

Weed density

Weeds in sample quadrates were collected from each plot separately at 30 and 60 DAS and root clipped off, oven dried at 80°C ± 5°C till a constant weight obtained and expressed in g m^{-2}.

Weed control efficiency

Weed Control Efficiency (WCE) was calculated as per the procedure given by Mani *et al* (1973) and expressed in per cent.

$$WCE(percent) = \frac{WPC - WPT}{WPC} X100$$

where,

WPC = Weed population in un weeded control plot

WPT = Weed population in treated plot

Results and Discussion

Weed flora

The predominant weed species observed in the experimental field were were, *Cynodon dactylon, Cyperus rotundus, Echinochloa crusgalli, Echinochloa colonum* (L), *Dactyloctenium aegyotium, Panicum repens*. L., *Trianthema portulacastrum, L. and Cleome viscosa*, *Euphorbia hirta*. Among the weed flora, *Cyperus rotundus* was the domiant sedge weed, with respect to grasses, *Cynodon dactylon* were found in higher population. Madhavi *et al*. (2014) observed that the experimental field comprised of *Cyperus rotundus* among sedges, *Digitaria spp, Dactyloctenium aegyptium, Dinebra arabica, Cynodon dactylon* and *Eleusine indica among grasses, Parthenium hysterophorus, Melilotus alba, Trianthema portulacastrum,Euphorbia geniculata, Commelina spp, Tridax procumbens and Amaranthus viridis* among broad leaved weeds in maize crop.

Weed density and weed control efficiency

Weed density were significantly reduced due to all weed-control treatments compared with the weedy check. Among the various weed management practices, the lowest weed density (33 g m^{-2}) were recorded under atrazine @0.25 kg a.i /ha as pre-emergence + twin wheel hoe weeding on 30 DAS (T_7) is at a par with alachlor @ 0.2 kg a.i/ha pre-emergence + twin wheel hoe weeding on 30 DAS (T_9-40 g m^{-2}) (Table 1). This indicated that application of herbicides with mechanical weeding has reduced the weed density and higher weed control efficiency compared to the application of pre-emergence herbicides alone. Lower weed density was noticed at all the stages of crop growth. Invariably unweeded control (T_{15}-168 g m^{-2}) registered highest weed density with maximum grass, sedge and broad leaved weed populations. The current results are in conformity with the findings of Pandey *et al*. (2001), Maliya and Singh (2007).

Weed-control efficiency (WCE) of different treatments varied from 40.5-85.3%. Among all the treatments, atrazine @0.25 kg a.i /ha as pre-emergence + twin wheel hoe weeding on 30 DAS was the most effective in controlling the weeds (WCE 85.3%), followed by alachlor @ 0.2 kg a.i/ha pre-emergence + twin wheel hoe weeding on 30 DAS (T_9)(WCE 83.5%). Weed control efficiency recorded with pre-emergence application of atrazine with twin wheel hoe weeding was high at all the stages of crop growth. This could be due to the fact that the initial weed population was effectively controlled by persistence activity of pre-emergence application of atrazine. The results are in line with the findings of, Mundra *et al*. (2002) and Nagasai and Velayutham (2018).

Growth attributes

Plant height, leaf area index and dry matter production. Highest plant height (125.65 cm), leaf area index (95.87) and dry matter production (6439 kg/ha) was noticed with atrazine @0.25 kg a.i /ha as pre-emergence + twin wheel hoe weeding on 30 DAS (T_7) which was however, on par with alachlor @ 0.2 kg a.i/ha pre-emergence + twin wheel hoe weeding on 30 DAS (T_9) (Table 2). This might be due to lesser weed infestation as evident from lower weed density. The results are in accordance with Sathyapriya *et al.* (2019) who had reported that atrazine @0.25 kg a.i /ha as pre-emergence + twin wheel hoe weeding on 30 DAS resulted in significant plant height due to significant weed reduction of weed density and weed competition. LAI (leaf area index) increased upto 90 DAS and declined there after marginally due to senescence. Atrazine @0.25 kg a.i /ha as pre-emergence + twin wheel hoe weeding on 30 DAS created weed free environment, reduce weed density , which would have favoured the crop to grow well, producing more photosynthetic area, which ultimately lead to more higher LAI. Better stature of crop, as reflected by taller plants, higher LAI and dry matter production would have enhanced the photosynthesis, which in turn resulted in higher dry matter production (Table 2). The results are in confirmation with Sathyapriya and Chinnusamy (2020) findings that the lowered weed emergence and growth was due to reduced weed seed production in proceeding crop period ultimately leads to decreased weed biomass production. Weedy check had recorded lower plant height, LAI and dry matter production of 78.65 cm, 52.76, 4321 kg/ha compared to other treatments. This result was in accordance with Tesfay Amare *et al*. 2015, who reported that the unweeded check higher weed infestation in maize compared with other treatment.

