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EFFECT OF HERBICIDES ON MANAGEMENT OF WEEDS IN LAWN

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ABSTRACT
Field experiment was conducted during the period from November to December 2013 to February to March 2014 to manage the sedge and broad leaf weeds in lawn.The major weed species was observed in the experimental plots were *Cyperus rotundus* (sedge), *Panicum repens*, *Digitaria marginata* (among grasses), *Ageratum conyzoides, Bidens spilosa, Alternanthera sessilis, Cinebra didyma, Desmodium triflorum, Emilia sanchifolia, Euphorbia hirta, Oxalis latifolia* and minor weeds were *Borreria articularis, Chromalaena odorata, Cyanotis* spp., *Mimosa pudica, Parthenium hysterophorus, Phyllanthus niruri, Sida acuta, Tridax procumbens*. Among the herbicides at 60 days after application herbicides 2, 4-D dimethyl amine salt 58% EC 10 ml/lit of water,2, 4-D sodium salt 80 WP 4 g/lit water, 2, 4-D dimethyl amine salt 58% EC 7.5 ml/lit of water, 2, 4-D sodium salt 80 WP 2 g/lit water, showed weed control efficiency 92.6, 91.9, 87.7 and 87.4%, respectively as higher than that of hand weeding at 20 days interval (62.8%). Whereas 2, 4-D sodium salt 80 WP 4 g/lit water and 2, 4-D dimethyl amine salt 58% EC 10 ml/lit of water can be suggested for management of sedge and broad leaf weeds in lawn.

INTRODUCTION

The management of a lawn as a surface has become an important aspect of the landscape. Lawns provideopen space for recreational activities and relaxation aswell as a means to ameliorate heat and dust (Turgeon, 1999). Theirimportance is especially appreciated on universitycampuses, where the management outdoorgreen of lawn has becomean integral part of the overall development andenhancement. The multiple benefits of the lawn are alsoappreciated by the private and commercial estatedevelopers as well as by governmental estates. A weed is a plant that grows where it is not wanted, like a dandelion in a lawn (Janick, 1979). *Cyperus rotundus, Desmodium* spp., *Cinebra didyma, Euphorbia hirta* and other broadleaf weeds are most commonand troublesome weeds in lawn. There are several constraints in lawn establishment of which weeds often pose a serious problem. Weeds not only compete with crop plants for nutrients, soil moisture, space and sunlight but also serve as an alternative hosts for several insect pest and diseases (Pritee *et al.*, 2014). The best way to minimize weed problems in lawn is through the use of goodcultural practicesproper mowing height and frequency, sensible fertilization andadequate irrigation. A major challenge with lawn management is the increased invasion by weed species taking into consideration in lawn. Hand-weeding might be repeated 2-3times before the lawn is fully established. Extensive pre planting treatment of the soil to control weeds is not common but occasionally hand-picking may be carried out before the sprigs are planted. After the establishment of the lawn weeds are controlled by using herbicides because due to scarcity and high wages of labour, manual weeding is not economical even though it has high weed control efficiency (Srinivasarao *et al.*, 2014). Herbicides are the synthetic chemicals, which kills the target plant by interfering with the growth of the weed and often synthetic "limitation" of plant hormone (Turgeon, 2011). Metsulfuron controls several broadleaf weeds in bermudagrass (Anonymous, 2010). Most of theherbicides have short half-life period ranges from few days' to1-3 months and therefore they are repeatedly used. Mostcommonly used are (Glyphosate, Roundup, 2, 4-D, Atrazine, Pursuit, Paraquat etc.) Deshmukh *et al.*, 2013. Despitethe efforts to control weeds, most of the lawn do notlast more than three years as a result of weed pressureand invasion. Therefore the current research aimed to determine the effect of herbicides to manage the weeds in lawn.

MATERIALS AND METHODS

The field experiments were carried out at College of Agriculture, Gandhi KrishiVigyan Kendra (GKVK), Bengaluru. Experimental plot was located at 12º58' latitude and 77º35' east longitude with an altitude of about 930m above mean sea level (MSL). The experimental plot irrigated through sprinkler at every two days interval based on water requirement for lawn and mowed at every 20 days interval and care should be taken that never mowed shorter than two inches (5 cm). Herbicide treatments were single application of 2, 4-D sodium salt 80 WP at (2, 3 and 4g/lit of water), 2, 4-D

dimethyl amine salt 58% EC at (5, 7.5 and 10 mL/lit of water), carfentrozone ethyl 40 DF at (0.25, 0.5 and 1 g/lit of water), fluroxypyr meptyl 48 EC at (1.5, 3 and 6 mL/lit of water) and chlorimuron methyl + metasulfuron methyl at (0.3, 0.4 and 0.5 g/lit of water) were sprayed using a hand operated knapsack sprayer fitted with flood jet nozzle on *Cynodon dactylon* a spray volume of 500 lit/ha. The herbicides were sprayed uniformly covering all areas of the plots. Hand weeding was done at every 20 days interval at 20 days after application of herbicides and also maintained one unweeded control. The plots were 2.0 m X 2.0 m with each treatment replicated three times. Treatments were arranged in a randomized complete block design. Species wise weed count was recorded before herbicide application, 30 and 60 days after application of herbicides two spots in each plot. Weds are expressed as number 0.25 m^{-2} and averaged over two random spots per plot. Weed control efficiency (%) recorded at 30 and 60 days after application of herbicides.

