RESEARCH ARTICLE

GROWTH AND PRODUCTIVITY OF MAIZE AS INFLUENCED BY INTEGRATED WEED MANAGEMENT PRACTICES

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Abstract: A field experiment was conducted during *Kharif* 2018-19 and 2019-20 at Bagushala farmers field (odisha, India) to find out most efficientmethod of weed control in *kharif* maize. The treatments comprised of intercropping of maize + cowpea, maize + cowpea with pre-emergence application of pendimethalin @ 1 kg ha^{-1}, pre emergence application of atrazine @ 1 kg ha^{-1} either alone or with hand weeding at 30 days after sowing, pre emergence application of atrazine @ 0.5 kg + pendimethalin @ 0.5 kg ha^{-1} + hand weeding at 30 DAS, hand weeding at 15 DAS and hand weeding at 15 and 30 Das were compared with unweeded control.The results revealed that growth of maize in terms of plant height, leaf area index and crop growth rate were remarkably augmented in maize + cowpea + pendimethalin followed by atrazine + pendimethalin + hand weeding, atrazine + hand weeding and twice hand weeding treatments which were at par. The maximum maize grain yield of 63.25 q ha^{-1} and stover yield of 79.15 q ha^{-1} were recorded in atrazine + pendimethalin + hand weeding practice.

Keywords: Crop growth, Weed management, Intercropping, Herbicide, Grain yield

INTRODUCTION

Maize is the world's third most cereal crop after wheat and rice. Maize, being a rainy season and widely spaced crop, gets infested with variety of weeds and subjected to heavy weed competition, which often inflicts huge losses ranging from 28 to 100 per cent. Integrated weed management is the most preferable strategy to reduce the weed population below economic injury level and to minimize weed competition to achieve enhanced yield and profit. Timely weed control plays a decisive role in successful crop production. Weeds are effectively managed by feasible method of weed control such as preventive, mechanical, cultural and chemical methods. The manual method is laborious, tedious and costly. However among cultural practices intercropping has been identified as a popular farming practice from time immemorial. Intercropping suppress weed better than sole cropping and provides an opportunity to utilize crop themselves as a tool of weed management. Besides to this it reduces weeding cost and realizes higher productivity of system and monetary returns. Although intercropping itself appears to offer considerable potential as a means of weed suppression but it alone is not sufficient to check the weed competition. That's why the weed control needs to be restored during initial period so that initial competition can be reduced. Therefore, pre emergence use of herbicides holds a key for early season weed control in such a system.

MATERIALS AND METHODS

The experiment was carried out at Farmers field of Bagushala village, Paralakhemundi, Odisha ,India during *kharif*2018and 2019. The experimental soil was clayey in texture and low in available N and P, and moderate in available potash. Hybrid maize variety 'Nirmal-51' and cowpea variety SFB – 2 were used in the experiment.The crop was sown on 12thJune with the seed rate of 20 kg ha^{-1} at spacing of 60 cm x 20 cm. Standard package of practices was followed throughout thecropping season.To evolve integrated weed management, pre-emergence (PRE) herbicides viz., atrazine and pendimethalin were combined either with hand weeding (HW) or intercropping practices. The experiment comprised eight treatments, namely, (T1) Maize + cowpea, (T2) Maize + cowpea with pre emergence application of pendimethalin @ 1 kg ha^{-1}, (T3)Pre emergence application of atrazine @ 1 kg ha^{-1}, (T4) Pre emergence application of atrazine @ 0.5 kg ha^{-1}+ hand weeding at 30 DAS, (T5) Hand weeding at 15 DAS, (T6) Two hand weeding at 15 and 30 DAS, (T7) Pre emergence application of atrazine @ 0.5 kg + pendimethalin 0.5 kg ha^{-1}at 2 DAS *fb* hand weeding at 30 DAS, (T8)Unweeded control, were replicated thrice in randomized block design.The spraying was done using knapsack sprayer with flat fan nozzle keeping spray volumeof 500 L ha^{-1}. Weeding was done by labours respectively at 15 and 30 DAS.

RESULTS AND DISCUSSION

Effect on weed dynamics and crop growth

The experimental site was infested with altogether 17 weed species consisting of 10 narrow leaved and 7 broad leaved weeds. The grass and sedges occurred to an extent of 70.5 to 72.2 % while broad leaves to 27.8 to 29.5 %. The predominant narrow leaved weeds were *Digitariaciliaris* followed by

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*Echonochloacolonum, Sporobolus diander, Cynodondactylon and Cyperus rotundus. Commelinabenghalensis, Cleome viscose, Ageratum conyzoides*and *Celosia argentea*were the most prevalent broad leaved weed invading the hybrid maize during *kharif* season.

