SHORT COMMUNICATION

IMPACT OF NEW HERBICIDES ON THE PRODUCTIVITY OF MAIZE

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Abstract: A field experiment was conducted during the *kharif* season 2020-21 at Instructional-cum-Research Farm, Raj Mohini Devi College of Agriculture & Research Station, Ambikapur (C.G.). Soil of the experimental field was sandy loam in texture. To evaluate the **"**Impact of new herbicides on the productivity of maize" under Northern hill zone of Chhattisgarh to find out the best chemical weed management practices in maize. Eight treatments were evaluated in a randomized block design with three replications. 2 HW at 20 and 40 DAS were recorded lowest weed density, weed fresh & dry weight, weed index and higher weed control efficiency (72.64%) found very effective against complex weed flora and also recorded highest growth parameters, yield attributes *viz*., no. of cob plant^{-1}, no. of kernel cob^{-1} and kernel yield (5.98 t ha^{-1}) followed by atrazine 1000 g/ha as PE fb tembotrine 110g/ha as PoE (5.83 t ha^{-1}) and atrazine 1000 g/ha as PE fb topramezone 25 g/ha as PoE (5.67 t ha^{-1}). Highest net returns (Rs.108045 ha^{-1}) was also recorded under 2 HW at 20 and 40 DAS followed by atrazine 1000 g/ha as PE fb tembotrine 110g/ha as PoE (Rs.105487 ha^{-1}) but higher B:C ratio (2.58) was noticed under application of atrazine 1000 g/ha as PE fb tembotrine 110g/ha as PoE followed by atrazine 1000 g/ha as PE fb topramezone 25 g/ha as PoE (2.52) due to lower cost of cultivation as compare to 2 HW at 20 and 40 DAS.

Keywords: Maize, Weed management practices, Atrazine, Pre and post emergence herbicides

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereals in the world agricultural economy both as a food and fodder crop. It has higher yield potential than any other cereal. It ranks third most important food grain crop after rice and wheat in India providing food, feed, fodder and also serves as a source of basic raw material for number of industrial products for food (25%), animal feed (12%), poultry feed (49%), starch (12%), brewery (1%) and 1% of seed (Dass *et al*. 2008). Maize grains are a good source of carbohydrates (60% starch), lipids (5%) and protein content (7-8%). Maize are also called queen of cereals. It is one of the most efficient crops which give high biological yield as well as grain yield in a short period of time due to its unique photosynthetic mechanism owing to C_4 mechanism. The average maize yield in the developed countries is more than 7 t/ha while in the developing countries it is only around 3 t/ha (Dass *et al*. 2008).

In India, it is grown over an area of 9.23 m ha with total production of 25.66 m tonnes and average productivity of 25.64 q ha^{-1} (Anonymous, 2015). Maize is the most versatile crop with wider adaptability to grow in varied agro-ecological regions from semi-arid to sub-tropical condition in India and diverse growing seasons.The most important maize growing states are Karnataka, Andhra Pradesh, Maharashtra, Tamil Nadu, Rajasthan, Bihar, Uttar Pradesh, Gujarat and Madhya Pradesh, which account for more than 80% of the total maize area of the country and also account for similar share in production. Both area and production of maize have been steadily increasing.

In Chhattisgarh, it occupies an area of 0.23 m ha and productivity was 2458 kg ha^{-1}. It is cultivated around the year, though more than 80% is grown in rainy or *kharif* season as rainfed crop.

It is well known that maize is a heavy feeder for both nutrients and soil moisture due to its high productivity. 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 (Patel *et al*. 2006). A wider row spacing and sowing of the crop with the onset of monsoon provides a favorable environment for weed growth. Apart from offering competition for light, space and moisture, it also helps the weeds to absorb more nutrients and it varies from 30-40% of the applied nutrients (Mundra *et al*. 2003). A higher level of infestation combined with many weed species poses a serious problem in *kharif* maize which include almost all types of weeds viz., grassy, broad leaved and sedges.

There are about 100 weed species in 66 genera and 24 plant families known to be problematic for maize in the country as they affect on the growth and development of maize. Weeds are generally vigorous growers and their nutrient requirements are often greater than that of the crop plants. The magnitude of yield reduction due to infestation of grassy weeds, non-grassy weeds and sedges alone has been reported around 54.4, 31.7 and 21.5 per cent, respectively. Chemical weed control is a better supplement to conventional methods and forms an integral part of the modern crop production.

