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*Short Communication*

# Weed Management in Tropical Turf Established with Bermuda Grass (*Cynodon dactylon* (L.) Pers. X *Cynodon transvaalensis* L.)

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Aesthetic quality is the beauty and value that turfgrass adds to a managed landscape. Usability can be the durability of a sport field, trueness of golf putting green roll, or reduction in soil loss from water runoff or wind. Any weed presence in turfgrass can decrease the aesthetic quality and usability of turfgrass. Utilizing herbicides is the only way to completely control weeds in a turfgrass stand. Weeds decrease the aesthetic value and the usability of turfgrass. Herbicides are a vital and necessary component for turfgrass weed management. Herbicides are primarily classified in two ways, first by chemistry and then by use [1]. A significant weed infestation can detract from turfgrass visual quality, but often poses no functional or environmental problem. Weeds are best kept under control through prevention [2]. Herbicide classification by chemistry organizes herbicides according to mode of action and family. A mode of action is the physiological or biochemical mechanism by which an herbicide kills or injures plants [3]. With respect to selective herbicides, there are four main groups of weeds that are targeted by herbicides: broadleaf (dicots), grasses (monocots), sedges (monocots), and other non-grass monocots. Pre-emergent application controls certain annual weeds. Post emergent application control lawn weeds once they are visible. Normally, a home garden can easily be managed without a weedicide, but for a good lawn to be maintained at less labour cost, it is useful to apply weedicides. Modern weedicides vary in their chemical characteristics and thus in the way plants respond to them. Many are selective, meaning they affect certain plants but leave others unharmed. Some herbicides are non-selective and can kill nearly any plant. The selection of an herbicide depends on the type of weed to be controlled and the duration of herbicidal effect. Further, the dose of the selected herbicide depends on the type of lawn grass, variety and climatic conditions. Pre-plant application of Glyphosate has been recommended as a standard practice to eliminate all weeds before lawn establishment. However, it does not provide prolonged control as it is only a contact herbicide. Thus, pre-plant application of Glyphosate and post planting application of 2,4-D have been recommended by many workers [4]. Recently, combination of Glyphosate with the new generation weedicides like Halosulfuron or Pyrazosulfuron have been recommended to have complete control of sedges, annuals and broad-leaved weeds. Hence, an experiment is formulated to the effect of various weedicides on growth and control of weeds and to compare the effect of various forms of weedicides applied alone and in combination.

The experiment was conducted to study the weed management in lawn establishment with Bermuda grass (*Cynodon dactylon* (L.) Pers. X *Cynodon transvaalensis* L.) was carried at the Floriculture Complex, Department of Horticulture during 2018-2019. The effect of pre-planting, post-planting application of herbicides and hand weeding was studied with eleven treatments comprising of different concentrations of both pre and post-emergent herbicides viz., Hand weeding @ 20 days interval, Glyphosate @ 1.5 kg a.i. $ha^{-1}$, Pyrazosulfuron @ 35 g a.i. $ha^{-1}$, 2, 4-D @ 1.5 kg a.i. $ha^{-1}$ and their combinations. Pre-planting application involving glyphosate alone was carried out 20 days before planting. The gross pre-emergence application of herbicides Pyrazosulfuron and Halosulfuron were carried out five days after planting and the post-emergence application of 2,4-D was given 25 days after planting. Observation on weed count, weed biomass, weed control index and vigour index were recorded and analyzed.

The important weed flora observed in the experimental field were *Panicum repense*, *Phyllanthus niruri*, *Echinocola colanum*, *Cyperus rotundus*, *Cyperus eria*, *Eclipta alba*. Among the weed species recorded, five species namely *Panicum repense*, *Phyllanthus niruri*, *Echinocola colanum*, *Cyperus rotundus* and *Cyperus eria* occurred in major proportions and the influence of the treatments on these weed species were significant. Sedges population was observed to be higher compared to grasses and broad-leaved weeds. The weed species like *Eclipta alba* occurred in negligible proportion and were not significantly influenced by the treatments. Among the treatments, $T_9$ (Glyphosate @ 1.5 kg a.i. $ha^{-1}$ + Pyrazosulfuron @ 35 g a.i. $ha^{-1}$ + 2, 4-D @ 1.5 kg a.i. $ha^{-1}$) controlled significantly most of the broad-leaved weeds, sedges and grasses. It was followed by $T_2$ (hand

