IMPACT OF DIFFERENT DOSES OF HERBICIDES ON WEED DENSITY AND WEED CONTROL EFFICIENCY IN MAIZE

ABSTRACT

A field experiment was conducted at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during Kharif season of 2021, to evaluate effect of different doses of Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC on growth and yield of maize (Zea mays L.). The experiment was laid down in the Randomized block design with ten treatments which was replicated three times. Experimental Field was infested with *Echinochloacolona*, *Digitariasanguinalis*, *Dactyloctenіumaegyptium*, *Commelinabenghalensis*, *Trianthema*and *Cyperus rotundus*.Ready-mix herbicide,Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC*(CalarisXtra)* manufactured by *Syngenta* was used in the experiment. Among the herbicidal treatments, the application of Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC @ 1.750 kg a.i. ha^{-1}recorded the lowest weed density and highest weed control efficiency (approx. 90%) at every growth stage of maize. However, among herbicidal treatments, grain yield of maize was maximum with the application of Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC @ 1.0 kg a.i. ha^{-1}(T4) which might be due do toxicity effect of herbicide.

Keywords: doses, ready-mix

Introduction

Maize (*Zea mays* L.) is a key cereal and adaptable crop in the*Poaceae*family. Its relevance covers many uses, which include human dietary needs, animal and poultry feed, and industrial utilisation for the production of maize starch, dextrose, maize syrup, and maize flakes**(Sachan etal., 2024).**Being a C4 plantit is capable of utilizing solar radiation more efficiently than several other cereal crops **(Deewan et al., 2017).**It is grown in many agro-ecological zones worldwide, with the United States, China, Brazil, and Mexico being the top producers**(Sachan et. al., 2023).**

Maize, after rice and wheat, is India's most important cereal crop in terms of food security and agricultural revenue. The majority of maize is grown during the kharif season, and weed infestation is one of the most critical yield-limiting factors. However, the first six weeks following crop planting are the most essential period for crop weed competition, since

initial sluggish growth in wider spacing of maize, along with favourable weather conditions, allow luxuriant weed development, which may cut production by 28-100%**(Dass et. al., 2012).**

Weeds alone represent for one-third of the entire projected productivity losses caused by pests, insects, diseases, and weeds globally. Weeds are the most major factor limiting output in maize farming in India. Weed infestation in maize is fairly prevalent, and it typically leads in a large reduction in production, especially in dry land conditions **(Sulewska et al., 2012).**Chemicals are more efficient in maize fields because they can control weeds before they develop, kill both vegetative and deep-rooted weeds, and are also more cost-effective and produce faster results**(Chikoye et al., 2005).**

Materials and Methods

Experimental site

The experiment was conducted at 'Student's Instructional Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. The experimental field had an even topography and good drainage facility. Geographically, experimental site falls under the sub-tropical and semi- arid tract of North India of Indo- Gangetic plains and lies on the right bank of holy river Ganga. It is located on 260 28'36" N latitude, 800 18' 26" E longitude and at an altitude of 126 meters above mean sea level. The experimental plot was homogenous in fertility with assured irrigation and other required facilities.

Experimental Design and Treatment Details

The experiment was designed as **Randomized block design (RBD)** with 10 Treatments replicated thrice. The treatment was allocated randomly in each block. The treatment details is given in table 1.

Table 1: Treatment Details

T1	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 0.375 kg a.i. ha^{-1}
T2	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 0.75 kg a.i. ha^{-1}
T3	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 0.875 kg a.i. ha^{-1}
T4	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 1.0 kg a.i. ha^{-1}
T5	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 1.125 kg a.i. ha^{-1}

T6	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 1.750 kg a.i. ha^{-1}
T7	Atrazine 50% WP @ 1.0 kg a.i. ha^{-1}
T8	Hand weeding at 15 and 30 DAS
T9	Weed Free
T10	Control (Weedy check)

(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) is ready mix or premix herbicide bearing trade name ***CalarisXtra*** *manufactured by Syngenta.*

Seed Sowing and Spacing

The field was ploughed with a tractor drawn cultivator and after with the rotavator to obtain a fine tilth. The seed was sown at the spacing of 45 cm between rows and 15 cm between plant. The Maize Variety *Azad Uttam* was sown and the applied seed rate was 25 kg ha^{-1}. Thinning and gap filling was after 20 days after sowing wherever it was required for maintaining optimum plant population.

