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Weed control options in cotton as influenced by various detection techniques

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Abstract
A field experiment was conducted in Agricultural college and Research institute, Madurai during 2019-2020 to study weed control options in cotton as influenced by various weed detection techniques. Experiment design is Split plot and replicated thrice. Treatments tested were, three weed detection techniques viz. Manual method (M_1), Image detection with manually operated camera (M_2) and Image detection with drone camera (Heli-cam) (M_3) as main plot treatments combined with eight weed management practices as sub plot treatments. Experiment results obtained, concludes that detection of weeds through Image detection with drone camera (M_3) with the application of 75% dosage of Quizalofop ethyl 50 g a.i ha^{-1} + Pyrithiobac Sodium 62.5 g a.i ha^{-1} at 15 DAS as early post emergence followed by post emergence application of Fluazifop butyl 140 g a.i ha^{-1} + Fenoxaprop ethyl40 g a.i. ha^{-1} at 40 DAS proves to be a best weed control option by reducing herbicide dosage and cost incurred.

Keywords: Weed control options, weed detection techniques, herbicide combination

1. Introduction
Cotton is currently the leading plant fibre crop worldwide and is grown commercially in the temperate and tropical regions of more than 50 countries, with a total coverage of 34.5 million ha. In India, the area under cotton is 13.47 M ha in 2019-20 with production of 360.6 lakh bales and productivity was 455 kg lint ha^{-1}. In Tamil Nadu, cotton is the most important traditional fibre crop grown over an area of 0.17 M ha, with the production of 0.04 Million tonnes (M t) and with the productivity of 418 kg lint ha^{-1}. The initial slow growth and adoption of wider spacing favours the weeds to grow luxuriously in cotton fields (Javaid and Anjum, 2006) [6]. In cotton, weeds remove about 30-50 per cent of applied fertilizer, 20-40 per cent moisture (Jayakumar *et al.*, 2008) [7] and reduce seed cotton yield by 13-41 per cent (Iqbal and Cheema, 2008) [4]. To control this jeopardy knowledge about the kind of weeds, their growth stage and density of current weeds infesting a cotton field is important for deciding the most appropriate herbicide. All of this information should be obtain through mapping weeds individually in the field through different weed detection techniques.
Also weed are usually distributed in patches; thus, a uniform treatment is not efficient from both economic and agronomic perspectives. A method of herbicide application that depends on the level of weed infestation could help to improve this situation.

2. Materials and Methods
An experiment was conducted during 2019 in the garden land farms of the Agricultural college and Research institute, Madurai to study the Weed control options in cotton as influenced by various weed detection techniques. The experiment was laid out in a Split plot Design with three replication. It consist of Three weed detection techniques as main plot *viz.*, M_1 - Manual method, M_2 - Image detection with manually operated camera and M_3 - Image detection with drone camera and eight weed management practices with altered herbicide doses *viz.*, S_1 - 100% dosage of EPoE Propaquizofop @ 100 g a.i. ha^{-1} on 15 DAS followed by POE Fenoxaprop ethyl @ 67.5 g a.i. ha^{-1} on 40 DAS based on weed rating 1, S_2 – 75% dosage of EPoE Propaquizofop @ 100 g a.i. ha^{-1} on 15 DAS followed by POE Fenoxaprop ethyl @ 67.5 g a.i. ha^{-1} on 40 DAS based on weed rating 2, S_3 – 50% dosage of EPoE Propaquizofop @ 100 g a.i. ha^{-1} on 15 DAS followed by POE Fenoxaprop ethyl @ 67.5 g a.i. ha^{-1} on 40 DAS based on weed rating 3, S_4 – 100% dosage of EPoE Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} on 15 DAS followed by POE Fluazifop butyl @ 140 g a.i ha^{-1} +

Fenoxaprop ethyl @ 40 g a.i. ha^{-1} on 40 DAS based on weed rating 1, S_5 - 75% dosage of EPoE Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} on 15 DAS followed by POE Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethyl @ 40 g a.i. ha^{-1} on 40 DAS based on weed rating 2, S_6 - 50% dosage of EPoE Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} on 15 DAS followed by POE Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethyl @ 40 g a.i. ha^{-1} on 40 DAS based on weed rating 3, S_7 – Recommended practice (PE Pendimethalin @ 1 kg a.i. ha^{-1} on 3 DAS + 1 HW on 40 DAS), S_8 – Unweeded control.