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weeding at 20 days intervals). The highest population of grasses, sedges and broad-leaved weeds were found in the unweeded control ($T_1$). Better weed control efficiency in the treatment $T_9$ compared with other treatments could be attributed to the broad-spectrum control of weeds by pre-planting application of Glyphosate followed by application of Pyrazosulfuron ethyl five days after planting. Pyrazosulfuron ethyl is a potent seed germination inhibitor and acts by interfering with protein synthesis. The late emerged weeds were effectively tackled by the post-emergence application of 2,4-D at 21 days after establishment. This might have contributed for efficient control of predominant weed flora in the lawn establishment as reflected by lesser population of these weeds in treatment $T_9$.

Table 1 Effect of weedicides on individual weed count $m^{-2}$ at 40 DAP

| Treatments | *Panicum repense* | *Phyllanthus niruri* | *Echinocola colanum* | *Eclipta alba* | *Cyperus rotundus* | *Cyperus eria* |
|---|---|---|---|---|---|---|
| T: Control | (11.33) 3.44 | (15.00) 4.53 | (20.00) 3.59 | (12.00) 3.59 | (45.66) 6.77 | (22.66) 4.81 |
| $T_2$: Hand weeding 20 days interval | (3.00) 1.85 | (3.66) 2.03 | (5.33) 2.41 | (2.66) 1.77 | (5.66) 2.48 | (2.33) 1.67 |
| $T_3$: Glyphosate @ 1.5 a.i kg $ha^{-1}$ | (7.66) 2.86 | (10.00) 3.24 | (12.00) 3.54 | (5.66) 2.48 | (20.33) 4.55 | (13.66) 3.76 |
| $T_4$: Pyrazosulfuron @ 35 g a.i. $ha^{-1}$ | (10.30) 3.27 | (13.00 3.67 | (13.00) 3.67 | (6.00) 2.55 | (28.66) 5.39 | (17.66) 4.26 |
| $T_5$: Halosulfuron @ 20 g a.i. kg $ha^{-1}$ | (8.66) 3.02 | (12.00) 3.54 | (14.00) 3.81 | (5.66) 2.48 | (24.33) 4.97 | (14.35) 3.84 |
| $T_6$: 2, 4-D @ 1.5 kg a.i. $ha^{-1}$ | (11.00) 3.37 | (12.66) 3.62 | (13.33) 3.71 | ((6.00) 2.55 | (30.33) 5.54 | (16.33) 4.10 |
| $T_7$: Glyphosate @ 1.5 kg a.i. $ha^{-1}$ + Halosulfuron @ 20 g a.i. kg $ha^{-1}$ | (6.33) 2.11 | (7.00) 2.73 | (8.33) 2.97 | (5.00) 2.34 | (14.66) 3.88 | (8.00) 2.90 |
| $T_8$: Glyphosate @ 1.5 kg a.i. $ha^{-1}$ + 2, 4-D @ 1.5 kg a.i. $ha^{-1}$ | (7.00) 2.73 | (9.00) 3.08 | (10.33) 3.28 | (5.00) 2.32 | (17.66) 4.25 | (10.00) 3.23 |
| $T_9$: Glyphosate @ 1.5 kg a.i. $ha^{-1}$ + Pyrazosulfuron @ 35 g a.i. $ha^{-1}$ + 2, 4-D @ 1.5 kg a.i. $ha^{-1}$ | (1.66) 1.46 | (1.66) 1.46 | (4.00) 2.06 | (1.66) 1.46 | (3.66) 2.03 | (1.66) 1.46 |
| $T_{10}$: Glyphosate @ 1.5 kg a.i. $ha^{-1}$ + Pyrazosulfuron @ 35 g a.i. $ha^{-1}$ + Halosulfuron @ 20 g a.i. kg $ha^{-1}$ | (5.66) 2.47 | (5.33) 2.38 | (6.00) 2.55 | (4.00) 2.11 | (14.00) 3.78 | (6.33) 2.60 |
| $T_{11}$: Glyphosate @ 1.5 kg a.i. $ha^{-1}$ + Halosulfuron @ 20 g a.i. kg $ha^{-1}$ +2, 4-D @ 1.5 kg a.i. $ha^{-1}$ | (5.33) 2.41 | (5.00) 2.35 | (6.00) 2.53 | (4.00) 2.11 | (16.33) 2.61 | (5.00) 2.34 |
| SED | 0.18 | 0.15 | 0.18 | 0.12 | 0.21 | 0.13 |
| CD(p=0.05) | 0.40 | 0.33 | 0.40 | 0.26 | 0.45 | 0.07 |

