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Studies on weed management in lawn

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ABSTRACT

The present investigations were carried out to study the effect of different weeding treatments on sedge and broad leaf weed management of *Cynodon dactylon* L. Calcutta grass var. Sel-1 lawn. The experiment was laid out during March to December 2017 with eight treatments and three replications in radmonized complete block design. Eight treatment comprises 2, 4-D amine at 580 g ha^{-1}, metsulfuron methyl + chlorimuron ethyl at 4 g ha^{-1}, halosulfuron at 67.5 g ha^{-1}, metsulfuron at 5 g ha^{-1}, carfentrazone ethyl at 20 g ha^{-1}, metsulfuron methyl + carfentrazone ethyl at 25 g ha^{-1}, hand weeding at 15 days interval and unweeded. Results indicated that among herbicide treatments, broad leaf weeds density reduced by 2, 4-D amine. Halosulfuron decreased weed density of sedge significantly. The weed control efficiency recorded highest in hand weeding. Among the herbicides, 2, 4-D amine was recorded higher weed control efficiency, lower dry matter of weeds in case of broadleaf weeds. Halosulfuron recorded the highest weed control efficiency and the lowest dry matter of sedge. Weed nutrient uptake was higher in unweeded plot while lower in 2, 4-D amine followed by metsulfuron methyl + carfentrazone ethyl application.

Key words: Weed management, *Cynodon dactylon* L., lawn, herbicides and nutrients.

INTRODUCTION

The lawn serves as the focal point and vital element of a well-designed landscape, playing a significant role in enhancing our immediate environment. It stands out as the most defining feature of a garden, with a growing awareness of its importance within the community. Bermuda grass, also known as Dog's tooth grass, Bahama grass, Indian dhoob is a warm-season perennial species which is well-adapted to tropical and subtropical climates. It thrives better under high temperatures, mild winters, and moderate to high precipitation.

Weed infestation poses a significant challenge in maintaining a healthy lawn, as weeds compete with grasses for essential resources such as moisture, nutrients, and sunlight (Paikekari *et al.*, 2016; Pritee *et al.*, 2014). To address weed-related issues, herbicides are employed after the establishment of the lawn. However, recently various softwares have been developed (Parra *et al.*, 2020) to identify and kill weeds they are still quite expensive.

Hence, this study aims to manage sedge and broad leaf weeds in lawn with the use of herbicides which may reduce dependency on manual labour in addition to timely weed management in lawn.

MATERIALS AND METHODS

The present studies entitled, "Weed Management in lawn (*Cynodon dactylon* L.) Calcutta grass var. Sel-1" were carried out at the established lawn of PAU landscape nursery, Department of Floriculture and Landscaping, Punjab Agricultural University, Ludhiana during the year 2017. A well-established lawn of plot size 5m × 3m was used for recording the observations. Experiment was started from the March and continued upto December (2017). The experiment was laid out in the pattern of Randomized Complete Block Design with three replications. Standard application of NPK in the ratio of 10:4:6 was applied to the lawn at the rate of 6 kg 100 m^{-2} areas at spring season. Eight treatments were taken (2, 4-D amine at 580 g ha^{-1}, Metsulfuron methyl + Chlorimuron ethyl at 4 g ha^{-1}, Halosulfuron at 67.5 g ha^{-1}, Metsulfuron at 5 g ha^{-1}, Carfentrazone ethyl at 20g ha^{-1}, Metsulfuron methyl + Carfentrazone ethyl at 25g ha^{-1}, Hand weeding at 15 days interval and Unweeded) at three durations over the year (Table 1). The herbicides were applied then immediately weed count was done. The herbicides were applied with knapsack sprayer by using the flood jet nozzle in full sunshine.

Table 1: The duration of experiment in three phases.

