International Journal of Plant & Soil Science

33(21): 137-145, 2021; Article no.IJPSS.76126
ISSN: 2320-7035

Optimization of Spray Fluid for Herbicide Application for Drones in Irrigated Maize (*Zea mays* L.)

C. Supriya[1*], P. MuraliArthanari[1], R. Kumaraperumal[2] and A. P. Sivamurugan[1]

[1]Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore - 641 003, Tamil Nadu, India.
[2]Department of remote sensing and GIS, Tamil Nadu Agricultural University, Coimbatore - 641 003, Tamil Nadu, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2021/v33i2130665
Editor(s):
(1) Prof. Ahmed Medhat Mohamed Al-Naggar, Cairo University, Egypt.
Reviewers:
(1) Silvio Cesar Godinho Teixeira, Petrobras University, Brasil.
(2) Maryam Afrousheh, Pistachio Research Center, Iran.
Complete Peer review History: https://www.sdiarticle4.com/review-history/76126

Original Research Article

Received 09 August 2021
Accepted 18 October 2021
Published 19 October 2021

ABSTRACT

A field experiment was conducted in a randomized complete block design to screen the optimum spray fluid of herbicide application for drone based on visual toxicity and weed control efficiency in maize (*Zea mays* L.) during the *summer* season (March 2021) at eastern block farms of Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu. Three herbicide treatments namely Atrazine, Tembotrione and 2, 4-D with recommended dosages, 75% and 125% as pre-emergence herbicides applied on 3 days after, early post-emergence herbicides applied on 15 days after sowing and post-emergence applied on 25 days after sowing respectively. Totally thirty treatments with different spray fluids such as 500, 400, 300, 200, 100, 80, 60, 40, 30 L ha-1 and 20 L ha-1 were replicated three times. The study revealed that T5- Recommended dosage of pre emergence Atrazine – early post emergence Tembotrione – post emergence 2, 4-D (spray fluid 100 L of water ha-1),T6- Recommended dosage of pre emergence Atrazine – early post emergence Tembotrione–post emergence 2, 4-D (spray fluid 80 L of water ha-1), T7- Recommended dosage of pre emergence Atrazine – early post emergence Tembotrione – post emergence 2, 4-D (spray fluid 60 L of water

**Corresponding author: E-mail: supriya1chinna@gmail.com;*

ha-1) and T8- Recommended dosage of pre emergence Atrazine – early post emergence Tembotrione – post emergence 2, 4-D (spray fluid 40 L of water ha-1) produced the best results with respect to phytotoxicity and weed control efficiency. Based on the results it was concluded that the application of spray fluid 80 L ha-1 was optimum for herbicide application through drones with recommended dosage pre emergence Atrazine 1 kg a.i ha-1 on 3 days after sowing – early post emergence Tembotrione 120 g a.i ha-1 on 15-20 days after sowing - post emergence 2, 4-D 1 kg a.i ha-1 on 30 - 35 days after sowing.

Keywords: Drone; weed density; weed dry weight; Atrazine; Tembotrione; 2; 4-D; Phytotoxicity; spray fluid.

1. INTRODUCTION

Maize (*Zea mays* L.) is the third most important cereal crop after rice and wheat, which is widely grown in the world and also used as a primary staple food in many developing countries.in maize production weeds one of the important factors which influence the productivity of maize. Among different weed management options, chemical weed management is turning out to be more reliable because of the benefits in terms of time, labour efficiency and economic weed suppression [1].