Yield attributes and yield

Atrazine @ 0.25 kg a.i /ha as pre-emergence + twin wheel hoe weeding on 30 DAS (T_9) recorded significantly the higher cob length (19.60 cm), Cob diameter (14.62 cm) and number of grains per cob (524) and it was on par with alachlor @ 0.2 kg a.i/ha pre-emergence + twin wheel hoe

weeding on 30 DAS. It was mainly due to minimum crop-weed competition throughout the crop growth period, thus enabling the crop for maximum utilization of nutrients, moisture, light and space which favoured increased length, cob diameter and number of grains per cob The results are in accordance with the findings of Hatti *et al*. (2014).

Atrazine @0.25 kg a.i /ha as pre-emergence + twin wheel hoe weeding on 30 DAS recorded the highest grain and stover yield of 7198 kg ha^{-1} and 9877 kg ha^{-1}, respectively (Table 3). The highest grain yield obtained under atrazine @0.25 kg a.i /ha as pre-emergence + twin wheel hoe weeding on 30 DAS and was on par with alachlor @ 0.2 kg a.i/ha pre-emergence + twin wheel hoe weeding on 30 DAS. This was due to lesser crop weed competition for growth resources throughout the crop growth period and availability of congenial environment for better expression of growth and yield potential. Similar findings were reported by Pandey *et al*. (2001), Sunitha *et al*. (2011) and Sandhya Rani and Karuna Sagar (2013). Heavy weed infestation in weedy check (T_{15}) had deprived the crop for all the growth resources and resulted in poor performance of corn. These results corroborate with the findings of Swetha *et al*. (2015).

Conclusion

Based on the experimental results, it can be concluded that by atrazine @0.25 kg a.i /ha as pre-emergence + twin wheel hoe weeding on 30 DAS as followed by alachlor @ 0.2 kg a.i/ha pre-emergence + twin wheel hoe weeding on 30 DAS would result in higher yield, improves net returns and B: C ratio of maize production.

Table 1 : Weed density and weed control efficiency of hybrid maize as influenced by different weed management practices

Treatments	Weed density on 35 DAS (g m^{-2})	weed control efficiency (%)
T_1-Atrazine @0.25 kg a.i /ha as pre-emergence + hand weeding on 30 DAS	91	63.6
T_2-Pendimethalin @0.75 kg a.i/ha as pre-emergence + hand weeding on 30 DAS	114	54.4
T_3- Alachlor @ 0.2kg a.i/ha as pre-emergence + hand weeding on 30 DAS	102	56.4
T_4- Atrazine @0.25 kg a.i /ha as pre-emergence + early post emergence tembotrione 100g ha^{-1}on 21 DAS	58	77.5
T_5- Pendimethalin @0.75 kg a.i/ha pre-emergence + early post emergence tembotrione 100g ha^{-1}on 21 DAS	82	73.6
T_6- Alachlor @ 0.2 kg a.i/ha as pre-emergence + early post emergence tembotrione 100g ha^{-1}on 21 DAS	71	76.5
T_7- Atrazine @0.25 kg a.i /ha as pre-emergence + twin wheel hoe weeding on 30 DAS	33	85.3
T_8- Pendimethalin @0.75 kg a.i/ha pre-emergence + twin wheel hoe weeding on 30 DAS	47	80.4
T_9- Alachlor @ 0.2 kg a.i/ha pre-emergence + twin wheel hoe weeding on 30 DAS	40	83.5
T_{10}-Maize + cowpea without weeding	147	38.6
T_{11}-Maize + cowpea + hand weeding on 30 DAS	133	42.6
T_{12}- Maize+cowpea + pendimethalin @0.75 kg a.i/ha as pre-emergence	121	43.6
T_{13}-Hand weeding on 15 and 30 DAS	142	40.5
T_{14}-Weed free	42	78.5
T_{15}-Weedy check	168	0
S.Ed	1.03	1.43
CD (P=0`05%)	2.17	3.01

Table 2 : Growth parameter of hybrid maize as influenced by different weed management practices

