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Effect of integrated weed management practice on weed growth, yield attributes and yield of irrigated maze (*Zea mays* L.)

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Abstract
A Field investigation were carried out at the farmer's field Namasivayapuram Village, Chinnasalem Taluk, Villupuram District and Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, during *summer* and *kharif* season 2013 to study the effect of Integration of chemical and cultural methods for weed management in maize. The experiment was laid out by adopting randomized block design with three replications. The experiment comprised of twelve treatments. The results of the experiments revealed that weed management practices had positive influence on yield attributes, yields and nutrient uptake of maize, number of grains per Cob, Test weight, No of grains per row, Grain weight per cob, Grain and Stover yield were recorded higher in, pre emergence application of atrazine at 1 kg ha^{-1} + two hand weeding on 30 DAS. These treatments were found economical by recording higher net returns and B: C ratio compared to unweeded check.

Keywords: Maize, weeds, yield and yield components

Introduction
Maize (*Zea mays* L.) is the most widely distributed crop of the world. Maize is native of South America, but extensively cultivated in various other countries as well like India, Thailand, Pakistan, China and in several parts of Philippines. As regard to area and production, maize ranks third in world production following wheat and rice. It is widely used for animal feed and industrial raw material in the developed countries, whereas, the developing countries use in general for feed. In Indian Agriculture, maize occupies a prominent position and each part of the maize plant is put to one or the other use and nothing goes as waste.

A number of weed species compete with corn plant and have been observed to reduce yield as much as 65% with delay in weed control. Sohrab *et al.* (2009) [6] reported that the critical period of crop-weed competition of corn was from 5 to 15 leaf stage (19-55 DAE) to prevent yield losses of five per cent. As there are limitations of every weed control method, therefore integrated weed management is a good option for sustainable agriculture. It involves the combination of all the possible methods to suppress the weeds below economic threshold level, although some methods are effective against weeds, but they prove uneconomical for the farmers or pose environmental hazards.

The cultural, biological and chemical control methods are the most popular means of management of weeds in maize field. IWM involves a combination of cultural, mechanical, biological and chemical methods for an effective and economical weed control that reduces weed interference with the crop, while maintaining acceptable crop yields. To overcome these problems, the present field experiment was planned and conducted to study the effect of Integration of chemical and cultural methods for weed management in maize at the farmer's field Namasivayapuram Village, Chinnasalem Taluk, Villupuram District and Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University.

Materials and Methods
The experiment was carried out at the farmer's field Namasivayapuram Village, Chinnasalem Taluk, Villupuram District and Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, during *summer* and *kharif* season 2013 to study the effect of Integration of chemical and cultural methods for weed management in maize. The experiment was laid out in randomized block design and replicated thrice. The experiment comprised twelve treatments, namely, T_1 - PE Oxyfluorfen 0.2 kg ha^{-1} on 3 DAS,T_2 - PE Atrazine 1 kg ha^{-1} on 3 DAS, T_3 - PE Pendimethalin 1 kg ha^{-1} on 3 DAS, T_4 - PE Oxyfluorfen 0.2 kg ha^{-1} on 3 DAS + HW on 30 DAS, T_5 - PE Atrazine 1 kg ha^{-1} on 3 DAS + HW on 30

DAS, T_6 - PE Pendimethalin 1 kg ha^{-1} on 3 DAS + HW on 30 DAS, T_7 - PE Oxyfluorfen 0.2 kg ha^{-1} on 3 DAS + TWH weeder on 30 DAS, T_8 - PE Atrazine 1 kg ha^{-1} on 3 DAS + TWH weeder on 30 DAS, T_9 - PE Pendimethalin 1 kg ha^{-1} on 3 DAS + TWH weeder on 30 DAS, T_{10} - HW twice on 20 and 40 DAS, T_{11} – TWH weeder twice on 20 and 40 DAS, T_{12} - Unweeded control. The soil of the farmer's field is red loamy in texture having 5.75 pH and poor in available nitrogen (192.3 kg ha^{-1}), medium in available phosphorus (26.0 kg ha^{-1}) appreciably rich in available potash (262.5 kg ha^{-1}). Whereas the soil of Annamalai nagar is clay loam in texture with 7.8 pH and poor in available nitrogen (183.0 kg ha^{-1}), medium in available phosphorus (19.8 kg ha^{-1}) appreciably rich in available potash (334.0 kg ha^{-1}). The recommended doses of the fertilizers and other cultivation practices were carried out as per the schedule. Randomly five plants were selected from each plot and regular biometric observations on crop and weed parameters were recorded from 30 DAS up to harvest. Weed density (no.m^{-2}) and dry weight of weeds (g m^{-2}) were recorded by putting a quadrate of 0.25 m^{-2} at two random spots in each plot. Weed control efficiency and weed index was calculated by the formulae. The yield parameters and yields were recorded and analyzed as per Gomez and Gomez (1984) [2]. The treatment comparisons were made using t-test at 5% level of significance. For economic study, prevailing market price was used for different outputs and inputs.