$$\text{Weed control efficiency (\%)} = \frac{Wc - Wt}{Wc} \times 100$$

Where,

Wc = number of weeds in unweeded control, Wt = number of weeds in imposed treatments

Data on weed count were square root transformed and subjected to analyze statistically for test of significant following the Fisher's method of "Analysis of Variance" as described by Sunderaraj *et al*. (1972). The level of significance 'F' test was tested at five per cent (5%). The interpretation of data was done using LSD values calculated at P=0.05.

RESULTS AND DISCUSSION

The important weeds observed in the experimental plot were *Cyperus rotundus*(sedge), *Panicum repens*, *Digitaria marginata* among (grasses), *Ageratum conyzoides*, *Alternanthera sessilis*, *Borreria articularis*, *Bidens spilosa*, *Cinebra didyma*, *Cyanotis* spp, *Desmodium triflorum*, *Emilia sanchifolia*, *Euphorbia hirta*, *Mimosa pudica*, *Parthenium hysterophorus*, *Oxalis latifolia*, *Phyllanthus niruri*, *Sida acuta*, *Chromalaena odorata* and *Tridax procumbens* (among broad leaf weeds). Kamal *et al*. (2009) observed total of 79 different weed species belonging to 16 families (30 grassy weeds, 17 sedges and 32 broadleaf weeds) in turfgrass.

The present study revealed that sedge and broad leaf weeds were controlled very effectively with use of herbicides without any detrimental effect on the beneficial grass *Cynodon dactylon*. Pre-emergence herbicides are often applied to turfgrass stands in early spring to control annual grasses and broadleaf weeds (Turgeon, 2011). Contrary to this in unweeded control, there was a profuse growth of weeds throughout the experimental period resulting in the suppression of growth and quality of lawn grass. Hand weeding at every 20 days interval recorded minimum weed density (Rekha *et al.*, 2002), however it was tedious, time consuming under present conditions of labour scarcity.

The number of sedge, grassy weeds, broad leaf weeds andtotal weed density before herbicide application, 30 and 60 days after application of herbicides differed significantly with lower weed population in herbicide treatments indicating effective control as compared to unweeded control (Table 1 to Table

Table 1: Sedge weed density (number 0.25 m^{-2})in lawn at different stages as influenced by weed management practices