Manual weeding is declining due to labour scarcity and increased labour costs [2].Conventionally farmers spray herbicide by hand operated sprayer with a high volume of spray fluid. It consumes more time and water. In the current scenario, to overcome the scarcity of water and farm labour, an alternate method of application of herbicide is needed. In order to save water, time and energy, application of herbicides by drones is the best alternate method for the application of herbicides. The herbicide application can cause phytotoxicity to the crops, particularly when they are not used according to the recommended dosages and higher concentration

In this connection, the present investigation was conducted to understand the impact of spray fluid for herbicides on phytotoxicity and WCE (Weed Control Efficiency) in maize (*Zea mays* L.) and will utilize the understanding to identify optimum spray fluids which are more reliable to use in drone

2. MATERIALS AND METHODS

2.1 Experimental Details

A field experiment was conducted at the eastern block farm of Tamil Nadu Agricultural University, Coimbatore during *the summer* season (March 2021) on maize variety CO(H) 8. The experimental farm is geographically situated at 11°N latitude and 77°E longitude and at an altitude of 426.7 m above the mean sea level (MSL). The soil texture was sandy clay loam with pH 8.7 and electrical conductivity (EC) 0.2 dSm^{-1}. The soil exhibited low nitrogen (187 kg ha^{1}), high phosphorous (37.6 kg ha^{-1}) and high potassium (670 kg ha^{-1}) content. The study was arranged in randomized complete block design with two replications with the plot 1 x 1 meter. A total of thirty treatments were taken up in two replications, which are namely, T_1-T_{10} contains RD (recommended dosage) of PE (pre-emergence) Atrazine 1 kg a.i ha^{-1} on 3 DAS (days after sowing) - EPOE (early post-emergence) Tembotrione 120g a.i/ha on 15-20 DAS – POE (post-emergence) 2, 4-D 75g ha^{-1} on 25-30 days with spray fluid of 20, 30, 40, 60, 80, 100, 200, 300, 400 and 500 L ha^{-1}, T_{11}-T_{20} contains 125% or 75% of RD of PE - EPOE with spray fluid of 20, 30, 40, 60 and 80 L ha^{-1} and T_{21}-T_{30} contains 125% or 75% of RD of PE - POE with spray fluid of 20,30, 40, 60 and 80 L ha^{-1}. Whereas RD considered to be PE Atrazine 1 kg a.i ha^{-1} on 3 DAS – EPOE Tembotrione 120 g a.i ha^{-1} on 15-20 DAS - POE 2, 4-D 1 kg a.i ha^{-1} on 30 - 35 DAS, 125% considered to be PE Atrazine 1.25 kg a.i ha^{-1} on 3 DAS - EPOE Tembotrione 150g a.i ha^{-1} on 15-20 DAS - POE 2, 4-D 1.25 Kg a.i ha^{-1} on 30 - 35 DAS and 75% considered to be PE Atrazine 0.75 kg a.i ha^{-1} on 3 DAS - EPOE Tembotrione 90 g a.i ha^{-1} on 15-20 DAS - POE 2, 4-D 0.75 Kg a.i ha^{-1} on 30-35 DAS. Whereas,

T_1- RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 500 L of water ha^{-1}) T_2-

RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 400 L of water ha^{-1}) T_3- RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 300 L of water ha^{-1}) T_4- RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 200 L of water ha^{-1}) T_5- RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 100 L of water ha^{-1}) T_6- RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 80 L of water ha^{-1}) T_7- RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 60 L of water ha^{-1}) T_8- RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 40 L of water ha^{-1}) T_9- RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 30 L of water ha^{-1}) T_{10}- RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 20 L of water ha^{-1}) T_{11} - 125% of RD of PE Atrazine - EPOE Tembotrione (spray fluid 80 L of water ha^{-1}) T_{12} -75% of RD of PE Atrazine - EPOE Tembotrione (spray fluid 80 L of water ha^{-1}) T_{13} - 125% of RD of PE Atrazine - EPOE Tembotrione (spray fluid 60 L of water ha^{-1}) T_{14} -75% of RD of PE Atrazine - EPOE Tembotrione (spray fluid 60 L of water ha^{-1}) T_{15} - 125% of RD of PE Atrazine - EPOE Tembotrione (spray fluid 40 L of water ha^{-1}) T_{16} - 75% of RD of PE Atrazine - EPOE Tembotrione (spray fluid 40 L of water ha^{-1}) T_{17}- 125% of RD of PE Atrazine - EPOE Tembotrione (spray fluid 30 L of water ha^{-1}) T_{18}- 75% of RD of PE Atrazine - EPOE Tembotrione (spray fluid 30 L of water ha^{-1}) T_{19}- 125% of RD of PE Atrazine - EPOE Tembotrione (spray fluid 20 L of water ha^{-1}) T_{20}- 75% of RD of PE Atrazine - EPOE Tembotrione (spray fluid 20 L of water ha^{-1}) T_{21} - 125% of RD of PE Atrazine - POE 2, 4-D (spray fluid 80 L of water ha^{-1}) T_{22} - 75% of RD of PE Atrazine - POE 2, 4-D (spray fluid 80 L of water ha^{-1}) T_{23} - 125% of RD of PE Atrazine - POE 2, 4-D (spray fluid 60 L of water ha^{-1}) T_{24} - 75% of RD of PE Atrazine - POE 2, 4-D (spray fluid 60 L of water ha^{-1}) T_{25} - 125% of RD of PE Atrazine - POE 2, 4-D (spray fluid 40 L of water ha^{-1}) T_{26} - 75% of RD of PE Atrazine - POE 2, 4-D (spray fluid 40 L of water ha^{-1}) T_{27} - 125% of RD of PE Atrazine - POE 2, 4-D (spray fluid 30 L of water ha^{-1}) T_{28} - 75% of RD of PE Atrazine - POE 2, 4-D (spray fluid 30 L of water ha^{-1}) T_{29} - 125% of RD of PE Atrazine - POE 2, 4-D (spray fluid 20 L of water ha^{-1}) T_{30} - 75% of RD of PE Atrazine - POE 2, 4-D (spray fluid 20 L of water ha^{-1}) DAS- Days After SowingDAA-Days After Application.

All the other crop production management aspects were followed as per the Tamil Nadu Agricultural University Crop Production Guide (2019).

2.2 Phytotoxic Effect

The phytotoxic effect of herbicides on maize crop was assessed on 3,5,7 and 9 days after pre-emergence, early-post emergence and post-emergence herbicide treatment by using a simple rating scale of 0 to 10 (equal to 0 to 100%) as suggested by Rao [3], where 0 indicates no injury and 10 indicates complete destruction.

2.3 Weed Control Efficiency

Observations on weed parameters *viz*., weed density and weed dry weight were recorded. Weed count was recorded through placing four quadrats of size 0.25 m x 0.25 m in each plot and the weeds falling within the quadrat were counted, collected and dried in the hot-air oven at 80^0C for 72 hrs. Weed control efficiency was computed as per the procedures given by Mani *et al.* [4] and expressed in percentage.

$$\text{WCE} = \frac{Wpc - Wpt}{Wpc} \times 100$$

Where,

Wpc - Weed population in control plot, Wpt - Weed population in treatment plot

RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 500 L of water ha^{-1}) (T_1) considered as a control plot for calculating weed control efficiency. The experimental data obtained during the investigation were subjected

to statistical analysis following the procedure of Gomez and Gomez [5] .