Experiment duration		
Phases (60 days for each phase)	Intiation of experiment	Ending of experiment
First	20 May	19 July
Second	10 August	9 October
Third	1 November	30 December

Observations recorded were weed density per square meter at before spray and 60 days interval (species wise), dry weight of weed (g m^{-2}) and weed control efficiency (%) after 60 days interval after application of herbicides group wise. phytotoxicity rating was recorded at 3, 7, 10, 15 and 25 days after application of herbicides to know the extent of toxicity suggested by Rao (1986). The data of weed count and dry weight of weeds were subjected to square root transformation $\sqrt{x+1}$ before statistical analysis. The comparisons were made at 5 per cent level of significance by using Duncan's Multiple Range Test (DMRT). Data were subjected to statistical analyses in SPSS Proprietary Software Version 23.00.

RESULTS AND DISCUSSION

The predominant weed species at experiment site were *Anagalis arvensis*, *Coronopus didymus*, *Convolvulus arvensis*, *Malva parviflora, Medicago denticulata, Euphorbia microphylla, Melilotus indica, Rumex dentatus, Amaranthus viridis, Chenopodium album Gomphrena celosioides, Phyllanthus niruri, Celosia argentea, Parthenium hysterophorus, Ageratum conyzoides, Bidens pilosa, Alternanthera philoxeroides, Euphorbia hirta, Oxalis martiana* as broadleaf weeds and *Cyperus rotundus* as sedge.

Species-wise weed density (number m-2) : Before weed control treatments, species showed no significant difference on weed density during different months (2017) (Table 2, 3 and 4). However, weed density was significantly influenced by weed management treatments during the May-July, August-October and November-December (2017). In all three durations, unweeded plot had maximum weeds. At 60 days after herbicide application, 2, 4-D amine at 580 g ha^{-1} effectively controlled maximum number and diverse weeds in all three durations of experiment among broadleaf weeds (Table 2, 3 and 4). During May-June, the carfentrazone ethyl at 20 g ha^{-1}, metsulfuron methyl + carfentrazone ethyl at 25 g ha^{-1} effectively controlled *Euphorbia microphylla. Gomphrena celosioides* responded while

Table 2: Species-wise weed density (number m^{-2}) in lawn influenced by weed management practices before herbicides application and after 60 days of treatment during May-July (2017).

Treatment	Dose ($g\ ha^{-1}$)	Broadleaf weeds: *Coronopus didymus*		*Gomphrena celosioides*		*Euphorbia microphylla*		*Amaranthus viridis*		*Convolvulus arvensis*		Sedge: *Cyperus rotundus*	
2, 4-D amine	580	4.00a (16.0)	0.71a (0)	6.50a (42.7)	0.71a (0)	6.50a (42.7)	4.00b (16.0)	4.00a (16.0)	0.71a (0)	6.08a (37.3)	0.71a (0)	10.32a (106.7)	4.55bc (21.3)
Metsulfuron methyl + Chlorimuron ethyl	4	4.00a (16.0)	0.71a (0)	4.00a (16.0)	4.00b (16.0)	4.00a (16.0)	4.00b (16.0)	4.55a (21.3)	4.00b (16.0)	4.00a (16.0)	4.00b (16.0)	8.31a (69.3)	4.00b (16.0)
Halosulfuron	67.5	4.00a (16.0)	4.00b (16.0)	5.66a (32.0)	0.71a (0)	4.00a (16.0)	4.00b (16.0)	4.00a (16.0)	4.00b (16.0)	4.55a (21.3)	4.00b (16.0)	7.64a (58.7)	0.71a (0)
Metsulfuron	5	4.00a (16.0)	4.00b (16.0)	6.50a (42.7)	4.00b (16.0)	6.50a (42.7)	4.00b (16.0)	6.50a (42.7)	4.00b (16.0)	4.55a (21.3)	0.71a (0)	10.32a (106.7)	5.66c (32.0)
Carfentrazone ethyl	20	4.55a (21.3)	4.00b (16.0)	5.66a (32.0)	4.00b (16.0)	4.55a (21.3)	0.71a (0)	4.55a (21.3)	4.00b (16.0)	6.50a (42.7)	0.71a (0)	15.30a (234.7)	4.00b (16.0)
Metsulfuron methyl + Carfentrazone ethyl	25	5.66a (32.0)	0.71a (0)	4.00a (16.0)	4.00b (16.0)	5.66a (32.0)	0.71a (0)	4.98a (26.7)	4.00b (16.0)	6.50a (42.7)	0.71a (0)	9.51a (90.7)	4.55bc (21.3)
Hand weeding (15 days interval)	-	4.00a (16.0)	0.71a (0)	4.00a (16.0)	0.71a (0)	4.55a (21.3)	0.71a (0)	4.00a (16.0)	0.71a (0)	4.55a (21.3)	0.71a (0)	8.00a (64.0)	0.71a (0)
Unweeded control	-	6.50a (42.7)	7.22c (53.3)	6.08a (37.3)	7.29c (53.3)	5.66a (32.0)	6.93c (48.0)	6.08a (37.3)	5.10c (26.7)	4.55a (21.3)	4.00b (16.0)	15.83a (250.7)	14.23d (202.7)

