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Chemical Control and Management Strategies of *Leucaena leucocephala* in R&D Estates at Kanchanbagh, Hyderabad, Telangana

SelvarajT[a], AnkurA[a], SenthilK[b]and PrasanthR[c]

[a]Defence Institute of Bio-Energy Research (DIBER), Haldwani – 263139

[b]Agriculture College and Research Institute, Madurai – 625 104

[c]RVS Agricultural College, Thanjavur – 613 402

Corresponding author: tselvarajsc@gmail.com

ABSTRACT

Weeds are plants that harm socio-economic, environmental, food security, biodiversity, ecosystem and human health. The present study aimed to assess the control and management efficiency of the most useful perennial weed species Subabul. Randomized Block Design was employed to control the Subabul in the R& D estates, KanchanBagh, Hyderabad. The chemicals of Glyphosate 41% (T1), Paraquat Dichloride 24% (T2), 2, 4-D sodium salt 80% (T3), Atrazine 50% (T4) and Vinegar 5% (T5) were applied in the field and studied with a Control (T6) in One acre on major weed of Subabul and observed the effects up to 75 days duration. Glyphosate 41% systemic herbicide application showed very effective performance by killing above-ground growth and deteriorating underground plant parts at 1.5%, followed by Paraquate Chloride at 24%. Vinegar showed eco-friendly, broad-spectrum, biopesticide activity and is suitable to control Subabul, especially on buildings/ structures. The study not found herbicide residues in the experimental area after 75 days.

Keywords: Allelopathy; Glyphosate; Herbicide; Subabul; Weed

INTRODUCTION

Weeds are a major disincentive to agricultural, forest productivity, urban, natural plant communities, human, economic losses, spread, identification sources, population shifts, thresholds, competitive index, effects on tillage production systems, major species of the world in agriculture, forestry, urban areas, and natural communities (Campbell, 1923; Pieters, 1973; Bryson, 2003; Zimdahl, 2018).There are 8000 weeds species in the world, in it about 200 species are most responsible for 95% of weed problems in food, feed, fiber, and livestock production (Bryson, 2003). About 73% of the weeds are dicots or broadleaf weeds, 25% are monocots or grasses, sedges, rushes, and other and remaining 2% are peridiophytes orferns and fern allies and gymonsperms or conifers and conifer allies (Bryson, 2003).*Leucaenaleucocephala*is a small fast growing species, native to Southern Mexico and it is also used for a variety of purposes such as firewood, fiber, livestock fodder, etc.(Badal, 2017; Bageel et al., 2020; Aleman et al., 2022). *Leucaenaleucocephala*is a thorn less long-lived shrub or tree which may grow to heights of 7- 20 m (Shelton and Brewbaker, 1994;

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Awe et al., 2013). Leaves are bipinnate with 6-8 pairs of pinnae bearing 11-23 pairs of leaflets 8-16 mm long (Shelton and Brewbaker, 1994; Zarina et al., 2017). The inflorescence is a cream coloured globular shape which produces a cluster of flat brown pods 13-18 mm long containing 15-30 seeds (Shelton and Brewbaker, 1994; Muhammad et al., 2019). It requires temperatures ranges from 25-30°C day time for optimum growthnot tolerant to even light frosts which cause leaf shed (Shelton and Brewbaker, 1994; Hiwale, 2015; Kabir et al., 2018). Subabul (miracle tree) was promoted from 1970 to 1980 for multiple uses (Srivastava and Madhuchhanda, 1997; Rusdy et al., 2016). It's also one of fast growing tree species and it will reach around 20 feet in two year time period (Rahman et al., 2020; Tamilarasan et al., 2021). In India, Subabulwas initially promoted for afforestation due to its fast-growing nature (Balooni and Singh, 2001; Pal and Sharma, 2001). It's also described as a conflict tree because it's used for forage production but it spreads like a weed in some places (Borah et al., 2018).However, now Subabul is considered as unsuitable for urban planting because of its tendency to get uprooted in rain and wind (Madhurapperuma and Kuruppuarachchi, 2016).It's anallelopathic tree (Kato and Kunrniadie, 2022). The seeds contain mimosine, an amino acid known to be toxic to non-ruminant vertebrates (D'Mello et al., 1991; Hakimiet al., 2017). Weed control is essential in R & D estates at Kanchanbagh, Hyderabad,Telangana. So, the present study focused on developing intergraded weed strategies for annual and perennial weeds, mainly *Leucaena leucocephala,* in R&D estates at Hyderabad, Telangana.

Materials and methods

Experimental Design (Fig 1)

The experiment was conducted from 2017 to 2019 in R&D estates at KanchanBagh, Hyderabad, Telangana and located at 17° 19' 58.4256" North and 78° 29' 59.0424 east. The study site contains the soil type of sandy loam and red sandy loam. 'Subabul weed' control and management strategies were carried on about 60 acres in R&D estates, Hyderabad.

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Figure 1. Weed Management and control study area.