Cotton test variety used was SVPR-6. The recommended seed rate of 15 kg ha^{-1} was used. The fuzzy seeds were treated with cow dung slurry and then with biofertilizers. Sowing was done on the ridges with 75 cm row spacing and 30 cm intra row spacing. Weed detection with manually operated camera was done with Canon 1200D camera and drone images were taken with DJI Phantom 4 pro. The weed area was determined with MATlab software. The crop was irrigated as and when required. The herbicides were promptly applied with the help of Rope wick applicator. Weed density, weed dry weight and yield of cotton were recorded.

3. Results and Discussion

3.1. Weed density

A perusal of data regarding total weed density indicated that weed detection technique exerted a significant effect on weed density. Among the weed detection techniques, the minimum weed density was recorded in image detection with drone camera (M_3) (68.51 m^{-2}, 84.81 m^{-2} and 66.11 m^{-2} at 20, 40 and 60 DAS respectively).This may be due to higher resolution, achieved from the data of drone camera corresponding to the target area which results in wide and precise coverage. However this technique was at par with the image detection technique with manually operated camera (M_2) (73.34 m^{-2}, 90.56 m^{-2} and 71.69 m^{-2} at 20, 40 and 60 DAS respectively) (Table 1). This is in line with the findings of (Rew *et al*., 1997; Cousens & Croft, 2000) [10, 3].

The calculated mean data revealed that weed control options had a significant effect on weed density. At 20 DAS, Recommended practice of applying Pre emergence Pendimethalin @ 1 kg a.i ha-1 at 3 DAS + One Hand weeding on 40 DAS) (S_7) achieved lowest weed density of 52.72 m^{-2}.

At 40 and 60 DAS, application of 75% dosage of Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} as early post emergence herbicide on 15 DAS followed by Post emergence application of Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethyl @ 40 g a.i. ha^{-1} on 40 DAS based on weed rating 2 (S_5) has lowest weed density (64.39 m^{-2} and 45.5 m^{-2} at 40 and 60 DAS respectively) which was found significantly lower than the rest of the weed control options. This might be due to the different properties of each herbicide used as combination in this treatment. For instance, Pyrithiobac sodium is basically a broadleaf weed killer (Singh and Punia, 2007) [11] and quizalofop ethyl is a grass weed killer (Rajanand *et al*., 2013) [8]. These results suggest that quizalofop ethyl and pyrithiobac sodium need to be tank-mixed to provide broad spectrum weed control in cotton. Also usage of fluazifop butyl herbicide in cotton controlled the grassy weeds effectively during the critical period of crop growth. (A.S. Rao, 2018) [9]. It was followed by the application of pre emergence application of Pendimethalin @ 1 kg a.i. ha^{-1} on 3 DAS + 1 hand weeding on 40 DAS (S_7) which is on par with application of 100% dosage of EPoE Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} on 15 DAS followed by POE Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethyl @ 40 g a.i. ha^{-1} on 40 DAS based on weed rating 1 (S_4). The highest weed population was found with the unweeded control (S_8) (123.95 m^{-2}, 153.73 m^{-2} and 185.04 m^{-2} at 20, 40 and 60 DAS respectively).

Condisering the interaction effect, scouting of weeds through image detection with drone camera and the application of 75% dosage of Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} as early post emergence herbicide on 15 DAS followed by Post emergence application of Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethy @ l40 g a.i. ha^{-1} on 40 DAS based on weed rating 2 (M_3S_5) recorded the minimum weed density (26.39 m^{-2}) at 60 DAS.