* Data were subjected to square root transformation √x+1. Parentheses are original values.

* In a column, means followed by common letters do not differ significantly at the 5% level by Duncan's Multiple Range Test.

Table 3: Species-wise weed density in lawn influenced by weed management practices before herbicides application and after 60 days of treatment of herbicides during August-October (2017).

Treatment	Dose ($g\ ha^{-1}$)	Broadleaf weeds														Sedge	
		Phyllanthus niruri		*Celosia argentea*		*Euphorbia microphylla*		*Amaranthus viridis*		*Convolvulus arvensis*		*Rumex dentatus*		*Parthenium hysterophorus*		*Cyperus rotundus*	
2, 4-D amine	580	4.00a (16.0)	0.71a (0)	4.55a (21.3)	4.00b (16.0)	4.00a (16.0)	4.00b (16.0)	4.00a (16.0)	0.71a (0)	6.08a (37.3)	0.71a (0)	5.10a (32.0)	0.71a (0)	4.00a (16.0)	0.71a (0)	10.32a (106.7)	4.55b (21.3)
Metsulfuron methyl+ Chlorimuron ethyl	4	4.00a (16.0)	4.00b (16.0)	4.00a (16.0)	4.00b (16.0)	4.00a (16.0)	4.00b (16.0)	5.10a (32.0)	4.00b (16.0)	4.00a (16.0)	4.00b (16.0)	5.10a (32.0)	0.71a (0)	4.00a (16.0)	4.00b (16.0)	8.31a (69.3)	4.00b (16.0)
Halosulfuron	67.5	4.00a (16.0)	4.00b (16.0)	5.10a (32.0)	0.71a (0)	4.00a (16.0)	0.71a (0)	4.00a (16.0)	4.00b (16.0)	4.55a (21.3)	4.00b (16.0)	4.00a (16.0)	4.00b (16.0)	5.10a (32.0)	4.00b (16.0)	7.64a (58.7)	0.71a (0)
Metsulfuron	5	4.00a (16.0)	0.71a (0)	6.50a (42.7)	4.00b (16.0)	6.08a (37.3)	4.00b (16.0)	4.55a (21.3)	4.00b (16.0)	4.55a (21.3)	0.71a (0)	5.10a (32.0)	4.00b (16.0)	4.55a (21.3)	4.00b (16.0)	10.32a (106.7)	6.08c (37.3)
Carfentrazone ethyl	20	6.50a (42.7)	4.00b (16.0)	5.66a (32.0)	4.00b (16.0)	5.10a (32.0)	4.00b (16.0)	4.55a (21.3)	4.00b (16.0)	6.50a (42.7)	4.00b (16.0)	4.00a (16.0)	4.00b (16.0)	4.00a (16.0)	4.00b (16.0)	15.30a (234.7)	6.08c (37.3)
Metsulfuron methyl+ Carfentrazone ethyl	25	6.50a (42.7)	0.71a (0)	4.00a (16.0)	4.00b (16.0)	5.10a (32.0)	0.71a (0)	4.98a (26.7)	0.71a (0)	6.50a (42.7)	0.71a (0)	4.00a (16.0)	0.71a (0)	5.10a (32.0)	4.00b (16.0)	9.51a (90.7)	4.55b (21.3)
Hand weeding (15 days interval)	-	4.00a (16.0)	0.71a (0)	4.00a (16.0)	0.71a (0)	4.55a (21.3)	0.71a (0)	4.00a (16.0)	0.71a (0)	4.55a (21.3)	0.71a (0)	5.10a (32.0)	0.71a (0)	5.10a (32.0)	0.71a (0)	8.00a (64.0)	0.71a (0)
Unweeded control	-	6.50a (42.7)	7.22c (53.3)	6.08a (37.3)	7.29c (53.3)	5.10a (32.0)	6.93c (48.0)	6.08a (37.3)	5.10c (26.7)	4.55a (21.3)	4.00b (16.0)	4.55a (21.3)	6.93c (48.0)	4.00a (16.0)	4.00b (16.0)	15.83a (250.7)	14.05d (197.3)