Values in parentheses indicates original value

Table 2 Effect of weedicides on weed biomass (g $m^{-2}$), weed control index (%) and vigour index

| Treatments | Weed biomass (g $m^{-2}$) | weed control index (%) | Vigour Index |
|---|---|---|---|
| T: Control | 19.06 | - | 11.22 |
| $T_2$: Hand weeding 20 days interval | 3.46 | (82.10) 64.90 | 60.63 |
| $T_3$: Glyphosate @ 1.5 a.i kg $ha^{-1}$ | 12.53 | (34.20) 35.70 | 26.05 |
| $T_4$: Pyrazosulfuron @ 35 g a.i. $ha^{-1}$ | 16.96 | (30.50) 32.50 | 15.60 |
| $T_5$: Halosulfuron @ 20 g a.i. kg $ha^{-1}$ | 13.20 | (11.00) 19.36 | 21.56 |
| $T_6$: 2, 4-D @ 1.5 kg a.i. $ha^{-1}$ | 16.86 | (11.50) 19.82 | 17.25 |
| $T_7$: Glyphosate @ 1.5 kg a.i. $ha^{-1}$ + Halosulfuron @ 20 g a.i. kg $ha^{-1}$ | 8.23 | (56.80) 48.90 | 37.62 |
| $T_8$: Glyphosate @ 1.5 kg a.i. $ha^{-1}$ + 2, 4-D @ 1.5 kg a.i. $ha^{-1}$ | 10.26 | (46.30) 42.80 | 31.85 |
| $T_9$: Glyphosate @ 1.5 kg a.i. $ha^{-1}$ + Pyrazosulfuron @ 35 g a.i. $ha^{-1}$ + 2, 4-D @ 1.5 kg a.i. $ha^{-1}$ | 1.96 | (90.00) 71.50 | 65.20 |
| $T_{10}$: Glyphosate @ 1.5 kg a.i. $ha^{-1}$ + Pyrazosulfuron @ 35 g a.i. $ha^{-1}$ + Halosulfuron @ 20 g a.i. kg $ha^{-1}$ | 6.93 | (63.60) 52.80 | 43.80 |
| $T_{11}$: Glyphosate @ 1.5 kg a.i. $ha^{-1}$ + Halosulfuron @ 20 g a.i. kg $ha^{-1}$ +2, 4-D @ 1.5 kg a.i. $ha^{-1}$ | 5.03 | (73.60) 59.00 | 52.80 |
| SED | 0.28 | 0.64 | 0.49 |
| CD(p=0.05) | 0.61 | 1.36 | 1.02 |

All the treatments exerted significant influence on weed biomass. Among the weed control measures, $T_9$ (Glyphosate @ 1.5 kg a.i. $ha^{-1}$ + Pyrazosulfuron @ 35 g a.i. $ha^{-1}$ + 2, 4-D @ 1.5 kg a.i. $ha^{-1}$) excelled others by recording the least weed biomass of 1.96 g $m^{-2}$. This was followed by $T_2$ (3.46 g $m^{-2}$). Control ($T_1$) encouraged higher weed population with the highest weed biomass of 19.06 g $m^{-2}$. This treatment recorded a weed biomass of 1.98 g $m^{-2}$ as against 19.06 g $m^2$ in control plot. The combination treatment $T_9$ resulted in significantly least biomass of weeds, because of the less weed count. Unweeded control recorded significantly higher weed biomass compared to other treatments. This may be due to more number of weeds in the lawn establishment [5-6]. All the treatments had shown significant influence on weed control index in the field experiment. Among the treatments, $T_9$ (Glyphosate @ 1.5 kg a.i. $ha^{-1}$ + Pyrazosulfuron @ 35 g a.i.