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MATERIALS AND METHODS

The experiment was conducted during *kharif* 2020 at Research-cum-instructional farm of Raj Mohini Devi College of Agriculture and Research Station, Ambikapur, situated at 23^0 18' N latitude and 83^0 15' E longitude and at altitude of 611 meter above mean sea level which represents the northern hills agroclimatic zone of Chhattisgarh. The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 5.7), medium in organic carbon (0.56), available nitrogen (234 kg ha^{-1}), available phosphorus (8.4 kg ha^{-1}) and available potassium (268 kg ha^{-1}) Chhattisgarh. The experiment was laid out in a randomized block design (RBD) with the following treatments *viz,*. atrazine 1000 g/ha as PE, tembotrine 110g/ha as PoE, topramezone 25 g/ha as PoE, atrazine 1000 g/ha as PE fb tembotrine @ 110g/ha as PoE, atrazine 1000 g/ha as PE fb topramezone 25 g/ha as PoE, pendimethaline 750 g/ha as PoE fb halosulfuron methyl 90g/ha as PoE, weedy check and replicated thrice. Maize variety IAMH 49-2019 was sown on july month at 60 x 20 cm spacing. Before sowing, the field was thoroughly ploughed and leveled. The crop was fertilized evenly irrespective of treatments with N : P_2O_5 : K_2O (150:80:60 kg/ha). All the herbicides and their combinations were applied as per treatment using knapsack sprayer fitted with flat fan nozzle using in 500 liters water ha^{-1}.

RESULTS AND DISCUSSION

Weed density

Among the different weed management practices **(**Table : 1) at 30 and 60 DAS lowest total weed density (4.95 and 6.26 no.m^{-2} respectively) was recorded under 2 HW at 20 and 40 DAS which was significantly superior over rest of the treatments. In herbicidal treatment application of atrazine 1000 g/ha as PE fb tembotrine 110g/ha as PoE had minimum total weed density (5.90 and 7.27 no.m^{-2} respectively) followed by atrazine 1000 g/ha as PE fb topramezone 25 g/ha as PoE and pendimethaline 750 g/ha as PE fb halosulfuron methyl 90g/ha as PoE. The highest total weed density (12.32 and 14.52 no.m^{-2} respectively) was recorded under weedy check. Similar results were reported by Swetha *et al*. (2015) and Biswas *et al*. (2018).

Weed fresh and dry weight

The significant lowest weed fresh and dry weight (Table : 1) were recorded under 2 HW at 20 and 40 DAS treatment at all the stages. The corresponding value were 7.32 and 3.12, 10.08 and 4.07, 16.15 and 6.33 g m^{-2} respectively at 30, 60 DAS and at harvest as compared to all the treatments. Among the herbicidal treatments most effective treatment was atrazine 1000 g/ha as PE fb tembotrine 110g/ha as PoE followed by atrazine 1000 g/ha as PE fb topramezone 25 g/ha as PoE, pendimethaline 750 g/ha as PE fb halosulfuron methyl 90g/ha as PoE and atrazine 1000 g/ha as PoE. The significantly higher weight of fresh and dry weeds were recorded under weedy check at 30, 60 DAS and at harvest, the value were 17 and 6.43, 27.54 and 10.70, 29.93 and 12.06 g m^{-2} respectively.

Weed control efficiency

Different weed management practices, highest weed control efficiency at 60 DAS (85.68%) was recorded in 2 HW at 20 and 40 DAS. however, amongst the herbicidal treatments highest value of weed control efficiency was recorded under atrazine 1000 g/ha as PE fb tembotrine 110g/ha as PoE (63.31%) followed by atrazine 1000 g/ha as PE fb topramezone 25 g/ha as PoE (60.09%). The higher values of weed control efficiencies could be attributed to lower weeds number and weeds dry weight owing to better efficacy among various treatments which might have shifted the pendulum in favour of crop plants rather than weeds. Kolage *et al*. (2004), Singh *et al*. (2012) and Yadav *et al*. (2012) also reported similar findings in maize.

Table 1. Weed density, fresh & dry weight and weed control efficiency as influenced by different weed management practices

Treatments	Total weed density (no.m^{-2})		Fresh weight (g m^{-2})	Dry weight (g m^{-2})	WCE (%)
	30 DAS	60 DAS	60 DAS	60 DAS	
T_1: Atrazine 1000 g/ha ai as a (PE)	8.15 (66)	10.54 (110.67)	20.18 (407)	7.82 (60.67)	46.78
T_2: Tembotrine 110g/ha ai as (PoE)	8.57 (73)	10.79 (116)	23.95 (601.67)	9.61 (92)	19.29
T_3: Topramezone 25 g/ha ai as (PoE)	9.14 (83)	11.51 (132)	24.63 (640)	9.77 (95)	16.66

T_4: Atrazine 1000 g/ha ai as a (PE) fb tembotrine 110g/ha ai as (PoE)	5.90 (34.33)	7.27 (52.33)	16.42 (270)	6.50 (41.83)	63.31
T_5: Atrazine 1000 g/ha ai as a (PE) fb topramezone 25 g/ha ai as (PoE)	7.36 (53.67)	8.88 (78.33)	17.32 (300.32)	6.76 (45.50)	60.09
T_6: Pendimethaline 750 g/ha (PE) halosulfuron methyl 90g/ha (PoE)	7.99 (63.33)	9.69 (93.33)	18.48 (341)	7.54 (56.33)	50.59
T_7: Two hand weeding at 20 and 40 DAS	4.95 (24)	6.26 (38.67)	10.08 (101)	4.07 (16.33)	85.68
T_8: Control plot (Weedy check)	12.32 (151.33)	14.52 (210.33)	27.51 (720)	10.70 (114)	----
SEm±	0.48	0.87	0.99	0.38	----
CD (at 5%)	1.47	2.65	3.99	1.33	----

Growth & yield attributes and yield

In case of growth parameters apply 2 HW at 20 and 40 DAS resulted in the significantly higher plant height, no. of leaves, leaf area index, plant fresh and dry weight, crop growth rate and relative growth rate followed by application of atrazine 1000 g/ha PE fb tembotrine 110g/ha as PoE than atrazine 1000 g/ha as PE fb topramezone 25 g/ha PoE.