* Data were subjected to square root transformation $\sqrt{x+1}$. Parentheses are original values.
* In a column, means followed by common letters do not differ significantly at the 5% level by Duncan's Multiple Range Test.

Table 4: Species-wise weed density in lawn influenced by weed management practices before herbicides application and after 60 days of treatment during November - December (2017).

Treatment	Dose (g ha^{-1})	Broadleaf weeds																Sedge	
		Ageratum conyzoides		*Bidens pilosa*		*Alternanthera philoxeroides*		*Convolvulus arvensis*		*Malva parviflora*		*Euphorbia hirta*		*Oxalis martiana*		*Anagalis arvensis*		*Cyperus rotundus*	
2, 4-D amine	580	4.00a (16.0)	4.00b (16.0)	4.00a (16.0)	4.00b (16.0)	5.66a (32.0)	4.00b (16.0)	5.66a (32.0)	0.71a (0)	4.00a (16.0)	0.71a (0)	5.10a (26.7)	0.71a (0)	5.10a (26.7)	0.71a (0)	4.55a (21.3)	0.71a (0)	6.08a (37.3)	4.55b (21.3)
Metsulfuron methyl+ Chlorimuron ethyl	4	4.55a (21.3)	4.55b (21.3)	4.00a (16.0)	0.71a (0)	5.66a (32.0)	0.71a (0)	5.66a (32.0)	4.00b (16.0)	5.66a (32.0)	4.00b (16.0)	5.10a (26.7)	0.71a (0)	5.10a (26.7)	0.71a (0)	4.55a (21.3)	0.71a (0)	5.66a (32.0)	4.00b (16.0)
Halosulfuron	67.5	4.00a (16.0)	4.55b (21.3)	4.00a (16.0)	4.00b (16.0)	4.00a (16.0)	4.00b (16.0)	4.00a (16.0)	0.71a (0)	5.66a (32.0)	0.71a (0)	4.00a (16.0)	0.71a (0)	5.10a (26.7)	0.71a (0)	4.55a (21.3)	0.71a (0)	6.93a (48.0)	0.71a (0)
Metsulfuron	5	5.66a (32.0)	4.55b (21.3)	4.55a (21.3)	4.00b (16.0)	5.66a (32.0)	0.71a (0)	5.10a (26.7)	4.00b (16.0)	5.10a (26.7)	4.00b (16.0)	4.00a (16.0)	4.00b (16.0)	5.10a (26.7)	4.00b (16.0)	4.55a (21.3)	4.00b (16.0)	7.64a (58.7)	4.00b (16.0)
Carfentrazone ethyl	20	4.00a (16.0)	4.00b (16.0)	4.55a (21.3)	4.55b (21.3)	4.00a (16.0)	0.71a (0)	5.10a (26.7)	0.71a (0)	4.00a (16.0)	0.71a (0)	4.00a (16.0)	4.00b (16.0)	5.10a (26.7)	4.00b (16.0)	4.55a (21.3)	4.00b (16.0)	7.29a (53.3)	4.00b (16.0)
Metsulfuron methyl+ Carfentrazone ethyl	25	4.00a (16.0)	0.71a (0)	4.00a (16.0)	4.00b (16.0)	4.00a (16.0)	0.71a (0)	5.10a (26.7)	0.71a (0)	4.00a (16.0)	0.71a (0)	5.10a (26.7)	4.00b (16.0)	4.00a (16.0)	4.00b (16.0)	4.55a (21.3)	4.00b (16.0)	5.10a (26.7)	4.00b (16.0)
Hand weeding (15 days interval)	-	4.00a (16.0)	0.71a (0)	4.55a (21.3)	0.71a (0)	5.66a (32.0)	0.71a (0)	4.00a (16.0)	0.71a (0)	5.66a (32.0)	0.71a (0)	4.00a (16.0)	0.71a (0)	4.00a (16.0)	0.71a (0)	4.55a (21.3)	0.71a (0)	6.08a (37.3)	0.71a (0)
Unweeded control	-	5.10a (26.7)	4.00b (16.0)	5.66a (32.0)	5.10c (26.7)	4.00a (16.0)	5.10c (26.7)	6.50a (42.7)	5.66c (32.0)	4.55a (21.3)	5.10c (26.7)	4.00a (16.0)	4.55b (21.3)	4.55a (21.3)	5.66c (32.0)	4.00a (16.0)	5.10c (26.7)	10.83a (117.3)	9.51c (90.7)