3.2. Weed dry matter production

Significant variations were found on the total weed dry weight. Among the weed detection technique, the least weed dry matter was found with the image detection with drone camera (M_3) (198.54 kg ha^{-1}, 345.45 kg ha^{-1} and 224.81 kg ha^{-1} at 20, 40 and 60 DAS respectively). Higher precision in detection of weed target area under this technique could be attributed to the better weed control, wherein weed patches and small weeds were covered efficiently. This results coincide with the finding of Barroso *et al*., (2004) [1]. However, this treatment was equally effective as that of image detection technique with manually operated camera (M_2) (215.46 kg ha^{-1}, 372.91 kg ha^{-1} and 238.89 kg ha^{-1} at 20, 40 and 60 DAS respectively) which has less weed area detection due to shallow image capturing height in aerial imaging (Table 2).

Regarding weed control option, Pre emergence application of Pendimethalin @ 1 kg a.i ha-1 at 3 DAS + One Hand weeding on 40 DAS) (S_7) achieved lowest weed dry matter production of 142.66 kg ha^{-1} at 20 DAS.

At 40 and 60 DAS, application of 75% dosage of Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} as early post emergence herbicide on 15 DAS followed by Post emergence application of Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethyl @ 40 g a.i. ha^{-1} on 40 DAS based on weed rating 2 (S_5) had least weed dry matter production (244.81 kg ha^{-1} and 130.35 kg ha^{-1} at 40 and 60 DAS respectively). This might be due to the effective action of herbicides on entire foliage, which prevents the formation of new growth of the shoots. Also it depletes the CHO resources stored in the leaves, which results in the decrease in dry matter content. (Terry *et al*, 1996) [12]. It was followed by the pre emergence application of Pendimethalin @ 1 kg a.i. ha^{-1} on 3 DAS + 1 hand weeding on 40 DAS (S_7) which is on par with application of 100% dosage of EPoE Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} on 15 DAS followed by POE Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethyl @ 40 g a.i. ha^{-1} on 40 DAS based on weed rating 1 (S_4). The highest weed dry matter was found with the unweeded control (S_8) (409.51 kg ha^{-1}, 630.46 kg ha^{-1} and 753.42 kg ha^{-1} at 20, 40 and 60 DAS respectively).

Rearding the interaction effect, weed dry matter was found least (63.11 kg ha^{-1}) with the image detection through drone camera and the application of 75% dosage of Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} as early post emergence herbicide on 15 DAS followed by Post emergence application of Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethy @ l40 g a.i. ha^{-1} on 40 DAS based on weed rating 2 (M_3S_5).

3.3. Seed cotton yield

Analysis of yield data revealed that the image detection with drone camera yielded highest seed cotton yield (1271 kg ha^{-1}). This may be due to the indirect effect of weed control option

on the crop. Comparing the methods of weed detection, the lower resolution leads to the negligence of small weeds which may not be accounted. So the drone camera with higher resolution helps to solve this problem which results in better yield of seed cotton (Bishwa *et al*., 2020) [2].

In the aspect of weed control option, application of 75% dosage of early post emergence herbicide Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} on 15 DAS followed by POE Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethyl @ 40 g a.i. ha^{-1} on 40 DAS based on weed rating 2 (S_5) has produced highest yield (1478 kg ha^{-1}). The usage of combination of herbicides increased the efficacy greatly, than a single herbicide usage. Also when the combination of fluazifop and fenoxaprop ethyl was used after the application of graminicides like pyrithiobac sodium, the injury on weeds were seemingly increased due to the combined action of chemicals on wide array of weeds (James, 2003) [5].

On comparing the interaction effect, weed image detection through drone camera and the application of 75% dosage of Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} as early post emergence herbicide on 15 DAS followed by Post emergence application of Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethyl @ 40 g a.i. ha^{-1} on 40 DAS based on weed rating 2 (M_3S_5) recorded highest yield (1752 kg ha^{-1}) and the lowest yield was found with manual weed scouting in Unweeded control lot (554 kg ha^{-1}).