Application of herbicide

Herbicide application was made at 25 Days after sowing (DAS) of maize crop with the knapsack sprayer.

Weed Density (No. /m2)

The weed density of different species was recorded at 15, 30, 45 and 60 days after application (DAA) of herbicides.

Results and Discussion

Weed Studies

Weed flora of the experimental plot were collected, identified and different species of weeds were observed during the course of investigation, which includes six species of weeds. *Echinochloacolona, Digitariasanguinalis, Dactylocteniumaegyptium,Commelinabenghalensis,* among monocot weeds, *Trianthema*spp. is among dicot weeds, and *Cyperus rotundus*among sedges were the weed flora predominantly observed in the experimental site.

Effect of treatments on density(per m^2)of *Cyperus rotundus*

The data in table-2 revealed that the effect of herbicides was found significantly in reducing the population of *Cyperus rotundus* at 15, 30, 45 and 60 days after application of herbicides.Among the herbicide applications it was observed that the significantly minimum density of *Cyperus rotundus* wasrecorded under the application of(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 1.750 kg a.i. ha^{-1}. This result was in the line with **Samant et al., (2015)** and **Dey et al., (2018).**

Table-2:density(per m^2) of *Cyperus rotundus*

Treatment	Treatment details	15 DAA	30 DAA	45 DAA	60 DAA
T1	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 0.375 kg a.i. ha^{-1}	4.40	5.49	5.88	7.09
		(18.90)	(29.67)	(34.10)	(49.7)
T2	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 0.75 kg a.i. ha^{-1}	3.45	4.77	5.62	6.47
		(11.40)	(22.30)	(31.10)	(41.40)
T3	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 0.875 kg a.i. ha^{-1}	3.05	4.17	4.89	5.68
		(8.80)	(16.90)	(23.40)	(31.80)
T4	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 1.0 kg a.i. ha^{-1}	2.83	3.83	4.52	5.22
		(7.50)	(14.20)	(19.90)	(26.70)
T5	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 1.125 kg a.i. ha^{-1}	2.61	3.56	4.37	5.11
		(6.30)	(12.20)	(18.60)	(25.60)
T6	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 1.750 kg a.i. ha^{-1}	2.27	3.24	4.12	5.01
		(4.67)	(10.00)	(16.50)	(24.60)
T7	Atrazine 50% WP @ 1.0 kg a.i. ha^{-1}	3.55	4.67	5.59	6.43
		(12.10)	(21.30)	(30.70)	(40.80)
T8	Hand Weeding @ 15 and 30 DAS	2.61	3.70	5.47	6.12
		(6.30)	(13.20)	(29.40)	(37.00)
T9	Weed Free	0.71	0.71	0.71	0.71
		(0.00)	(0.00)	(0.00)	(0.00)
T10	Control	4.91	6.80	8.23	9.74

		(23.60)	(45.80)	(67.20)	(94.40)
	SE(m)±	0.34	0.36	0.45	0.83
	C.D at 5%	1.03	1.07	1.34	1.21

Data in the parenthesis are actual values.

Effect of treatments on density(per m^2) of *Echinochloacolona*

Data pertaining to density of *Echinochloa* is given in table-3. Among the herbicide applications it was observed that the significantly minimum density of *Echinochloacolona*wasrecorded under the treatment (Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 1.750 kg a.i. ha^{-1}(T6). Maximum density of *Echinochloa* was observed in the weedy check(T10) at each stage of crop growth period. This result was supported by **IspitaDey (2020).**

Table-3: density (per m^2) of *Echinochloacolona*

Treatment	Treatment details	15 DAA	30 DAA	45 DAA	60 DAA
T1	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 0.375 kg a.i. ha^{-1}	3.94	4.34	4.63	5.15
		(15.10)	(18.40)	(20.90)	(26.00)
T2	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 0.75 kg a.i. ha^{-1}	3.24	3.75	4.12	4.58
		(10.00)	(13.60)	(16.50)	(20.50)
T3	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 0.875 kg a.i. ha^{-1}	3.16	3.58	3.86	4.31
		(9.50)	(12.30)	(14.40)	(18.10)
T4	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 1.0 kg a.i. ha^{-1}	3.16	3.56	3.74	4.12
		(9.50)	(12.20)	(13.50)	(16.50)
T5	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 1.125 kg a.i. ha^{-1}	3.03	3.33	3.59	3.97
		(8.70)	(10.60)	(12.40)	(15.30)
T6	(Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 1.750 kg a.i. ha^{-1}	2.33	2.94	3.32	3.87
		(4.95)	(8.20)	(10.50)	(14.5)
T7	Atrazine 50% WP @ 1.0 kg a.i. ha^{-1}	3.24	3.69	3.97	4.53
		(10.00)	(13.10)	(15.30)	(20.00)
T8	Hand Weeding @ 15 and 30 DAS	2.79	3.30	4.32	4.70