* Data were subjected to square root transformation $\sqrt{x+1}$. Parentheses are original values.
* In a column, means followed by common letters do not differ significantly at the 5% level by Duncan's Multiple Range Test.

Convolvulus arvensis was not responding to Halosulfuron at 67.5 g ha^{-1}. During August-October, halosulfuron at 67.5 g ha^{-1} is highly effectively managed *Celosia argentia* and *Euphorbia microphylla*. Metsulfuron methyl + carfentrazone ethyl at 25 g ha^{-1} and metsulfuron at 5 g ha^{-1} were effective against *Phyllanthus niruri*, *Amaranthus viridis* and *Euphorbia microphylla* while at 4 g ha^{-1} and at 25 g ha^{-1} they effectively control *Rumex dentatus*. During November-December (2017), metsulfuron methyl + chlorimuron ethyl at 4 g ha^{-1} helped to control *Bidens pilosa* effectively while at 25 g ha^{-1} controlled *Ageratum conyzoides, Oxalis martiana*, *Euphorbia hirta* and *Anagalis arvensis*. *Alternanthera philoxeroides* is controlled by all the herbicides except 2, 4-D amine at 580 g ha^{-1} and halosulfuron at 67.5 g ha^{-1}.

In unweeded plot, there was a profuse growth of weeds throughout the experimental period. Treatments resulted in the suppression of growth and quality of lawn grass. Hand weeding at every 15 days interval for each phase of experiment recorded minimum weed density. Similar results were obtained by Rekha *et al.* (2002) by hand weeding. But the process was tedious and time consuming. Poa annua is considered as challenge for the lawn industry (Erwin *et al.*, 2022) however, the density of *Poa annua* in this research did not reach problematic levels. For the management of *Cyperus rotundus*, similar results for Halosulfuron application at 75% was found effective and improve aesthetic value and weed control (Desai *et al.*, 2017).