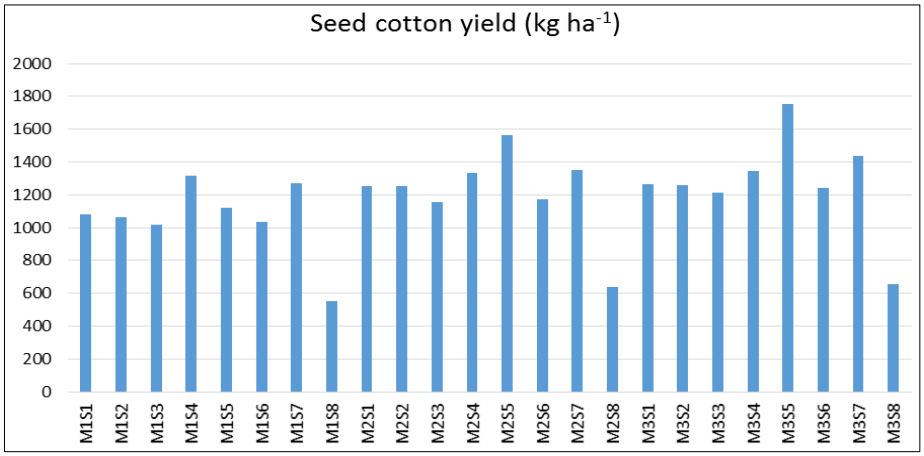

Fig 1: Effect of weed control options as influenced by various weed detection techniques on Seed cotton yield (kg ha^{-1})

Table 1: Effect of weed control options as influenced by various weed detection techniques on density of total weeds (no. m^{-2}) in cotton during 2019-2020

Treatment	20 DAS				40 DAS				60 DAS			
	M_1	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**	**M_1**	**M_2**	**M_3**	**Mean**
S_1	9.72 (94.05)	8.35 (69.37)	8.27 (67.91)	8.81 (77.11)	10.8 (116.33)	9.3 (86.06)	9.22 (84.57)	9.8 (95.66)	9.54 (90.6)	7.95 (62.84)	7.86 (61.38)	8.45 (71.01)
S_2	9.93 (98.26)	8.47 (71.29)	8.34 (69.2)	8.94 (79.58)	11.04 (121.6)	9.34 (86.76)	9.25 (85.07)	9.91 (97.81)	9.75 (94.66)	8.06 (64.59)	7.93 (62.46)	8.58 (73.22)
S_3	10.45 (108.9)	8.83 (77.55)	8.73 (75.82)	9.37 (87.43)	11.41 (129.71)	9.63 (92.42)	9.54 (90.58)	10.23 (104.24)	10.36 (107.01)	8.41 (70.28)	8.31 (68.61)	9.03 (81.07)
S_4	8.18 (66.43)	8.09 (65.02)	8.06 (64.52)	8.11 (65.33)	9.01 (80.69)	8.96 (79.92)	8.95 (79.73)	8.97 (80.11)	7.77 (59.95)	7.66 (58.29)	7.62 (57.57)	7.68 (58.6)
S_5	8.22 (67.23)	7.93 (62.45)	7.22 (51.67)	7.8 (60.45)	9.97 (98.94)	7.52 (56.1)	6.21 (38.13)	8.05 (64.39)	8.81 (77.13)	6.35 (39.82)	5.18 (26.39)	6.78 (45.5)
S_6	10.41 (108.01)	8.73 (75.8)	8.54 (72.52)	9.27 (85.44)	11.31 (127.46)	9.58 (91.38)	9.39 (87.69)	10.13 (102.18)	10.22 (104.05)	8.31 (68.69)	8.13 (65.61)	8.89 (78.56)
S_7	9.21 (84.5)	5.51 (29.88)	6.65 (43.79)	7.29 (52.72)	9.13 (82.86)	8.07 (64.68)	8.85 (77.88)	8.69 (75.14)	7.87 (61.49)	6.82 (46.13)	7.54 (56.35)	7.41 (54.47)
S_8	11.59 (133.87)	11.04 (121.4)	10.82 (116.59)	11.15 (123.95)	12.63 (159.18)	12.42 (153.96)	12.18 (148.05)	12.41 (153.73)	13.79 (189.84)	13.65 (186.04)	13.4 (179.32)	13.62 (185.04)
Mean	9.78 (95.16)	8.59 (73.34)	8.3 (68.51)		10.72 (114.6)	9.54 (90.56)	9.23 (84.81)		9.76 (94.93)	8.49 (71.69)	8.16 (66.11)	
	M	S	M x S	S x M	M	S	M x S	S x M	M	S	M x S	S x M
SEd	0.17	0.28	0.49	0.49	0.15	0.31	0.53	0.54	0.21	0.29	0.52	0.51
CD (p=0.05)	0.49	0.57	1.04	0.99	0.44	0.63	1.11	1.09	0.6	0.59	1.12	1.03