ha$^{-1}$ + 2, 4-D @ 1.5 kg a.i. ha$^{-1}$) was found to be superior as indicated by the2 higher weed control index (90 per cent). This was followed by $T_2$ (hand weeding 20 days intervals) (82.1 per cent). The weed control index was found to be the least (11.0 per cent) in the treatment $T_5$ (Halosulfuron @ 20 g a.i. ha$^{-1}$). This was on par with $T_6$ (2, 4-D @ 1.5 kg a.i. ha$^{-1}$), which recorded a value of 11.50 per cent. Among the treatments, $T_9$ excelled others by recording the highest vigour index (65.20 per cent). This was followed by $T_{12}$ with a value of 60.63 per cent and the lowest vigour index (11.22 per cent) was observed in $T_1$ (control). The treatment $T_9$ recorded a higher weed control index and was found to be superior to other treatments [7]. It was mainly due to use of pre-planting herbicide Glyphosate which effectively controlled the standing weeds especially the sedges before the lawn establishment, followed by application of Pyrazosulfuron on fifth day after planting which effectively controlled the grass and broad-leaved weeds followed by application of 2,4-D on 25 days after planting which effectively controlled the broad-leaved weeds. Earlier works of [8] also reported the failure of alone application of any one type of herbicide to prevent regeneration of perennial grass weeds. The present trend of results indicating better performance of combination of herbicides in weed control is in line with earlier reports of [9]. From the experiment it could be concluded that, higher densities of weeds coupled with higher weed biomass in unweeded control might have resulted in greater depletion of nutrients and moisture. This could have deprived the factors of the lawn establishment which was ultimately reflected in poor growth and less weed control index.

Among the weed control measures, $T_9$ (Glyphosate @ 1.5 kg a.i. ha$^{-1}$ + Pyrazosulfuron @ 35 g a.i. ha$^{-1}$ + 2, 4-D @ 1.5 kg a.i. ha$^{-1}$) controlled significantly most of the broad-leaved weeds, sedges and grasses and excelled others by recording the least weed biomass of 1.96 g m$^{-2}$ and was found to be superior as indicated by the higher weed control index (90 per cent).

## SUMMARY

The value of turfgrass is its inherent aesthetic quality and usability. Aesthetic quality is the beauty and value that turfgrass adds to a managed landscape. Coming to the maintenance aspects, weed management is a herculean task in lawn care. Weeds present in turfgrass decrease the aesthetic quality and usability of turfgrass. Maintaining the weeds through cultural, chemical methods does not have complete solution as like in other countries. Hence, an experiment was conducted to study the weed management in lawn establishment with Bermuda (*Cynodon dactylon* (L.) Pers. X *Cynodon transvaalensis* L.) was carried at the Floriculture Complex, Department of Horticulture during 2016-2017. The effect of pre-planting, post-planting application of herbicides and hand weeding was studied with Glyphosate, Pyrazosulfuron and Halosulfuron alone and in combination with eleven treatments replicated thrice. Observation on weed count, weed biomass and weed control index were recorded and analyzed. Among the weed control measures, $T_9$ (Glyphosate @ 1.5 kg a.i. ha$^{-1}$ + Pyrazosulfuron @ 35 g a.i. ha$^{-1}$ + 2, 4-D @ 1.5 kg a.i. ha$^{-1}$) controlled most of the broad-leaved weeds, sedges and grasses and excelled others by recording the least weed biomass of 1.96 g m$^{-2}$ and was found to be superior as indicated by the higher weed control index (90 per cent).

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