Treatments	Before herbicide application			30 days after application of herbicides			60 days after application of herbicides		
	Nov-Dec (+)	Feb-Mar (+)	Pooled (+)	Nov-Dec (+)	Feb-Mar (+)	Pooled (+)	Nov-Dec (+)	Feb-Mar (+)	Pooled (+)
T_1	3.21 (9.3)	1. 94(3.5)	2.67 (6.4)	1.46 (1.2)	1.32 (0.8)	1.76 (1.0)	1.21(0.5)	1.07 (0.2)	1.14 (0.3)
T_2	2.94 (8.7)	2.00(4.0)	2.67 (6.3)	1.48 (1.3)	1.41 (1.0)	1.20 (1.1)	1.21 (0.5)	1.21 (0.5)	1.21 (0.5)
T_3	3.29 (9.8)	1.96 (3.7)	2.72 (6.7)	1.38 (1.0)	1.28 (0.7)	1.14 (0.8)	1.15 (0.3)	1.00 (0.0)	1.07 (0.1)
T_4	1.64 (2.7)	2.38 (4.7)	2.14 (3.7)	1.15 (0.3)	1.28 (0.7)	1.23 (0.5)	1.07 (0.2)	1.07 (0.2)	1.07 (0.2)
T_5	1.14 (0.3)	2.44 (5.0)	1.79 (2.6)	1.28 (0.7)	1.33 (0.8)	1.32 (0.7)	1.07 (0.2)	1.15 (0.3)	1.11 (0.2)
T_6	3.46(11.0)	2.08 (3.3)	2.77 (7.1)	1.48 (1.3)	1.21 (0.5)	1.39 (0.9)	1.14 (0.3)	1.00 (0.0)	1.07 (0.1)
T_7	2.16 (3.7)	1.51 (2.3)	1.95 (3.0)	2.50 (5.3)	2.29 (5.7)	1.74 (5.5)	2.50 (5.3)	2.29 (5.7)	2.40 (5.5)
T_8	2.58 (5.7)	1.58 (2.5)	2.22 (4.1)	2.58 (5.7)	2.24 (5.2)	1.80 (5.4)	2.58 (5.7)	2.24 (5.2)	2.41 (5.4)
T_9	3.65(12.3)	1.96 (3.7)	2.90 (8.0)	3.65 (12.3)	2.33 (6.0)	2.13 (9.1)	3.65 (12.3)	2.33(6.0)	2.99 (9.1)
T_{10}	2.77 (6.7)	1.96 (3.7)	2.46 (5.2)	2.77 (6.7)	2.03 (3.7)	1.66 (5.2)	2.77 (6.7)	2.07 (4.1)	2.40 (5.2)
T_{11}	1.73 (2.0)	2.23 (4.0)	1.98 (3.0)	2.64 (6.0)	2.01 (3.0)	1.72 (4.5)	2.64 (6.0)	2.10 (4.2)	2.27 (4.5)
T_{12}	1.96 (3.7)	1.96 (3.7)	1.96 (3.7)	2.38 (4.7)	2.03 (3.3)	1.75 (4.0)	2.38 (4.7)	2.12 (4.3)	2.20 (4.2)
T_{13}	2.58 (5.7)	1.73 (3.0)	2.28 (4.3)	2.58 (5.7)	2.20(5.0)	1.67 (5.3)	2.58 (5.7)	2.20 (5.0)	2.39 (5.3)
T_{14}	3.11 (8.7)	2.00 (4.0)	2.67 (6.3)	3.11 (8.7)	2.05 (4.0)	1.91 (6.3)	3.11 (8.7)	2.05 (4.0)	2.58(6.3)
T_{15}	2.45 (5.0)	1.87 (3.5)	2.28 (4.2)	2.45 (5.0)	2.11 (4.3)	1.70 (4.6)	2.45 (5.0)	2.11 (4.3)	2.28 (4.6)
T_{16}	3.16 (9.0)	1.48 (2.2)	2.47 (5.6)	1.52 (1.3)	2.07 (3.3)	1.79 (2.1)	2.41 (5.0)	2.28 (4.3)	2.34(4.6)
T_{17}	3.41(10.7)	2.64 (6.0)	2.88 (8.3)	4.43 (18.7)	3.65 (12.7)	4.04 (15.7)	4.69 (21.0)	4.17 (16.7)	4.43 (18.8)
S. Em ±	0.07	0.07	0.06	0.12	0.34	0.25	0.11	0.35	0.23
CD at 5 % level	0.20	0.20	0.18	0.35	0.99	0.74	0.31	1.01	0.66

Note: T_1: 2, 4-D sodium salt 80 WP at 2 g/lit, T_2: 2, 4-D sodium salt 80 WP at 3 g/lit, T_3: 2, 4-D sodium salt 80 WPat 4 g/lit, T_4: 2, 4-D dimethyl amine salt 58% EC at 5 ml/lit, T_5: 2, 4-D dimethyl amine salt 58% EC at 7.5 ml/lit, T_6: 2, 4-D dimethyl amine salt 58% EC at 10 ml/lit, T_7: Carfentrozone ethyl 40 DF at 0.25 g/lit, T_8: Carfentrozone ethyl 40 DF at 0.5 g/lit, T_9: Carfentrozone ethyl 40 DF at 1 g/lit, T_{10}: Fluroxypyr meptyl 48 ECat 1.5 ml/lit, T_{11}: Fluroxypyr meptyl 48 EC at 3 ml/lit, T_{12}: Fluroxypyr meptyl 48 EC at 6 ml/lit, T_{13}: Chlorimuron methyl + metasulfuron methyl at 0.3 g/lit, T_{14}: Chlorimuron methyl + metasulfuron methyl at 0.4 g/lit, T_{15}: Chlorimuron methyl + metasulfuron methyl at 0.5 g/lit, T_{16}: Hand weeding at 20 days interval (2 weedings), T_{17}: unweeded control; Figures in parenthesis indicate original value, Nov-Dec = November to December 2013, Feb-Mar = February to March 2014, Pooled = Pooled analysis, + = Data analyzed using square root transformation (x + 1)

Table 2: Grassy weed density (number 0.25 m^{-2})in lawn at different stages as influenced by weed management practices