Among the herbicides, 2, 4-D amine at 580 g ha^{-1} followed by metsulfuron methyl + carfentrazone ethyl at 25 g ha^{-1} was significantly reduced the broad leaf weed density indicating their effectiveness against broad leaf weeds. Use of 2, 4-D amine at 580 g ha^{-1} very effectively controlled the majority of broad leaf weeds with great selectivity to *Cynodon dactylon*. Significantly higher density of broad leaf weeds noticed after 60 days in unweeded control might be due to unchecked weed growth resulting in higher uptake of nutrients from the soil. 2, 4-D amine is a synthetic auxin; the chemical disrupts the plant cell growth in newly forming stem and leaves. It was affected normal cell division and protein synthesis leading to malformed growth and tumours. Similar results of effective broad leaf weeds control in field trials with the application of 2, 4-D amine at 580 g ha^{-1} was reported by Neal (1990) and Siddappa *et al.* (2016).

Halosulfuron was blocked the normal function of aceto-lactate enzyme which is essential in amino acid (protein synthesis), without protein synthesis *Cyperus rotundus* was starve to death. Similar results of effective sedge control in field trials with the application of halosulfuron was reported by Brecke *et al.* (2006).

Dry matter of weeds : Weed dry matter was significantly influenced by different weed management practices (Table 5). The lowest weed biomass was obtained with hand weeding and maximum with unweeded control. In case of broadleaf weeds, among the herbicide treatments, 2, 4-D amine at 580 g ha^{-1} significantly lowered the dry matter of broadleaf weeds followed by others during all three durations.

During all three durations, halosulfuron at 67.5 g ha^{-1} effectively reduced dry matter of sedge followed by metsulfuron methyl + chlorimuron ethyl at 4 g ha^{-1} and at 25 g ha^{-1}, 2, 4-D amine at 580 g ha^{-1}, metsulfuron at 5 g ha^{-1} and carfentrazone ethyl at 20 g ha^{-1}.

Weed control efficiency (WCE) : Among the herbicide treatments, for control of broadleaf

Table 5: Group-wise Weed dry matter and weed control efficiency in lawn influenced by weed management practices at 60 days after application of herbicides during different months.

Treatment	Dose ($g\ ha^{-1}$)	Weed dry matter ($g\ m^{-2}$) Broad leaf May-July	Broad leaf Aug-Oct	Broad leaf Nov-Dec	Sedge May-July	Sedge Aug-Oct	Sedge Nov-Dec	Weed control efficiency (%) Broad leaf May-July	Broad leaf Aug-Oct	Broad leaf Nov-Dec	Sedge May-July	Sedge Aug-Oct	Sedge Nov-Dec
2, 4-D amine	580	17.40b (302.6)	19.08b 364.0)	16.24b (263.7)	14.47c (209.3)	15.94c (254.2)	15.30e (234.0)	52.2	51.6	65.4	57.9	57.7	59.8
Metsulfuron methyl+ Chlorimuron ethyl	4	20.70g (428.6)	20.70f (428.4)	17.80e (316.8)	12.12b (147.0)	15.31b (234.4)	14.03b (196.9)	32.2	43.1	58.5	70.4	60.7	66.2
Halosulfuron	67.5	20.54f (422.1)	20.97g (439.6)	17.70e (313.4)	0.71a (0)	0.71a (0)	0.71a (0)	33.3	41.6	58.9	100	100	100
Metsulfuron	5	20.42e (417.1)	20.42e (417.1)	17.21d (296.3)	14.45c (208.8)	16.83e (283.2)	14.91d (222.4)	34.0	44.5	61.7	58.0	52.6	61.8
Carfentrazone ethyl	20	20.26d (410.4)	20.34d (413.7)	17.28d (298.7)	14.88e (221.3)	17.14f (293.6)	15.25e (232.5)	35.1	45.0	60.8	55.5	50.8	60.1
Metsulfuron methyl+ Carfentrazone ethyl	25	19.20c (368.6)	19.66c (386.6)	16.34c (267.1)	14.70d (216.0)	16.35d (267.4)	14.78c (218.5)	41.7	48.6	64.9	56.5	55.2	62.5
Hand weeding (15 days interval)	-	0.71a (0)	0.71a (0)	0.71a (0)	0.71a (0)	0.71a (0)	0.71a (0)	100	100	100	100	100	100
Unweeded control	-	25.15h (632.4)	27.43h (752.3)	27.62f (762.9)	22.29f (497.1)	24.43g (597.0)	24.13f (582.4)	-	-	-	-	-	-

* Data were subjected to square root transformation $\sqrt{x+1}$. Parentheses are original values.
* In a column, means followed by common letters do not differ significantly at the 5% level by Duncan's Multiple Range Test.