		(7.30)	(10.40)	(18.20)	(21.60)
T9	Weed Free	0.71	0.71	0.71	0.71
		(0.00)	(0.00)	(0.00)	(0.00)
T10	Control	4.17	5.33	6.08	6.75
		(16.90)	(27.90)	(36.50)	(45.10)
	SE(m)±	0.31	0.32	0.51	0.54
	C.D at 5%	0.94	0.97	1.51	1.62

Data in the parenthesis are actual values.

Effect of treatments on density (per m^2) of *Digitariasanguinalis and Trianthema sp.*

Data pertaining to density of *Digitariasanguinalis and Trianthema sp.*is given in table-4. Among the herbicide applications it was observed that the significantly minimum density of *Digitariasanguinalisand trianthema*wasrecorded under the treatment T6 at each stage of crop growth while maximum density was recorded at Weedy check(T10).

Table-4: density (per m^2) of *Digitariasanguinalis and Trianthema sp.*

Treatment	***Digitariasanguinalis***				***Trianthema***			
	15 DAA	**30 DAA**	**45 DAA**	**60 DAA**	**15 DAA**	**30 DAA**	**45 DAA**	**60 DAA**
T1	3.14	4.14	4.36	5.04	3.0	3.72	4.05	4.68
	(9.40)	(16.67)	(18.50)	(24.90)	(8.50)	(13.40)	(15.90)	(21.40)
T2	2.79	3.49	4.20	4.40	2.02	2.81	3.45	3.91
	(7.30)	(11.70)	(15.70)	(18.90)	(3.60)	(7.40)	(11.40)	(14.80)
T3	2.70	3.24	3.73	4.05	1.73	2.39	2.77	3.29
	(6.80)	(10.00)	(13.40)	(15.90)	(2.50)	(5.20)	(7.20)	(10.30)
T4	2.65	3.18	3.59	3.86	1.64	2.26	2.66	2.98
	(6.50)	(9.60)	(12.40)	(14.40)	(2.20)	(4.60)	(6.60)	(8.40)
T5	2.59	3.07	3.36	3.42	1.58	2.02	2.35	2.74
	(6.20)	(8.90)	(10.80)	(11.20)	(2.00)	(3.60)	(5.00)	(7.00)
T6	2.09	2.82	3.15	3.66	1.47	1.81	2.19	2.79

	(3.87)	(7.50)	(9.40)	(12.9)	(1.67)	(2.79)	(4.31)	(7.3)
T7	2.79	3.38	3.90	4.23	2.10	2.70	3.36	3.87
	(7.30)	(10.90)	(14.70)	(17.40)	(3.90)	(6.80)	(10.80)	(14.50)
T8	2.65	3.19	3.74	4.28	1.52	2.07	2.95	3.63
	(6.50)	(9.70)	(13.50)	(17.80)	(1.80)	(3.80)	(8.20)	(12.70)
T9	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
T10	3.78	4.80	5.96	6.72	3.55	5.50	7.64	8.08
	(13.8)	(22.50)	(35.00)	(44.70)	(12.10)	(29.80)	(57.90)	(64.80)
SE(m)±	0.27	0.34	0.35	0.52	0.23	0.39	0.47	0.59
C.D at 5%	0.81	1.02	1.05	1.56	0.68	1.18	1.42	1.77

Data in the parenthesis are actual values.

Effect of treatments on density (per m^2) of *Dactylocteniumaegyptium*and*Commelinabenghalensis*

Data pertaining to density of *Dactylocteniumaegyptium* and *Commelinabenghalensisis* is given in table-5. Minimum density was observed in the T6 treatment in both the weeds at each stage of crop growth.The maximum density of *Commelinabenghalensis*and *Dactyocteniu*mwas recorded under weedy check(T10).