Treatments	Before herbicide application			30 days after application of herbicides			60 days after application of herbicides		
	Nov-Dec (+)	Feb-Mar (+)	Pooled (+)	Nov-Dec (+)	Feb-Mar (+)	Pooled (+)	Nov-Dec (+)	Feb-Mar (+)	Pooled (+)
T_1	2.06 (3.3)	1.91 (2.7)	1.99 (3.0)	1.81 (3.3)	1.73 (3.0)	1.77 (3.1)	2.22 (4.0)	1.63 (1.7)	1.67(2.8)
T_2	2.24 (4.3)	1.91 (2.7)	2.07 (3.5)	2.07 (4.3)	1.30 (1.7)	1.73 (3.0)	2.24 (4.3)	1.76 (2.2)	1.78 (3.2)
T_3	2.13 (3.7)	1.96 (2.8)	2.04 (3.2)	1.92 (3.7)	1.41 (2.0)	1.67 (2.8)	2.14 (3.7)	1.67 (2.0)	1.67(2.8)
T_4	2.16 (3.7)	1.91 (2.7)	2.04 (3.2)	1.92 (3.7)	1.41 (2.0)	1.67 (2.8)	2.16 (3.7)	1.66 (2.0)	1.67(2.8)
T_5	1.90 (3.0)	1.96 (2.8)	1.93 (2.9)	2.04 (4.2)	1.30 (1.7)	1.70 (2.9)	2.23 (4.2)	1.63 (1.7)	1.84 (3.4)
T_6	2.21 (4.0)	1.67 (2.0)	1.94 (3.0)	1.81 (3.3)	1.41 (2.0)	1.61 (2.6)	2.06 (3.3)	1.73 (2.0)	1.61 (2.6)
T_7	2.20 (3.8)	2.08 (3.3)	2.14 (3.5)	1.94 (3.8)	1.64(2.7)	1.78 (3.2)	2.20 (3.8)	1.91 (2.7)	1.76 (3.1)
T_8	2.11 (3.5)	2.16 (3.7)	2.14 (3.6)	1.87 (3.5)	1.30(1.7)	1.61 (2.6)	2.11 (3.5)	1.63 (1.7)	1.61 (2.6)
T_9	2.14 (3.7)	1.99 (3.0)	2.06 (3.3)	1.92 (3.7)	1.41 (2.0)	1.67 (2.8)	2.14 (3.7)	1.69 (2.0)	1.67(2.8)
T_{10}	2.23 (4.0)	1.91 (2.7)	2.07 (3.3)	2.00 (4.0)	1.41 (2.0)	1.73 (3.0)	2.23 (4.0)	1.73 (2.0)	1.73 (3.0)
T_{11}	2.08 (3.3)	2.15 (3.7)	2.11 (3.5)	1.81 (3.3)	1.73 (3.0)	1.76 (3.1)	2.08 (3.3)	2.00 (3.0)	1.76 (3.1)
T_{12}	2.15 (3.7)	2.14 (3.7)	2.14 (3.7)	1.92 (3.7))	1.78 (3.2)	1.81 (3.4)	2.15 (3.7)	2.03 (3.2)	1.84 (3.4)
T_{13}	2.00 (3.0)	1.49 (1.3)	1.74 (2.1)	1.51 (2.3)	1.14 (1.3)	1.34 (1.8)	1.82 (2.3)	1.49 (1.3)	1.34 (1.8)
T_{14}	1.90 (2.7)	1.82 (2.3)	1.86 (2.5)	1.64 (2.7)	1.76 (2.2)	1.54 (2.4)	1.90 (2.7)	1.76 (2.2)	1.54 (2.4
T_{15}	1.73 (2.3)	1.90 (2.7)	1.81 (2.5)	1.73 (3.0)	1.58 (2.5)	1.64 (2.7)	1.97 (3.0)	1.86 (2.5)	1.64(2.7)
T_{16}	1.73 (2.0)	2.16 (3.7)	1.94 (2.8)	1.26 (1.6)	1.30 (1.7)	1.30 (1.7)	1.72 (2.0)	2.30 (5.3)	1.89 (3.6)
T_{17}	2.20 (3.8)	2.00 (3.0)	2.10 (3.4)	3.35(10.7)	3.97 (15.3)	3.66 (8.0)	3.89(14.2)	3.46 (12.0)	3.73(13.1)
S.Em ±	0.23	0.15	0.13	0.21	0.23	0.16	0.19	0.21	0.14
CD at 5 % level	NS	NS	NS	0.61	0.66	0.45	0.54	0.59	0.41