Table 6: Phytotoxicity rating (0-10) scale at different stages as influenced by weed management practices in lawn

Treatment	Dose (g ha^{-1})	3 DAHA	5 DAHA	7 DAHA	10 DAHA	15 DAHA	25 DAHA
		Mar-Dec	Mar-Dec	Mar-Dec	Mar-Dec	Mar-Dec	Mar-Dec
2, 4-D amine	580	0.0	0.0	0.0	0.0	0.0	0.0
Metsulfuron methyl + Chlorimuron ethyl	4	0.0	0.0	0.0	0.0	0.0	0.0
Halosulfuron	67.5	0.0	0.0	0.0	0.0	0.0	0.0
Metsulfuron	5	0.0	0.0	0.0	0.0	0.0	0.0
Carfentrazone ethyl	20	0.0	0.0	0.0	0.0	0.0	0.0
Metsulfuron methyl + Carfentrazone ethyl	25	0.0	0.0	0.0	0.0	0.0	0.0
Hand weeding (15 days interval)	-	0.0	0.0	0.0	0.0	0.0	0.0
Unweeded control	-	0.0	0.0	0.0	0.0	0.0	0.0

DAHA =Days after application of herbicides, Mar-Dec = March- December

weeds, application of 2, 4-D amine at 580 g ha^{-1} resulted in highest WCE of 58.5%, 52.2% and 51.6% during three durations, respectively followed by metsulfuron methyl + carfentrazone ethyl at 25 g ha^{-1} and at 4 g ha^{-1}, carfentrazone ethyl at 20 g ha^{-1} and halosulfuron at 67.5 g ha^{-1} (Table 5). As concern with sedge, lowest WCE of 46.0% was obtained under carfentra zone ethyl. Highest WCE of 100% was resulted with halosulfuron at 67.5 g ha^{-1} in all three durations.

Significant variations in weed control efficiency were observed among different weed management practices. Hand weeding exhibited higher weed control efficiency (%), likely attributed to the manual removal, resulting in a weed-free environment for that specific treatment. Among the herbicides, the greatest weed control efficiency was achieved with 2, 4-D amine effectively targeting broadleaf weeds, and halosulfuron demonstrating superior efficacy in sedge control. This emphasizes the importance of these herbicide molecules for efficient weed management in lawns, offering reduced labor and economic benefits. The results obtained are in accordance with the Borah *et al.* (2019) in which application of weedicide reduced weed load in the lawn, further also Pablico and Moody (1982) in field crops found similar results for broadleaf weeds control and for the management of sedge and broad leaf weeds in lawn (Siddappa *et al.*, 2016).

Phytotoxicity : The phytotoxicity rating is displayed in table 6 in lawn on 3, 7, 10, 15 and 25 DAHA. During the course of experiment, no phytotoxicity symptoms were visible in the lawn out of all herbicide used implying the suitable dose of application which was not harmful for the crop. However, it was also effective for the broadleaf weeds and sedges present in the lawn. The results are in conformity with the findings of Johnson (1984), Anonymous (2014) and Siddappa *et al.* (2016).

CONCLUSION

Attempts to elucidate the differential behavior of chemical weed control compared to unweeded control were made. Significantly higher sedge density before and after herbicide application throughout the experimental period noticed in unweeded plot which might be due to unchecked weed growth in the absence of suitable weed management practices. Hand weeding at every 15 days interval recorded lower sedge density due to manual uprooting of *Cyperus rotundus*. Among the herbicides, 2, 4-D and halosulfuron significantly reduced the weed density indicating its superiority in controlling them effectively.

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