3. RESULTS AND DISCUSSION

3.1 Phytotoxicity and Crop Injury Scoring

The phytotoxicity score of the maize subjected to the thirty treatments involving various pre, early post and post-emergence herbicides is shown in Table 1. The visual injury symptoms ranged from no injury to severe injury. The treatment involving early post-emergence herbicide tembotrione resulted in severe injury, which was assigned a score of 5 - 4 up to 9 DAA (days after application). Early post-emergence herbicide Tembotrione showed evident symptoms of persistent injury including severe stunting,discolouration and tip burning which were pronounced on 7 DAA. Among the pre-emergence treatments, some of them RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D with spray fluid 40 L of water ha^{-1} (T_8), RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D with spray fluid 30 L of water ha^{-1}(T_9), 125% ofRD of PE Atrazine - EPOE Tembotrione with spray fluid 30 L of water ha^{-1}(T_{17}), 125% of RD of PEAtrazine - EPOE Tembotrione with spray fluid 20 L of water ha^{-1}(T_{19}) and 75% of RD of PE Atrazine - EPOE Tembotrione with spray fluid 20 L of water ha^{-1}(T_{20}) show slight stunting up to 7 DAA and the crop showed symptoms of recovery thereafter. Rest of the treatments are not showing symptoms. Post emergence herbicide 2, 4-D caused stunting of plant, growth reduction. Among these crop injury scoring very high in RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D with spray fluid 30 L of water ha^{-1}(T_9), RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D with spray fluid 20 L of water ha^{-1}(T_{10}), 75% of RD of PE Atrazine - EPOE Tembotrione with spray fluid 30 L of water ha^{-1}(T_{18}), 125% of RD of PE Atrazine - EPOE Tembotrione with spray fluid 20 L of water ha^{-1}(T_{19}), 75% of RD of PE Atrazine - EPOE Tembotrione with spray fluid 20 L of water ha^{-1} (T_{20}), 125% of RD of PE Atrazine - EPOE Tembotrione with spray fluid 40 L of water ha^{-1}(T_{15}), 125% of RD of PE Atrazine - EPOE Tembotrione with spray fluid60 L of water ha^{-1}(T_{13}) and 125% of RD of PE Atrazine - EPOE Tembotrione with spray fluid 80 L of water ha^{-1}(T_{11}).

Rao *et al*.(2009) [6] reported that application of atrazine 1.5 kg ha^{-1} singly on maize did not show any phytotoxic effect.Post emergence application of tembotriane on silty clay loam soil at 110, 120 and 130 g ha^{-1} did not show any phytotoxic effect on maize seedlings at 7, 14 and 21 DAS [7]. All doses of herbicides such as recommended doses of atrazine, pendimethalin and 2, 4-D were safe to the maize crop [8]. Recommended dose of Atrazine, oxyflurofen, pendimethalin, topramezone, 2, 4-D, tembotrione caused no phytotoxic effect on maize [9].

3.2 Weed Density and Weed dry Weight

The weed density and weed dry weight were significantly reduced by weed management practices (Table 2). The lowest total weed density was observed in the RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 80 L of water ha^{-1}) (T_8) and was significantly superior over the rest of the treatments. This was followed by RD of PE Atrazine - EPOE Tembotrione -POE 2, 4-D (spray fluid 60 L of water ha^{-1}) (T_7), RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 40 L of water ha^{-1}) (T_6) and RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 100 L of water ha^{-1}) (T_5). The above mentioned treatments are reduced spray fluid without phytotoxicity effect on the plants. The highest total weed density was observed in RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 500 L of water ha^{-1}) (T_1).

The total dry weight of weed was markedly reduced in the RD of PE Atrazine - EPOE Tembotrione – POE 2, 4-D (spray fluid 80 L of water ha^{-1}) (T_8) and was significantly superior over rest of the treatments. This was followed by RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 60 L of water ha^{-1}) (T_7), RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 100 L of water ha^{-1}) (T_5) and RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 40 L of water ha^{-1}) (T_6). The

Table 1. The phytotoxicity effect of herbicides with different spray fluid on Maize