Note: T_1: 2, 4-D sodium salt 80 WP at 2 g/lit, T_2: 2, 4-D sodium salt 80 WP at 3 g/lit, T_3: 2, 4-D sodium salt 80 WPat 4 g/lit, T_4: 2, 4-D dimethyl amine salt 58% EC at 5 ml/lit, T_5: 2, 4-D dimethyl amine salt 58% EC at 7.5 ml/lit, T_6: 2, 4-D dimethyl amine salt 58% EC at 10 ml/lit, T_7: Carfentrozone ethyl 40 DF- 0.25 g/lit, T_8: Carfentrozone ethyl 40 DFat 0.5 g/lit, T_9: Carfentrozone ethyl 40 DF at 1 g/lit, T_{10}: Fluroxypyr meptyl 48 EC at 1.5 ml/lit, T_{11}: Fluroxypyr meptyl 48 EC at 3 ml/lit, T_{12}: Fluroxypyr meptyl 48 EC at 6 ml/lit, T_{13}: Chlorimuron methyl + metasulfuron methyl at 0.3 g/lit, T_{14}: Chlorimuron methyl + metasulfuron methyl at 0.4 g/lit, T_{15}: Chlorimuron methyl + metasulfuron methyl at 0.5 g/lit, T_{16}: Hand weeding at 20 days interval (2 weedings), T_{17}: unweeded control; Figures in parenthesis indicate original value, Nov-Dec = November to December 2013, Feb-Mar = February to March 2014, Pooled = Pooled analysis, + = Data analyzed using square root transformation (x + 1), NS = Non-significant

Table 3: Broad leaf weed density (number 0.25 m^{-2})in lawn at different stages as influenced by weed management practices

Treatments	Before herbicide application			30 days after application of herbicides			60 days after application of herbicides		
	Nov-Dec (+)	Feb-Mar (+)	Pooled (+)	Nov-Dec (+)	Feb-Mar (+)	Pooled (+)	Nov-Dec (+)	Feb-Mar (+)	Pooled (+)
T_1	3.46(11.7)	3.21 (9.5)	3.34 (11.6)	1.77 (2.2)	2.54 (6.5)	1.65 (4.3)	1.77 (0.5)	1.64 (2.8)	1.80 (1.6)
T_2	3.75(13.2)	3.16 (10.5)	3.46 (11.8)	1.86 (2.7)	2.07 (4.3)	1.70 (3.3)	2.32 (0.2)	2.70 (7.3)	2.16 (3.7)
T_3	3.39(12.2)	3.28 (14.0)	3.33 (13.1)	1.65 (1.8)	1.73 (3.0)	1.48 (2.2)	1.28 (0.0)	1.39 (1.0)	1.33 (0.5)
T_4	4.36(18.0)	2.62 (6.8)	3.49 (12.4)	2.18 (3.8)	1.94 (3.8)	1.88 (3.8)	2.24 (1.7)	1.19 (0.5)	1.72 (1.1)
T_5	2.32 (7.8)	3.49 (11.8)	2.90 (9.8)	1.81 (2.5)	1.51 (2.3)	1.67 (2.4)	1.78 (0.2)	1.96 (3.3)	1.87 (1.7)
T_6	2.67 (7.0)	2.84 (7.7)	2.75 (7.3)	1.52 (1.3)	1.73 (3.0)	1.44 (2.1)	1.28 (0.0)	1.67 (3.8)	1.37 (1.9)
T_7	3.47(11.7)	3.68 (12.8)	3.58 (12.3)	3.17 (9.5)	1.44(2.1)	2.42 (5.8)	2.89 (4.7)	2.07 (3.8)	2.48 (4.2)
T_8	2.80 (7.8)	4.00 (15.0)	3.40 (11.4)	2.26 (4.3)	2.00 (4.0)	2.24 (4.1)	1.76 (1.2)	2.25 (4.3)	2.00 (2.7)
T_9	3.40(11.0)	2.84 (7.8)	3.12 (9.9)	2.72 (6.7)	2.00 (4.0)	2.38 (5.3)	2.57(1.0)	2.09 (4.3)	2.33 (2.6)
T_{10}	3.80(13.8)	2.93 (8.0)	3.36 (10.9)	2.47 (5.2)	2.50 (5.3)	2.49 (5.2)	1.99 (1.5)	2.19 (4.5)	2.09 (3.0)
T_{11}	2.75 (7.3)	2.69 (7.8)	2.72 (7.5)	1.81 (2.3)	2.2 (5.2)	1.92 (3.7)	1.62(0.3)	1.62 (2.2)	1.62 (1.2)
T_{12}	4.02(17.3)	3.00 (10.0)	3.51 (13.6)	2.41 (5.0)	1.48 (2.2)	1.89 (3.6)	2.12 (0.3)	1.86 (2.8)	1.99 (1.5)
T_{13}	2.80 (6.8)	3.98 (14.8)	3.39 (10.8)	2.15 (3.7)	1.67 (2.8)	1.78 (3.2)	1.74 (1.2)	2.34 (4.5)	2.04 (1.8)
T_{14}	3.48(11.5)	3.23 (10.8)	3.36 (11.1)	2.27 (4.2)	1.54 (4.2)	2.20 (4.2)	1.86 (0.8)	1.96 (3.3)	1.92 (2.0)
T_{15}	3.10 (9.2)	3.11 (9.2)	3.10 (9.2)	2.05 (3.3)	1.55 (2.7)	1.64 (2.7)	1.33 (0.2)	1.07 (0.2)	1.20 (0.2)
T_{16}	2.76 (7.8)	4.00 (15.0)	3.38(11.44)	1.76 (2.2)	1.79 (2.2)	1.77(2.2)	3.37 (10.6)	3.45 (11.5)	3.31(11.0)
T_{17}	3.60 (12.3)	4.04 (15.3)	3.82 (13.6)	5.75(32.6)	5.29(27.6)	5.52(30.2)	4.48(19.8)	4.64(21.0)	4.88(20.4)
S.Em ±	0.61	0.62	0.43	0.29	0.20	0.23	0.30	0.36	0.22
CD at 5 % level	NS	NS	NS	0.85	0.60	0.64	0.87	1.03	0.62