M_1 –Manual method; M_2 –Image detection with manually operated camera; M_3 – Image detection with drone camera; S_1– 100% dosage of EPoE Propaquizofop @ 100 g a.i. ha^{-1} at 15 DAS *fb* POE Fenoxaprop ethyl @ 67.5 g a.i. ha^{-1} at 40 DAS based on weed rating 1; S_2– 75% dosage of EPoE Propaquizofop @ 100 g a.i. ha^{-1} at 15 DAS *fb* POE Fenoxaprop ethyl @ 67.5 g a.i. ha^{-1} at 40 DAS based on weed rating 2; S_3– 50% dosage of EPoE Propaquizofop @ 100 g a.i. ha^{-1} at 15 DAS *fb* POE Fenoxaprop ethyl @ 67.5 g a.i. ha^{-1} at 40 DAS based on weed rating 3; S_4 – 100% dosage of EPoE Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} at 15 DAS *fb* POE Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethyl @ 40 g a.i. ha^{-1} at 40 DAS based on weed rating 1; S_5 - 75% dosage of EPoE Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} at 15 DAS *fb* POE Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethyl @ 40 g a.i. ha^{-1} at 40 DAS based on weed rating 2; S_6 - 50% dosage of EPoE Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} at 15 DAS *fb* POE Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethyl @ 40 g a.i. ha^{-1} at 40 DAS based on weed rating 3; S_7 – Recommended practice (PE Pendimethalin @ 1 kg a.i ha^{-1} at 3 DAS + 1 HW on 40 DAS); S_8 – Unweeded control

Table 2: Effect of weed control options as influenced by various weed detection techniques on total dry matter production of weeds (kg ha^{-1}) in cotton during 2019-2020