Treatments	PE				EPOE				POE			
	6 DAS	8 DAS	10 DAS	12 DAS	6 DAS	8 DAS	10 DAS	12 DAS	6 DAS	8 DAS	10 DAS	12 DAS
	3 DAA	5 DAA	7 DAA	9 DAA	3 DAA	5 DAA	7 DAA	9 DAA	3 DAA	5 DAA	7 DAA	9 DAA
T_1	0	0	0	0	0	0	0	0	0	0	0	0
T_2	0	0	0	0	0	0	0	0	0	0	0	0
T_3	0	0	0	0	0	0	0	0	0	0	0	0
T_4	0	0	0	0	0	0	0	0	0	0	0	0
T_5	0	0	0	0	0	0	0	0	0	0	0	0
T_6	0	0	0	0	0	0	0	0	0	0	0	0
T_7	0	0	0	0	0	0	0	0	0	0	0	0
T_8	0	0	0	0	0	0	0	0	0	0	0	0
T_9	0	0	1	1	0	3	2	1	0	1	1	0
T_{10}	0	0	2	2	0	4	3	1	0	2	1	0
T_{11}	0	1	0	0	3	2	2	1	-	-	-	-
T_{12}	0	0	0	0	0	1	0	0	-	-	-	-
T_{13}	0	1	0	0	3	3	2	2	-	-	-	-
T_{14}	0	0	0	0	0	1	1	0	-	-	-	-
T_{15}	0	1	1	0	4	4	2	2	-	-	-	-
T_{16}	0	1	0	0	0	2	1	0	-	-	-	-
T_{17}	0	2	1	0	4	4	4	3	-	-	-	-
T_{18}	0	1	1	0	3	2	1	0	-	-	-	-
T_{19}	0	2	2	1	5	4	4	3	-	-	-	-
T_{20}	0	2	1	1	4	4	4	3	-	-	-	-
T_{21}	0	1	0	0	-	-	-	-	0	1	0	0
T_{22}	0	0	0	0	-	-	-	-	0	0	0	0

Treatments	PE				EPOE				POE			
	6 DAS	8 DAS	10 DAS	12 DAS	6 DAS	8 DAS	10 DAS	12 DAS	6 DAS	8 DAS	10 DAS	12 DAS
	3 DAA	5 DAA	7 DAA	9 DAA	3 DAA	5 DAA	7 DAA	9 DAA	3 DAA	5 DAA	7 DAA	9 DAA
T_{23}	0	1	0	0	-	-	-	-	0	1	0	0
T_{24}	0	0	0	0	-	-	-	-	0	0	0	0
T_{25}	0	1	0	0	-	-	-	-	0	1	0	0
T_{26}	0	1	0	0	-	-	-	-	0	1	0	0
T_{27}	0	2	1	0	-	-	-	-	0	2	1	0
T_{28}	0	1	0	0	-	-	-	-	0	1	0	0
T_{29}	0	2	1	0	-	-	-	-	0	2	1	0
T_{30}	0	1	0	0	-	-	-	-	0	1	0	0

(*(-) Not applicable)
0- No injury 1- Slight stunting, Injury or Discoloration 2- Some stand loss, Stunting and discoloration
3- Injury more pronounced but not persistent 4- Moderate injury and recovery possible
5- Injury more persistent and recovery doubtful
DAS- days after sowing DAA- days after application PE- pre emergence
EPOE- early post emergence POE- post emergence

Table 2. The effect of weed management on weed density (Nos/m^2), weed dry weight (g m^{-2}) and weed control efficiency (%) in maize at 20 and 40 DAS