Note: T_1: 2, 4-D sodium salt 80 WP at 2 g/lit, T_2: 2, 4-D sodium salt 80 WP at 3 g/lit, T_3: 2, 4-D sodium salt 80 WPat 4 g/lit, T_4: 2, 4-D dimethyl amine salt 58% EC at 5 ml/lit, T_5: 2, 4-D dimethyl amine salt 58% EC at 7.5 ml/lit, T_6: 2, 4-D dimethyl amine salt 58% EC at 10 ml/lit, T_7: Carfentrozone ethyl 40 DF- 0.25 g/lit, T_8: Carfentrozone ethyl 40 DFat 0.5 g/lit, T_9: Carfentrozone ethyl 40 DF at 1 g/lit, T_{10}: Fluroxypyr meptyl 48 EC at 1.5 ml/lit, T_{11}: Fluroxypyr meptyl 48 EC at 3 ml/lit, T_{12}: Fluroxypyr meptyl 48 EC at 6 ml/lit, T_{13}: Chlorimuron methyl + metasulfuron methyl at 0.3 g/lit, T_{14}: Chlorimuron methyl + metasulfuron methyl at 0.4 g/lit, T_{15}: Chlorimuron methyl + metasulfuron methyl at 0.5 g/lit, T_{16}: Hand weeding at 20 days interval (2 weedings), T_{17}: unweeded control; Figures in parenthesis indicate original value, Nov-Dec = November to December 2013, Feb-Mar = February to March 2014, Pooled = Pooled analysis, + = Data analyzed using square root transformation (x + 1), NS = Non-significant

4). Similar results were obtained by Pandey *et al.* (1992).

Significantly higher sedgedensity before and after herbicide application throughout the experimental period noticed in unweededcontrol might be due to unchecked weed growth in the absence of suitable weed management practices. Two hand weeding at every 20 days interval recorded lower sedge density due to manual uprooting of *Cyperusrotundus*, alone sedge noticed in the experiment at regular intervals. Among the herbicides, 2, 4-D sodium salt 80 WP at 4 g/lit of water and 2,4-D dimethyl amine salt 58% ECat 10 mL/lit of water

Table 4: Total weed density (number 0.25 m^{-2})in lawn at different stages as influenced by weed management practices