Table-5: density (per m^2) of *Dactylocteniumaegyptium* and *Commelinabenghalensisis*

Treatment	***Dactylocteniumaegyptium***				***Commelinabenghalensis***			
	15 DAA	**30 DAA**	**45 DAA**	**60 DAA**	**15 DAA**	**30 DAA**	**45 DAA**	**60 DAA**
T1	3.34	4.47	4.86	5.47	3.13	4.00	4.82	5.31
	(10.67)	(19.56)	(23.10)	(29.40)	(9.30)	(15.50)	(22.70)	(27.70)
T2	2.63	3.62	4.31	4.96	2.43	3.29	4.06	4.60
	(6.40)	(12.60)	(18.10)	(24.10)	(5.40)	(10.30)	(16.00)	(20.70)

T3	2.32	3.08	3.61	4.23	2.17	2.79	3.41	3.86
	(4.90)	(9.00)	(12.50)	(17.40)	(4.20)	(7.00)	(11.10)	(14.40)
T4	2.10	2.83	3.29	3.81	2.02	2.61	3.18	3.59
	(3.90)	(7.50)	(10.30)	(14.00)	(3.60)	(6.30)	(9.60)	(12.40)
T5	2.01	2.77	3.18	3.62	1.92	2.39	2.95	3.35
	(3.55)	(7.20)	(9.60)	(12.60)	(3.20)	(5.20)	(8.20)	(10.70)
T6	2.00	2.70	2.98	3.24	1.81	1.98	2.87	2.98
	(3.50)	(6.80)	(8.40)	(10)	(2.79)	(3.45)	(7.75)	(8.4)
T7	2.66	3.59	4.29	4.96	2.68	3.41	4.12	4.77
	(6.60)	(12.40)	(17.90)	(24.10)	(6.70)	(11.10)	(16.50)	(22.30)
T8	1.95	2.74	3.95	4.47	1.90	2.49	3.56	4.27
	(3.30)	(7.00)	(15.10)	(19.50)	(3.10)	(5.70)	(12.20)	(17.70)
T9	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
T10	3.87	5.39	6.40	7.75	3.80	4.89	5.76	6.86
	(14.50)	(28.50)	(40.50)	(59.60)	(14.10)	(23.40)	(32.70)	(46.60)
SE(m)±	0.25	0.38	0.43	0.58	0.29	0.34	0.40	0.51
C.D at 5%	0.75	1.13	1.29	1.75	0.86	1.02	1.21	1.54

Data in the parenthesis are actual values.

Effects of treatments on weed control efficiency(%) in maize

The data pertaining to weed control efficiency is given in table-6. At 15 DAA highest weed control efficiency (100%) was obtained with Weed free plot followed by two hand weeding at 15 and 30 DAS. The result was in conformity with the findings of **Sanodiya*et al.* (2013)**. Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) @ 1.750 kg a.i. ha^{-1}attained highest WCE at15 DAA. **Nadiger*et al*. (2013), Barla *et al.* (2016), Malik (2015)** and **Radheyshyam (2018)** also obtained similar results.

Table-6: Weed control efficiency (%) at 15 DAA

treatments	*Cyperus rotundus*	*Echinochloacolona*	*Digitariasanguinalis*	*Trianthema sp.*	*Commelinabenghalensisis*	*Dactyloctenium aegyptium*
T1	81.20	75.39	73.71	81.97	64.42	82.67
T2	85.30	79.49	80.91	85.76	73.69	86.57
T3	88.98	81.08	82.73	86.56	79.80	90.01
T4	89.20	85.78	86.59	88.34	84.78	89.67
T5	89.68	88.63	89.32	89.38	86.43	91.00
T6	90.28	90.63	90.98	91.52	88.90	91.28
T7	82.61	77.15	78.73	84.57	67.36	84.56
T8	88.86	79.47	76.69	92.77	86.91	90.50
T9	100	100	100	100	100	100
T10	-	-	-	-	-	-
SE(m)±	0.94	0.98	1.01	1.36	1.34	1.09
C.D at 5%	2.80	2.91	3.02	4.04	3.98	3.25

Conclusion:

The application of Mesotrione 2.27% w/w + Atrazine 22.7% w/w SC) at the rate of 1.750 kg a.i. ha^{-1}ismost efficient in controlling weeds and recorded the lowest weed density and highest weed control efficiency of approximately 90% on an average at every growth stage of maize.

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