Results and Discussion

Studies on Plant Characteristics

Plant height

Plant height tended to increase progressively with the advancement of the age of maize crop. At 60 and 90 DAS, pre emergence application of atrazine at 1 kg ha^{-1} + TWH on 30 DAS (T_8) recorded significantly taller plants of 234.5, 275.2 cm and 208.1, 241.6 cm for *summer* and *kharif* seasons, respectively. However this was closely followed by pre emergence application of Atrazine at 1 kg ha^{-1} + HW on 30 DAS (T_5) which was on par with hand weeding twice on 20 and 40 DAS (T_{10}). The unweeded control (T_{12}) produced shorter plants 163.8, 206.3cm and 131.9, 158.4 cm during both seasons, respectively. The plots having higher weed control efficiency with more resources produced taller plants as was earlier reported by Nadeem *et al*. (2010) [4].

Dry matter production

At 60 and 90 DAS, dry matter production was lucidly higher 6570,

12454 kg ha^{-1} in *summer* and 5979, 11854 kg ha^{-1} during *kharif* seasons with pre emergence application of Atrazine at 1 kg ha^{-1} + TWH on 30 DAS (T_8) and this was followed by application of Atrazine 1 kg ha^{-1} + HW on 30 DAS (T_5). Unweeded control (T_{12}) recorded lowest dry matter production of 3563, 7051 and 3326, 6956 kg ha^{-1} at both the stages of observation. Kumar *et al.* (2004) [3] who observed that effective control of weeds right from germination of crop allowed the crop to utilize the resources effectively and resulted in higher dry matter production of maize.

Leaf area index

At 60 and 90 DAS, pre emergence application of Atrazine at 1 kg ha^{-1} + TWH on 30 DAS (T_8) higher leaf area index was recorded with 8.41, 6.35 and 8.09, 6.11 in *summer* and *kharif* seasons, respectively. However, this was closely followed by application of Atrazine 1 kg ha^{-1} + HW on 30 DAS (T_5) whereas, unweeded control (T_{12}) registered lower leaf area index 4.65, 1.94 in *summer* and 4.25, 1.82 during *kharif* seasons.

Table 1: Effect of weed control treatments on growth attributes on 60 DAS

Treatments	Growth attributes					
	Summer Season			*Kharif* Season		
	Plant height	DMP	LAI	Plant height	DMP	LAI
T_1	182.5	4253	5.78	152.3	3921	5.69
T_2	188.2	4574	6.10	158.5	4170	6.02
T_3	175.3	3926	5.41	145.0	3703	5.37
T_4	220.2	5682	7.60	190.4	5232	7.34
T_5	232.1	6432	8.39	206.9	5853	8.04
T_6	207.3	5134	6.91	180.1	4710	6.66
T_7	224.8	5965	7.93	195.7	5483	7.63
T_8	234.5	6570	8.41	208.1	5979	8.09
T_9	211.7	5413	7.23	184.3	4973	6.97
T_{10}	230.6	6304	8.35	204.5	5744	7.98
T_{11}	198.0	4815	6.49	172.8	4463	6.31
T_{12}	163.8	3563	4.65	131.9	3326	4.25
SE_d	1.5	96.3	0.13	1.5	86.1	0.11
CD (P=0.05)	3.43	209	0.29	3.27	187	0.26

Effect of weed control methods on yield and yield components

Yield components

Among the yield components studied, statistical differences were observed in cob length, number of grains cob^{-1} and number of grains row^{-1}. Pre emergence application of Atrazine at 1 kg ha^{-1} + TWH on 30 DAS (T_8) registered significantly higher cob length of 21.3 and 21.1 cm, number of grains cob^{-1} of 435 and 416 grains and no of grains row^{-1} is 28.1 and 27.8 rows for *summer* and *kharif* seasons and this was followed by pre emergence application of Atrazine at 1 kg ha^{-1} + HW on 30 DAS (T_5). The unweeded control recorded (T_{12}) lower values of cob length of 15.4 and 15.2 cm, number of grains cob^{-1} 270 and 263 grains and no of grains row^{-1} is 15.2 and 15.0 rows yield attributing traits during both seasons, respectively. Provided favourable environment for recording higher yield attributes of maize against unweeded control which obviously experienced severe weed competition from germination phase to all the crop growth stages. Similar reduction of cob length and girth, number. of grains cob^{-1}, 100 grain weight, number of grains row^{-1} and grain weight cob^{-1} were reported by Pandey *et al*. (2001) [5] due to the competition offered by unchecked weeds in between crop plants in unweeded control maize fields.