Treatments	Before herbicide application			30 days after application of herbicides			60 days after application of herbicides		
	Nov-Dec (+)	Feb-Mar (+)	Pooled (+)	Nov-Dec (+)	Feb-Mar (+)	Pooled (+)	Nov-Dec (+)	Feb-Mar (+)	Pooled (+)
T_1	5.00 (24.3)	4.07 (15.7)	4.53(20.0)	2.58 (6.7)	2.93 (8.6)	2.75 (7.6)	2.44 (6.0)	2.07 (4.3)	2.07 (5.1)
T_2	5.20 (26.2)	4.20 (17.2)	4.70 (24.3)	2.88 (8.3)	2.75 (7.6)	2.81 (7.9)	2.23 (5.0)	3.01 (9.1)	2.64 (7.0)
T_3	5.05 (25.7)	4.38 (20.7)	4.71(23.2)	2.54 (6.5)	2.38 (5.7)	2.46 (6.1)	2.00 (4.0)	1.73 (3.0)	1.87 (3.5)
T_4	5.03 (24.3)	3.85 (14.2)	4.44 (19.2)	2.79 (7.8)	2.54 (6.5)	2.75 (7.6)	2.36 (5.6)	1.92 (3.7)	2.14 (4.6)
T_5	2.96 (11.2)	4.25 (17.8)	3.60 (14.5)	2.70 (7.3)	2.09 (4.4)	2.36 (5.6)	2.14 (4.6)	2.21 (4.9)	2.16 (4.7)
T_6	4.74 (22.0)	3.84 (14.0)	4.29 (18.0)	2.44 (6.0)	2.58 (6.7)	2.53 (6.3)	1.89 (3.6)	2.40 (5.8)	2.14 (4.6)
T_7	4.44 (19.2)	4.25 (17.5)	4.34 (18.3)	4.32 (18.7)	3.24 (10.5)	3.82 (14.6)	3.71 (13.8)	3.49 (12.2)	3.60 (13.0)
T_8	4.17 (17.0)	4.67 (20.8)	4.42 (17.4)	3.67 (13.5)	3.30 (10.9)	3.76 (14.2)	3.22 (10.4)	3.34 (11.2)	3.25 (10.6)
T_9	5.27 (27.0)	3.98 (15.2)	4.63 (21.1)	4.85 (22.7)	3.60 (10.0)	3.36 (11.3)	4.12 (17.0)	3.50 (12.3)	3.11 (9.7)
T_{10}	5.04 (24.5)	3.84(14.0)	4.44 (19.2)	4.10 (15.8)	3.31 (11.0)	3.81 (13.4)	3.49 (12.2)	3.25 (10.6)	3.37 (11.4)
T_{11}	3.65 (12.7)	3.90 (14.8)	3.78 (13.7)	3.56 (11.7)	3.52 (11.2)	3.37 (11.4)	3.54 (9.6)	3.33 (9.4)	3.43 (9.5)
T_{12}	4.94 (24.7)	4.32 (18.3)	4.63 (21.5)	3.78 (13.3)	2.77 (7.7)	3.24 (10.5)	2.94 (8.7)	3.20 (10.3)	3.08 (9.5)
T_{13}	4.06 (15.5)	4.48 (19.2)	4.27 (17.2)	3.56 (11.7)	3.08 (9.5)	3.25 (10.6)	3.03 (9.2)	3.34 (11.2)	3.19 (10.2)
T_{14}	4.87 (22.8)	4.19 (17.2)	4.53 (20.0)	3.93 (15.5)	3.22 (10.4)	3.59 (12.9)	3.49 (12.2)	3.08 (9.5)	3.27 (10.7)
T_{15}	4.14 (16.5)	3.93 (14.7)	4.03 (15.6)	3.49 (11.3)	3.08 (9.5)	3.34 (10.4)	2.86 (8.2)	2.64 (7.0)	2.75 (7.6)
T_{16}	4.39 (18.8)	4.71 (21.2)	4.55 (20.0)	2.30 (5.3)	2.86 (7.2)	2.50 (6.3)	4.20 (17.6)	4.58 (21.1)	4.39 (19.3)
T_{17}	5.26(26.8)	5.03 (24.3)	5.14 (25.6)	7.89(61.9)	7.43 (55.6)	7.66 (58.8)	7.46 (55.1)	7.04 (49.6)	7.23 (52.3)
S. Em ±	0.50	0.45	0.34	0.30	0.45	0.17	0.24	0.45	0.13
CD at 5 % level	NS	NS	NS	0.86	1.30	0.47	0.68	1.29	0.36

Note: T_1: 2, 4-D sodium salt 80 WP at 2 g/lit, T_2: 2, 4-D sodium salt 80 WP at 3 g/lit, T_3: 2, 4-D sodium salt 80 WPat 4 g/lit, T_4: 2, 4-D dimethyl amine salt 58% EC at 5 ml/lit, T_5: 2, 4-D dimethyl amine salt 58% EC at 7.5 ml/lit, T_6: 2, 4-D dimethyl amine salt 58% EC at 10 ml/lit, T_7: Carfentrozone ethyl 40 DF- 0.25 g/lit, T_8: Carfentrozone ethyl 40 DFat 0.5 g/lit, T_9: Carfentrozone ethyl 40 DF at 1 g/lit, T_{10}: Fluroxypyr meptyl 48 EC at 1.5 ml/lit, T_{11}: Fluroxypyr meptyl 48 EC at 3 ml/lit, T_{12}: Fluroxypyr meptyl 48 EC at 6 ml/lit, T_{13}: Chlorimuron methyl + metasulfuron methyl at 0.3 g/lit, T_{14}: Chlorimuron methyl + metasulfuron methyl at 0.4 g/lit, T_{15}: Chlorimuron methyl + metasulfuron methyl at 0.5 g/lit, T_{16}: Hand weeding at 20 days interval (2 weedings), T_{17}: unweeded control; Figures in parenthesis indicate original value, Nov-Dec = November to December 2013, Feb-Mar = February to March 2014, Pooled = Pooled analysis, + = Data analyzed using square root transformation (x + 1), NS = Non-significant

Table 5: Weed control efficiency (%) as influenced by different weed management practices in lawn