Treatments	Plant height (cm)	LAI	Dry matter production (kg/ha)
T_1-Atrazine @0.25 kg a.i /ha as pre-emergence + hand weeding on 30 DAS	105.54	74.76	5106
T_2-Pendimethalin @0.75 kg a.i/ha as pre-emergence + hand weeding on 30 DAS	97.54	68.65	4987
T_3- Alachlor @ 0.2kg a.i/ha as pre-emergence + hand weeding on 30 DAS	102.32	70.2	5012
T_4- Atrazine @0.25 kg a.i /ha as pre-emergence + early post emergence tembotrione 100g ha^{-1}on 21 DAS	115.34	86.76	5889
T_5- Pendimethalin @0.75 kg a.i/ha pre-emergence + early post emergence tembotrione 100g ha^{-1}on 21 DAS	107.25	80.54	5458
T_6- Alachlor @ 0.2 kg a.i/ha as pre-emergence + early post emergence tembotrione 100g ha^{-1}on 21 DAS	110.6	82.6	5666
T_7- Atrazine @0.25 kg a.i /ha as pre-emergence + twin wheel hoe weeding on 30 DAS	125.65	95.87	6439
T_8- Pendimethalin @0.75 kg a.i/ha pre-emergence + twin wheel hoe weeding on 30 DAS	119.54	90.65	6210
T_9- Alachlor @ 0.2 kg a.i/ha pre-emergence + twin wheel hoe weeding on 30 DAS	123.67	93.87	6389
T_{10}-Maize + cowpea without weeding	83.76	58.76	4345
T_{11}-Maize + cowpea + hand weeding on 30 DAS	92.65	63.87	4980
T_{12}- Maize+cowpea + pendimethalin @0.75 kg a.i/ha as pre-emergence	94.54	65.87	4950
T_{13}-Hand weeding on 15 and 30 DAS	90.67	60.76	4442
T_{14}-Weed free	122.54	92.76	6248
T_{15}-Weedy check	78.65	52.76	4321
S.Ed	2.55	1.43	99.09
CD (P=0`05%)	5.3	3.01	208.19

Table 3 : Yield attributes, grain and stover yield hybrid maize as influenced by different weed management practices

Treatments	cob length (cm)	Cob diameter (cm)	number of grains per cob	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1-Atrazine @0.25 kg a.i /ha as pre-emergence + hand weeding on 30 DAS	14.37	11.91	390	6305	8982
T_2-Pendimethalin @0.75 kg a.i/ha as pre-emergence + hand weeding on 30 DAS	13.65	10.19	345	5980	8664
T_3- Alachlor @ 0.2kg a.i/ha as pre-emergence + hand weeding on 30 DAS	14.00	10.52	350	6134	8817
T_4- Atrazine @0.25 kg a.i /ha as pre-emergence + early post emergence tembotrione 100g ha^{-1}on 21 DAS	17.83	13.35	494	6834	9518
T_5- Pendimethalin @0.75 kg a.i/ha pre-emergence + early post emergence tembotrione 100g ha^{-1}on 21 DAS	16.34	12.00	450	6645	9320
T_6- Alachlor @ 0.2 kg a.i/ha as pre-emergence + early post emergence tembotrione 100g ha^{-1}on 21 DAS	17.45	12.65	468	6745	9424
T_7- Atrazine @0.25 kg a.i /ha as pre-emergence + twin wheel hoe weeding on 30 DAS	19.60	14.62	524	7198	9877
T_8- Pendimethalin @0.75 kg a.i/ha pre-emergence + twin wheel hoe weeding on 30 DAS	18.72	13.64	498	6983	9664
T_9- Alachlor @ 0.2 kg a.i/ha pre-emergence + twin wheel hoe weeding on 30 DAS	19.04	14.04	510	7102	9783
T_{10}-Maize + cowpea without weeding	18.43	13.81	298	4565	7246
T_{11}-Maize + cowpea + hand weeding on 30 DAS	12.03	9.05	320	5832	8514
T_{12}- Maize+cowpea + pendimethalin @0.75 kg a.i/ha as pre-emergence	12.22	9.76	328	5982	8661
T_{13}-Hand weeding on 15 and 30 DAS	12.32	9.32	388	5743	8423
T_{14}-Weed free	19.02	14.00	498	7100	9720
T_{15}-Weedy check	11.76	8.76	218	5045	7725
S.Ed	0.28	0.21	6.97	64.11	110.57
CD (P=0`05%)	0.60	0.44	14.66	134.70	232.32

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