Treatments	Weed density (Nos m^{-2})		Weed dry weight (g m^{-2})	
	20 DAS	40 DAS	20 DAS	40 DAS
T_1	9.30 (86.08)	5.62 (31.29)	6.38 (40.17)	5.67 (31.59)
T_2	5.75 (32.57)	3.29 (10.58)	4.30 (18.00)	3.37 (10.84)
T_3	4.39 (18.81)	2.85 (8.07)	3.10 (9.11)	2.94 (8.14)
T_4	3.85 (14.30)	2.44 (5.82)	3.00 (8.52)	2.55 (5.98)
T_5	2.14 (4.10)	2.01 (4.02)	1.89 (3.07)	2.13 (4.06)
T_6	2.00 (3.52)	1.01 (1.00)	1.68 (2.34)	1.23 (1.01)
T_7	2.11 (3.95)	1.87 (3.58)	1.86 (2.95)	2.00 (3.51)
T_8	1.00 (0.51)	1.41 (1.99)	0.74 (0.05)	1.58 (2.00)
T_9	2.55 (5.99)	1.22 (1.49)	1.92 (3.20)	1.41 (1.48)
T_{10}	3.37 (10.83)	2.00 (4.03)	2.67(6.60)	2.12 (4.00)
T_{11}	2.55 (6.03)	2.43 (5.78)	2.18 (4.24)	2.53 (5.92)
T_{12}	3.48 (11.64)	2.24 (4.99)	2.67(6.60)	2.35 (5.01)
T_{13}	3.09 (9.04)	2.35 (5.50)	2.49 (5.68)	2.45 (5.50)
T_{14}	3.49 (11.67)	2.43 (5.75)	2.90 (7.89)	2.53 (5.91)
T_{15}	6.80 (45.80)	4.00 (15.98)	5.37 (28.33)	4.06 (15.99)
T_{16}	6.32 (39.43)	3.85 (14.78)	4.96 (24.06)	3.92 (14.86)
T_{17}	1.86 (2.97)	2.00 (3.95)	1.17 (0.88)	2.12 (4.01)
T_{18}	3.31(10.44)	2.34 (5.65)	1.78 (2.67)	2.44 (5.47)
T_{19}	2.83 (7.50)	1.74 (3.06)	2.21 (4.39)	1.88 (3.04)
T_{20}	2.65 (6.51)	1.74 (2.93)	1.97 (3.39)	1.87 (3.01)
T_{21}	4.60 (20.63)	2.88 (8.40)	3.28 (10.29)	2.97 (8.32)
T_{22}	4.84 (22.88)	3.09 (9.89)	3.43 (11.27)	3.17 (9.55)
T_{23}	5.30 (27.55)	3.15 (10.26)	3.63 (12.65)	3.23 (9.96)
T_{24}	5.74 (32.42)	3.32 (11.28)	4.16 (16.79)	3.40 (11.04)
T_{25}	3.32 (10.50)	3.00 (9.01)	2.09 (3.88)	3.09 (9.02)
T_{26}	7.90 (61.86)	4.26 (18.31)	6.09 (36.64)	4.32 (18.13)
T_{27}	4.60 (20.69)	3.88 (15.21)	4.12 (16.47)	3.94 (15.03)
T_{28}	5.33 (27.92)	3.93 (14.9)	4.09 (16.23)	3.99 (15.43)
T_{29}	5.85 (34)	4.98 (20.5)	5.26 (27.30)	5.03 (25.00)
T_{30}	3.19 (13.50)	4.01 (11.5)	2.83 (11.70)	4.08 (16.50)
SEd	0.52	0.19	0.53	0.18
CD(0.05)	1.07	0.40	1.10	0.38

**(√x+0.5 Transformed values and Data in parenthesis are transformed values)*

above mentioned treatments were reduced spray fluid without phytotoxicity effect on the plants. The highest total weed density was observed in 75% RD of PE Atrazine - POE 2, 4-D (spray fluid 20 L of water ha^{-1}) (T_{30}).

Among the different herbicides, the application of Tembotrione as post-emergence significantly reducing the grassy and non-grassy weeds by inhibits the 4-hydroxyphenyl-pyruvatedioxygenase (4-HPPD) enzymes which cause a lack of electron acceptor in photosynthesis. The same findings are recorded by Sonali Biswas *et al.*[10].