Data regarding (Table : 2) yield attributes of maize *viz*, number of kernels cob^{-1} (489.84), number of cob $plant^{-1}$(0.98) and 100 kernel weights influenced by different weed management practices were recorded highest under 2 HW at 20 and 40 DAS followed by herbicidal combination application of atrazine 1000 g/ha PE fb tembotrine 110g/ha as PoE and atrazine 1000 g/ha as PE fb topramezone 25 g/ha PoE.

The highest cob, kernel and stover yield were also noticed under 2 HW at 20 and 40 DAS (7.38, 5.98 and 8.52 t ha^{-1} respectively) which were comparable with application of atrazine 1000 g/ha as PE fb tembotrine 110g/ha as PoE (7.28, 5.83 and 8.30 t ha^{-1} respectively), atrazine 1000 g/ha as PE fb topramezone 25 g/ha as PoE (7.08, 5.67 and 8.09 t ha^{-1} respectively) and pendimethaline 750g/ha as PE fb halosulfuron methyl 90g/ha as PoE.

Yield attributes of maize were significantly influenced by adapting different weed management practices and highest yield attributes and yield obtained under hand weeding (weed free condition) 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 growth and yield components and also minimized weed interference. These results were in close conformity with Hatti *et al*.(2014), Ehsas *et al*.(2016), Kumar *et al*. (2017) and Biswas *et al*. (2018).

Economics

Data regarding economics as influenced by different weed management practices. Significantly maximum net return was recorded under 2 HW at 20 and 40 DAS (Rs.108045 ha^{-1}) which was at par with application of atrazine 1000 g/ha PE fb tembotrine 110g/ha as PoE (Rs.105487 ha^{-1}) and atrazine 1000 g/ha as PE fb topramezone 25 g/ha as PoE (Rs. 101910 ha^{-1}). The minimum net return (Rs. 46238 ha^{-1}) was recorded under weedy check but B : C ratio was highest under application of atrazine 1000 g/ha as PE fb tembotrine 110g/ha as PoE (2.58) followed by atrazine 1000 g/ha as PE fb topramezone 25 g/ha as PoE (2.52). The results are also supported with the findings of Sabiry and Babu (2019) and Swetha *et al*. (2015).

Table 2. Yield attributes, yield and economics of maize as influenced by different weed management practices

Treatments	Yield attributes		Cob yield ($t\,ha^{-1}$)	Kernel yield ($t\,ha^{-1}$)	Stover yield ($t\,ha^{-1}$)	Economics	
	No. of kernel cob^{-1}	No. of cob $plant^{-1}$				Net returns ($Rs.\,ha^{-1}$)	B:C ratio
T_1: Atrazine 1000 g/ha ai as a (PE)	397.10	0.94	6.28	4.96	7.40	89907	2.44
T_2: Tembotrine 110g/ha ai as (PoE)	394.48	0.94	5.94	4.69	7.34	80525	2.02
T_3: Topramezone 25 g/ha ai as (PoE)	377.49	0.93	5.79	4.58	6.81	77410	1.96

T_4: Atrazine 1000 g/ha ai as a (PE) fb tembotrine 110g/ha ai as (PoE)	446.79	0.96	7.28	5.83	8.30	105487	2.58
T_5: Atrazine 1000 g/ha ai as a (PE) fb topramezone 25 g/ha ai as (PoE)	436.55	0.96	7.08	5.67	8.09	101910	2.52
T_6: Pendimethaline 750 g/ha (PE) halosulfuron methyl 90g/ha (PoE)	431.89	0.95	6.97	5.58	7.93	96480	2.21
T_7: Two hand weeding at 20 and 40 DAS	489.84	0.98	7.38	5.98	8.52	108045	2.14
T_8: Control plot (Weedy check)	305.25	0.92	4.02	3.26	5.02	46238	1.24
SEm±	22.51	0.01	0.15	0.12	0.36	4972.51	0.14
CD (at 5%)	65.85	NS	0.43	0.35	1.06	14547.19	0.45

***Figures in without parenthesis indicates the transformed value.** $\sqrt{X + 0.5}$

CONCLUSION

It may be concluded that under weed management practices 2 HW at 20 and 40 DAS, atrazine 1000 g/ha as a PE fb tembotrine 110g/ha as a PoE and atrazine 1000 g/ha as PE fb topramezone 25 g/ha as a PoE were found to be optimum growths, yield attributes, kernel yield and net return.

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