Treatment	20 DAS				40 DAS				60 DAS			
	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_1	16.63 (276.3)	14.28 (203.61)	14 (195.77)	14.97 (225.23)	21.89 (478.73)	19.19 (368.06)	18.95 (358.86)	20.01 (401.89)	16.13 (259.88)	13.3 (176.51)	13.19 (173.53)	14.21 (203.31)
S_2	16.78 (281.32)	14.45 (208.32)	14.12 (198.9)	15.11 (229.51)	22.27 (495.64)	19.38 (375.1)	18.99 (360.13)	20.21 (410.29)	16.37 (267.77)	13.52 (182.45)	13.35 (177.75)	14.41 (209.32)
S_3	17.85 (318.26)	14.82 (219.27)	14.63 (213.81)	15.77 (250.45)	22.99 (528.31)	20.46 (418.2)	20.2 (407.82)	21.22 (451.45)	17.35 (300.69)	14.24 (202.45)	14.08 (197.88)	15.22 (233.68)
S_4	13.56 (183.53)	13.48 (181.45)	13.39 (178.85)	13.48 (181.28)	17.94 (321.39)	17.66 (311.58)	17.65 (311.17)	17.75 (314.72)	12.82 (164.1)	12.53 (156.7)	12.47 (155.08)	12.61 (158.63)
S_5	13.84 (191.06)	13.17 (173.19)	11.29 (127.01)	12.77 (163.75)	20.63 (425.24)	13.78 (189.53)	10.96 (119.67)	15.12 (244.81)	15.1 (227.68)	10.03 (100.24)	7.97 (63.11)	11.03 (130.35)
S_6	17.58 (308.64)	14.72 (216.26)	14.51 (210.2)	15.6 (245.04)	22.94 (526.15)	20.35 (413.89)	19.87 (394.34)	21.05 (444.79)	17.06 (290.63)	14.01 (195.96)	13.74 (188.5)	14.94 (225.03)
S_7	15.63 (243.98)	10.63 (112.65)	8.47 (71.34)	11.58 (142.66)	18.72 (349.97)	16.81 (282.19)	14.79 (218.3)	16.77 (283.49)	13.37 (177.82)	12.14 (146.52)	10.74 (114.55)	12.09 (146.3)
S_8	20.67 (427.15)	20.23 (408.95)	19.82 (392.43)	20.24 (409.51)	25.95 (673.35)	25 (624.74)	24.36 (593.29)	25.11 (630.46)	27.97 (781.95)	27.39 (750.25)	26.99 (728.07)	27.45 (753.42)
Mean	16.57 (278.78)	14.47 (215.46)	13.78 (198.54)		21.67 (474.85)	19.08 (372.91)	18.22 (345.45)		17.02 (308.81)	14.65 (238.89)	14.07 (224.81)	
	M	S	M x S	S x M	M	S	M x S	S x M	M	S	M x S	S x M
SEd	0.26	0.48	0.82	0.83	0.42	0.57	1.02	0.99	0.39	0.51	0.92	0.88
CD (p=0.05)	0.72	0.97	1.73	1.69	1.18	1.15	2.19	2.0	1.1	1.03	1.98	1.79

M_1 –Manual method; M_2 –Image detection with manually operated camera; M_3 – Image detection with drone camera; S_1– 100% dosage of EPoE Propaquizofop @ 100 g a.i. ha^{-1} at 15 DAS *fb* POE Fenoxaprop ethyl @ 67.5 g a.i. ha^{-1} at 40 DAS based on weed rating 1; S_2– 75% dosage of EPoE Propaquizofop @ 100 g a.i. ha^{-1} at 15 DAS *fb* POE Fenoxaprop ethyl @ 67.5 g a.i. ha^{-1} at 40 DAS based on weed rating 2; S_3– 50% dosage of EPoE Propaquizofop @ 100 g a.i. ha^{-1} at 15 DAS *fb* POE Fenoxaprop ethyl @ 67.5 g a.i. ha^{-1} at 40 DAS based on weed rating 3; S_4 – 100% dosage of EPoE Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} at 15 DAS *fb* POE Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethyl @ 40 g a.i. ha^{-1} at 40 DAS based on weed rating 1; S_5 - 75% dosage of EPoE Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} at 15 DAS *fb* POE Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethyl @ 40 g a.i. ha^{-1} at 40 DAS based on weed rating 2; S_6 - 50% dosage of EPoE Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} at 15 DAS *fb* POE Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethyl @ 40 g a.i. ha^{-1} at 40 DAS based on weed rating 3; S_7 – Recommended practice (PE Pendimethalin @ 1 kg a.i ha^{-1} at 3 DAS + 1 HW on 40 DAS); S_8 – Unweeded control

4. Conclusions

According to the above results, weed detection with drone camera is the best weed detection technique and application of 75% dosage of Quizalofop ethyl @ 50 g a.i ha^{-1} + Pyrithiobac Sodium @ 62.5 g a.i ha^{-1} on 15 DAS as early post emergence herbicide followed by post emergence application of Fluazifop butyl @ 140 g a.i ha^{-1} + Fenoxaprop ethy @ l40 g a.i. ha^{-1} on 40 DAS is the better weed control option for achieve effective weed control and also to obtain higher yield in cotton.

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