In case of maize, maximum plant height of 189.6 cm and 193.42, respectivelyduring first and second year were recorded in maize + cowpea + pendimethalin treatment which was remained at par with atrazine + pendimethalin + hand weeding , atrazine + hand weeding and twice hand weeding (Table 1).

The LAI was in increasing trend up to 60 DAS and thereafter declined. Maize + cowpea + pendimethalin produced the highest LAI (2.84 and 2.95) at 60DAS during two years of study. During the crop development stages, crop growth rate of maize was highest for the treatments comprised of intercropping of maize + cowpea+ pendimethalin (4.28 and 4.35) and atrazine + pendimethalin + hand weeding (3.66 and 3.75) during two years of experimentation (Table 1).

Effect on Yield and Yield attributes

The maximum number of cobs per plant observed in maize + cowpea + pendimethalin (1.27 and 1.39) closely followed by atrazine + hand weeding (1.23 and 1.32) which were at par with atrazine + pendimethalin + hand weeding (1.20 and 1.31) both in first and second year. The number of rows per cob was significantly increased in atrazine + pendimethalin + hand weeding (14.20 and 15.36) which was at par with maize + cowpea + pendimethalin. The maximum number of grains per cob was recorded in atrazine + pendimethalin + hand weeding (490 and 509) whereas atrazine + hand weeding recorded the highest 1000 grain weight (270 g and 283 g) during both years of study (Table 2).

Atrazine + pendimethalin + hand weeding produced the highest grain yield of 63.25 q ha^{-1} and 80.44 q ha^{-1}in *kharif* maize during two years of study. However, highest stover yield of 79.15 q ha^{-1} and 96.97 q ha^{-1}were resulted in atrazine + pendimethalin + hand weeding treatment followed by maize + cowpea + pendimethalin and atrazine + hand weeding which were at par during two years of experimentation (Table 3).

DISCUSSION

The taller plants are produced in weed control treatments due to supply of all growth factors through reduction in weed growth.In case of maize, maximum plant height of was recorded in maize + cowpea + pendimethalin treatment.Taller plants of maize recorded with application of atrazine + hand weeding (Shinde *et al*., 2001), pendimethalin in maize + blackgram intercropping system (Sekhawat *et al*., 2002) and twice hand weeding (Sekhawat and Gautam, 2002). The favourable effect of intercropping of maize + blackgram with pendimethalin in increasing the LAI was reported by Sekhawat *et al*., 2002. Crop growth rate of maize was highest for the treatments comprised of intercropping of maize + cowpea+ pendimethalinand atrazine + pendimethalin + hand weeding. The improvement in CGR is due to increase in plant height, production of functional leaves and LAI.

The maximum number of cobs per plant wasrecorded in maize + cowpea + pendimethalin treatment, on the other hand,maximum number of rows per cob and grains per cob was resulted in atrazine + pendimethalin + hand weeding treatment during two years of study. This is due to the fact that low weed density and reduced weed competition which influence the availability of all growth factors to express better yield attributes. Pandey and Ved Prakash, 2002 observed the improvement in yield attributes of maize with pre emergence application of pendimethalin when intercropped with blackgram and soybean.Atrazine + pendimethalin + hand weeding treatment produced the highest grain and stover yieldof maize during two years of study. The increase in yield due to pre emergence application of atrazine with hand weeding observed by (Ramesh, G. and NandanassaBabady, 2005 and Mundra *et al*., 2003), atrazine + pendimjethalin (Saini and Angiras, 1998). Increase in yield of maize with pre emergence application of pendimethalin in intercropping of maize + blackgramalso reported by Deshveer and Singh, 2002.