Grain yield

The perusal of yield data clearly indicated that different weed management practices had significant influence on the grain yield of maize. Different weed control treatments enhanced the grain yield of maize to an extent of 19.69 to 159.28 and 21.02 to 166.51 per cent over unweeded check during *summer* and *kharif* seasons, respectively. Pre emergence application of atrazine at 1 kg ha^{-1} + TWH at 30 DAS (T_8) recorded higher grain yield of 6438 kg ha^{-1} in *summer* and 5754 kg ha^{-1} during *kharif* seasons. This was comparable with Pre emergence application of atrazine at 1 kg ha^{-1} + HW at 30 DAS (T_5) recorded 6322 and 5622 kg ha^{-1} during *summer* and *kharif* seasons, respectively. The unweeded control (T_{12}) treatment resulted in lesser yield of 2483 and 2159 kg ha^{-1} in both the seasons. Anil Dixit and Gautam (1993) [1] also reported that

pre-emergence Atrazine not only controlled the weeds but also increased the photosynthetic rate of maize plants and grain yield.

Stover yield

Pre emergence application of Atrazine at 1 kg ha^{-1} + TWH on 30 DAS (T_8) recorded the higher stover yield of 9128 and 8012 kg ha^{-1} in *summer* and *kharif* seasons. This was comparable with pre emergence Atrazine at 1 kg ha^{-1} combined with hand weeding on 30 DAS (T_5) 8853 and 7655 kg ha^{-1} and hand weeding twice on 20 and 40 DAS (T_{10}) 8624 and 7282 kg ha^{-1} during *summer* and *kharif* seasons respectively. The unweeded control (T_{12}) recorded conspicuously lower grain yield of 3625 and 2903 kg ha^{-1}during both seasons, respectively. Higher WCE and lower depletion of nutrients by weeds might have promoted the growth and development of maize, consequently favouring higher yield of stover. The lowest grain and stover yield were recorded in weedy check could be attributed to maximum weed density which suppressed the growth and development of maize plants by competing for moisture, light and nutrients (Toloraya *et al*. 2001 and Stefanovic *et al*. 2004) [8, 7]

Table 2: Effect of integrated weed management practice on yield components

Treatments	Yield components					
	Summer Season			*Kharif* Season		
	Cob length (cm)	No. of Grains/cob	No. of grain/row	Cob length (cm)	No. of Grains/cob	No. of grain/row
T_1	16.6	306	18.2	16.6	300	18.1
T_2	17.2	320	19.5	17.3	315	19.4
T_3	16.0	292	16.8	16.0	284	16.8
T_4	19.7	385	24.9	19.6	375	24.8
T_5	21.1	428	27.9	20.9	410	27.5
T_6	18.5	351	22.2	18.5	342	22.1
T_7	20.3	399	26.2	20.1	388	26.1
T_8	21.3	435	28.1	21.1	416	27.8
T_9	19.1	368	23.5	19.0	357	23.4
T_{10}	20.9	419	27.5	20.6	401	27.3
T_{11}	17.8	334	20.9	17.9	329	20.9
T_{12}	15.4	270	15.2	15.2	263	15.0
SE_d	0.23	5.26	0.55	0.18	4.85	0.46
CD (P=0.05)	0.50	11.42	1.2	0.40	10.54	1.0

Table 3: Effect of integrated weed management practice on yield

Treatments	Yield			
	Summer Season		*Kharif* Season	
	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1	3414	4785	2948	3782
T_2	3841	5318	3342	4265
T_3	2972	4219	2613	3320
T_4	5381	7502	4769	6160
T_5	6322	8853	5622	7655
T_6	4617	6421	4086	5162
T_7	5760	8016	5071	6728
T_8	6438	9128	5754	8012
T_9	5008	6938	4402	5636
T_{10}	6193	8624	5514	7282
T_{11}	4223	5844	3757	4699
T_{12}	2483	3625	2159	2903
SE_d	126.8	201.2	111.8	187.7
CD (P=0.05)	275.2	436.7	242.7	407.5

Conclusion

From the present investigation it can be concluded that pre emergence application of Atrazine at 1 kg ha^{-1} + TWH on 30 DAS proved practically more convenient and economically best feasible integrated weed management practice for maize considering the present condition of scarcity and high cost of labours, quality weed control, yield and rupee invested of cultivation of maize.

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