Treatments	30 DAAH			60 DAAH		
	Nov-Dec	Feb-Mar	Pooled	Nov-Dec	Feb-Mar	Pooled
T_1-2,4-D sodium salt 80 WP at 2 g/lit of water	89.2	85.0	87.1	88.2	86.6	87.4
T_2-2,4-D sodium salt 80 WP at 3 g/lit of water	86.5	86.8	86.7	84.6	89.3	86.9
T_3-2,4-D sodium salt 80 WP at 4 g/lit of water	89.5	92.2	90.8	91.5	92.3	91.9
T_4-2,4-D dimethyl amine salt 58% EC at 5 ml/lit of water	87.3	85.6	86.5	86.4	86.6	86.5
T_5-2,4-D dimethyl amine salt 58% EC at 7.5 ml/lit of water	88.1	84.1	86.1	88.2	87.2	87.7
T_6-2,4-D dimethyl amine salt 58% EC at 10 ml/lit of water	90.3	91.0	90.7	93.3	91.9	92.6
T_7 -Carfentrozone ethyl 40 DF at 0.25 g/lit of water	69.8	74.5	72.2	67.0	72.1	69.6
T_8 -Carfentrozone ethyl 40 DF at 0.5 g/lit of water	78.2	74.2	76.2	76.7	73.1	74.9
T_9 -Carfentrozone ethyl 40 DF at 1 g/lit of water	63.4	78.4	70.9	61.3	76.8	69.0
T_{10}–Fluroxypyrmeptyl 48 EC at 1.5 ml/lit of water	74.4	79.6	77.0	71.5	79.2	75.4
T_{11}–Fluroxypyrmeptyl 48 EC at 3 ml/lit of water	81.1	79.3	80.2	79.1	79.5	79.3
T_{12}–Fluroxypyrmeptyl 48 EC at 6 ml/lit of water	78.4	81.1	79.8	76.7	80.9	78.8
T_{13}-Chlorimuron methyl + metasulfuron methyl at 0.3 g/lit of water	81.1	79.9	80.5	79.1	81.2	80.2
T_{14}-Chlorimuron methyl + metasulfuron methyl at 0.4 g/lit of water	74.9	80.5	77.7	73.7	80.5	77.1
T_{15}-Chlorimuron methyl + metasulfuron methyl at 0.5 g/lit of water	81.7	83.5	82.6	83.7	83.5	83.6
T_{16} -Hand weeding at every 20 days interval	91.8	87.0	89.4	68.0	57.5	62.8
T_{17} -Unweeded control	0.0	0.0	0.0	0.0	0.0	0.0

Note: DAAH = Days after application of herbicides, Nov-Dec = November to December 2013, Feb-Mar = February to March 2014, Pooled = Pooled analysis

significantly reduced the sedge density as compared to other treatmentsindicating its superiority in controlling the sedge effectively compared to other herbicides. Similar results of effective sedge control (77 per cent reduction in shoot population of nutsedge) in field trials with the application of 2,4-D ethyl ester was reported by Bhargavi and Reddy, 1992.

Unweeded control recorded significantly higher grassy weeds density as compared to all other treatments throughout the experiment and lowest grassy weed density was noticed in hand weeding at 20 days interval due to uprooting of grassy weeds by laborers in latter treatment. But due to manual removal of other grassy weeds surrounding *Cynodon dactylon*, patchy appearance was noticed as the laborers also uprooted few *Cynodon dactylon* stolons along with grassy weeds which reduced the aesthetic value of lawn. Among herbicides the application of combination of effective grass killer chlorimuron methyl + metasulfuron methyl at 0.3 g/lit of water recorded lower density of grassy weeds. Similar results were obtained by Pandey and Singh (1994).

Among the herbicides, 2, 4-D sodium salt 80 WP at 4 g/lit of water, fluroxypyr meptyl 48 EC- 6 mL/lit of water, chlorimuron methyl + metasulfuron methyl at 0.5 g/lit of waterand 2, 4-D

dimethyl amine salt 58% EC at 10 ml/lit of water significantly reduced the broad leaf weed density as compared to other treatments indicating their effectiveness against broad leaf weeds these results are similar findings of (Mark and James, 2013). Use of 2, 4-D sodium salt 80 WP or 2, 4-D dimethyl amine salt 58% EC very effectively controlled the majority of broad leaf weeds in addition to *Cyperusrotundus* (sedge) with great selectivity to *Cynodon dactylon*. Significantly higher density of broad leaf weedsnoticed at different stages in unweededcontrol might be due to unchecked weed growth.

Weed control efficiency showed marked differences among the different weed management practices (Table 5). 30 DAAH, higher weed control efficiency (%) was noticed in hand weeding at every 20 days interval which might be due to manualremoval of sedge, grassy and broad leaf weeds in lawn which provided weed free condition in that treatment. However at 30 and 60 DAAH, highest weed control efficiency was obtained with 2, 4-D sodium salt 80 WP at 4 g/lit of water and2,4-D dimethyl amine salt 58% EC at 10 mL/lit of water due to effective control of sedge and broad leaf weeds indicating the superiority of these herbicide molecules over other herbicides and also manual weeding which is a requisite for effective management of weeds in a lawn with reduced drudgery and economics. The results obtained in this experiment are in accordance with the findings of Pablico and Moody (1982) in field crops.

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