Table 1. Effect of weed management treatments on plant height (cm), LAI and CGR of *kharif*maize

Treatments	Plant height (cm) at 90 DAS		LAI at 60 DAS		CGR at 75- 90DAS	
	2018	2019	2018	2019	2018	2019
T1 - Maize + cowpea	164.10	170.40	2.21	2.33	3.42	3.50
T2– Maize + cowpea + pendimethalin @ 1 kg ha^{-1}	189.60	193.42	2.84	2.95	4.28	4.35
T3 – Atrazine @ 1 kg ha^{-1}	175.70	182.37	2.48	2.53	3.28	3.37
T4 – Atrazine 0.5 kg ha^{-1} + HW at 30 DAS	175.60	187.43	2.42	2.50	3.31	3.39
T5 – HWat 15 DAS	179.30	183.55	1.89	2.01	2.33	3.34
T6 – HWat 15 and 30 DAS	183.60	187.57	2.62	2.69	3.63	3.74
T7 – Atrazine @ 0.5 kg ha^{-1} + pendimethalin @ 0.5 kg ha^{-1} + HWat 30 DAS	186.50	191.23	2.68	2.77	3.66	3.75

T8 – Unweeded control	168.70	174.45	1.38	1.45	1.17	1.28
SEm(±)	3.86	3.92	0.05	0.08	0.21	0.20
CD (P=0.05)	10.82	11.12	0.15	0.19	0.63	0.61

Table 2. Effect of weed management treatments on yield attributes of *kharif*maize

Treatments	**No. of cobsplant^{-1}**		**No. of rowscob^{-1}**		**No. of grainscob^{-1}**		**1000 grain weight(g)**	
	2018	**2019**	**2018**	**2019**	**2018**	**2019**	**2018**	**2019**
T1 - Maize + cowpea	1.13	1.24	12.33	13.46	358	372	263.67	274.35
T2– Maize + cowpea + pendimethalin @ 1 kg ha^{-1}	1.27	1.39	13.60	14.74	486	498	267.33	279.45
T3 – Atrazine @ 1 kg ha^{-1}	1.17	1.28	11.67	12.54	392	417	260.33	274.31
T4 – Atrazine 0.5 kg ha^{-1} + HW at 30 DAS	1.23	1.32	12.90	13.96	420	439	270.00	283.32
T5 – HW at 15 DAS	1.07	1.16	12.10	13.23	361	386	259.33	271.22
T6 – HW at 15 and 30 DAS	1.10	1.23	12.68	13.79	463	483	262.00	275.43
T7–Atrazine @ 0.5 kg ha^{-1} + Pendimethalin @ 0.5 kg ha^{-1} + HW at 30 DAS	1.20	1.31	14.20	15.36	490	509	263.67	278.43
T8 – Unweeded control	0.83	1.00	10.67	11.42	186	204	225.67	233.48
SE (m) ±	0.03	0.02	0.19	0.23	1.94	4.91	3.32	3.12
CD (P=0.05)	0.04	0,07	0.58	0.61	5.60	14.12	9.54	9.03

Table 3. Grain yield and stover yield of *kharif* maize as influenced by weed management treatments.

Treatments	**Grain yield (q ha^{-1})**		**Stover yield(q ha^{-1})**	
	2018	**2019**	**2018**	**2019**
T1 - Maize + cowpea	40.15	51.21	60.30	73.43
T2– Maize + cowpea + pendimethalin @ 1 kg ha^{-1}	60.20	74.43	75.35	90.43
T3 – Atrazine @ 1 kg ha^{-1}	54.65	68.54	68.57	83.84
T4 – Atrazine 0.5 kg ha^{-1} + HW at 30 DAS	58.60	69.43	72.45	84.44
T5 – HWat 15 DAS	38.67	51.23	50.36	65.25
T6 – HWat 15 and 30 DAS	55.37	67.32	70.65	82.57
T7 – Atrazine @ 0.5 kg ha^{-1} + pendimethalin @ 0.5 kg ha^{-1} + HWat 30 DAS	63.25	80.44	79.15	96.97
T8 – Unweeded control	15.06	28.32	42.40	56.32
SE (m) ±	0.97	2.64	1.36	2.01
CD (P=0.05)	2.86	5.88	2.76	5.11

CONCLUSION

Based on the result of two year experiment, it can be concluded that all weed control practices proved effective in controlling weeds thereby resulted in better growth and yield of *kharif* maize over the unweeded control. Among the different treatments, Pre emergence application of atrazine @ 0.5 kg + pendimethalin 0.5 kg ha^{-1} at 2 DAS *fb* hand weeding at 30 DAS (T7) and maize + cowpea with pre emergence application of pendimethalin @ 1 kg ha^{-1}(T2) are the most effective practice to maximise the growth, yield attributes and yield in *kharif* maize.

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