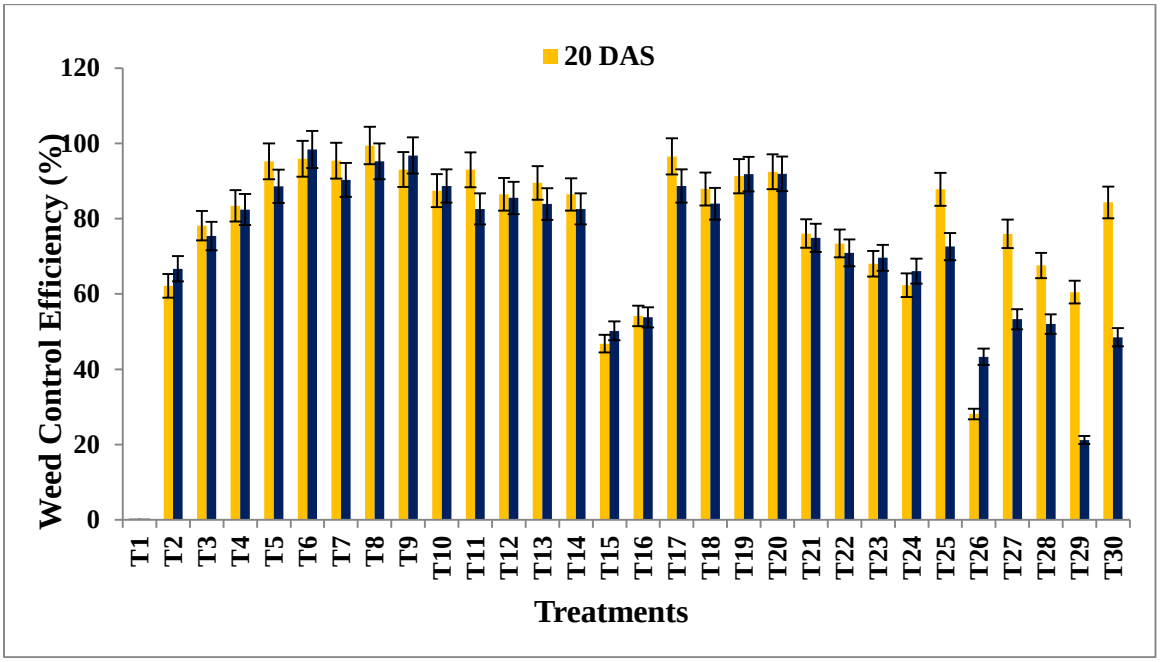

Fig. 1. Weed control efficiency at 20 DAS and 40 DAS

3.3 Weed Control Efficiency

Weed control efficiency (WCE) was worked out at different crop growth stages and was significantly influenced by weed management practices (Fig. 1). At 20 DAS, the highest weed control efficiency was recorded in RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 80 L of water ha^{-1}) (T_8) and was followed by RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 60 L of water ha^{-1}) (T_7) At 40 DAS, recorded the similar results Xuan Li *et al*. [11] concluded that in almond crop protection, two spray volumes, 46.8 l ha^{-1} (5 gals per acre) and 93.6 l ha^{-1} (10 gals per acre), were used for the drone application treatments. The UAV application at the higher spray volume of 93.5 l ha^{-1} provided a higher coverage percentage than the lower spray volume of 46.8 l ha^{-1}. Guobin Wang *et al*. [12] stated an optimal control efficacy using the UAV was obtained at >16.8 l ha^{-1} with a systemic insecticide.

4. CONCLUSION

In conclusion from the trial conducted, based on phytotoxicity, the highest WCE and reduced spray fluid which highly suitable for drone application were T_5- RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D(spray fluid 100 L of water ha^{-1}),T_6- RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 80 L of water ha^{-1}), T_7- RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D (spray fluid 60 L of water ha^{-1}) and T_8- RD of PE Atrazine - EPOE Tembotrione -POE 2, 4-D (spray fluid 40 L of water ha^{-1}).

RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D with spray fluid 500 L of water ha^{-1}(T_1), RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D with spray fluid 400 L of water ha^{-1}(T_2,), RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D with spray fluid 300 L of water ha^{-1} (T_3) and RD of PE Atrazine - EPOE Tembotrione - POE 2, 4-D with spray fluid 200 L of water ha^{-1}(T_4) were showed no phytotoxicity and optimum WCE, but it was not suitable for drone application. 75% of RD of herbicide shows comparatively low WCE and 125% of RD of herbicides showed phytotoxicity. From the experiment, it was concluded that the application of herbicides for weed control in maize by using drones could be achieved effectively with the spray fluid of 80 L ha^{-1}

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any Ligation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

ACKNOWLEDGEMENTS

Authors are thankful to all the members of Department of Agronomy and Department of Remote Sensing & GIS, Tamil Nadu Agricultural University, Coimbatore, Tamilnadu for their encouragement and support

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/76126