Chemical methods of weed management

The present experiment was conducted in 2019 with replications to control Subabul (Vinothkannan et al., 2022). In chemical weed management methods, we applied different chemicals in non-cropped areas (open fields). Chemicals of Glyphosate 41% (T1), Paraquat Dichloride 24% (T2), (2, 4-D) sodium salt 80% (T3), Atrazine 50% (T4) and Vinegar 5% (T5) and control (T6). In chemical 1%, 1.5% and 2% of Glyphosate 41% (T1), Paraquat Dichloride 24% (T2), 2, 4-D sodium salt 80% (T3), Atrazine 50% (T4) and 5%, 10% and 15% of Vinegar 5% (T5) were applied in the field having Subabul weed population (90%) and studied with a control (T6) in One-acre field area and observed for the effects up to 75 days (Hatcher and Melander, 2003; Jat et al., 2011; Gharibvandi et al., 2022). Herbicides Glyphosate 41% (T1) at 1.2 a.i/ha, Paraquat Dichloride 24% (T2) at 0.9kg in a.i/ha, 2, 4-D sodium salt 80% (T3) at 4kg in a.i/ha, Atrazine 50% (T4) at 1.5kg in a.i/ha, were applied on the non-cropped area having various types of weeds in a mixed population.

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Residue Analysis

Soil sample had collected for Glyphosate extraction for HPLC analysis. Glyphosate had derivatized with FMOC -Cl (2 g/L in acetonitrile) at 40°C in the Nep J Environ Sci (2015), presence of 50 mM borate buffer (pH 9.5). The reaction was stopped by 2% H3PO4 after the overnight reaction. Separation were carried on a C18 reverse phase HPLC column (5 µm 4.6 x 250 mm), and eluted with a mobile phase consisting of 50 mM phosphate buffer (pH 2.5) and acetonitrile at the flow rate of 0.8ml/min and fluorescence detection set at an emission wavelength of 325 nm with excitation at 270 nm. Calibration experiments were carried out in both solvent standard (deionized water) and matrix-matched standards to compare the matrix effect. The linearity of the method was determined by using calibration solutions ranging from 0.005 - 1.0 µg/ml. The limits of detection (LOD) and quantization (LOQ) were also determined. The method was validated by analyzing organic Subabul samples picked at three concentrations (0.05, 0.1 and 0.5 µg/ml). To determine the % recovery, six replicates of pre-spiked samples for each concentration were analyzed. To evaluate the repeatability, post-spiked six replicates for each concentration were injected on the same day and intermediate precision injections were made on three different days. The matrix-matched external standard method was used for the quantitative analysis of Glyphosate.

Results and Discussion

Effect of Herbicides

Chemical techniques of control include smearing herbicide on the girdled section of the trunk, repeatedly applying herbicide to cut the surface of stumps or basal barks, and injecting herbicide into the trunk each season (Peng et al., 2019). However, due to the plant's resistance to the majority of regularly used herbicides, the choice of chemicals should be made with caution (Idol, 2019). The markedly available herbicides of Glyphosate 41% (T1), Paraquat Dichloride 24% (T2), 2, 4-D sodium salt 80% (T3), Atrazine 50% (T4) and Vinegar 5% (T5) and control (T6) were applied and assessed against Subabul (fig 2 to fig 6). Figure 2 to Figure 6 contains after treatment of herbicides 10ml, 15ml and 20 with control. In the result part y-axis 1 to 10 represent; 1 is No effect and Little Effect on young foliage, 2 is 25 % yellowing, 3 is 50% leaves turn yellow; 4 is 95% leaf yellowing; few started drying, 5 is Complete (95%) foliage dried; stem still green, 6 is 100% leaves & Terminal branches dried; 10 % stem dried, 8 is 100% leaves & 25% stem dried; no new leaf & 5% new weeds on the ground and 10 is 100% leaves & 25% stem dried; no new leaf & no weeds on the ground.In Glyphosate 41% (T1) recorded Subabul control efficiency at 10 ml in 2 hours and high activity at 20 ml on the 45th day, followed by Paraquat Dichloride 24% (T2) recorded Subabul control efficiency at 10 ml in 2 hours and high activity at 20 ml on 10th day, 2, 4-D sodium salt 80% (T3) recorded Subabul control efficiency at 10 ml in 2 hours and high activity at 20 ml in 25th day, Atrazine 50% (T4) recorded Subabul control efficiency at 10 ml in 2 hours and high activity at 20 ml in 45th day and Vinegar 5% (T5) recorded Subabul control efficiency at 10 ml in 2 hours and high activity at 20 ml in 10th day.

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But overall the result indicates that the Glyphosate 41% (T1) is stable after suppression and other chemicals are not stable and they leave for new emergence. Similarly, Glyphosate, triclopyr, picloram, and metsulfuron-methyl are having the potential to control Subabul were reported by Olckers, 2011; Peng et al., 2019; Idol, 2019. Shaw and Arnold, 2002 assessed the glyphosate mixtures against Johnson grass, broadleaf signal grass, pitted morning glory, and hemp sesbania and they reported less activity recorded than the mixture. Recently, Anunciato *et al.*, 2022 reported a less dose of glyphosate showed better ability against *Digitariainsularis*. However, the efficacy of herbicides reduces during the rainy season (Peng et al., 2019) and the chemical treatments are often a subject of conflict, due to their environmental implications. Similarly, the present study also showed better ability on aerial and root part control on Subabul. The developed HPLC method was applied for the determination of glyphosate residues in soil samples of study plots. Residues were Non-Detectable (ND) limit after 30 days because of highly dynamic microbial population activity and the high organic matter content of the soil (Sharma et *al.*, 2015).

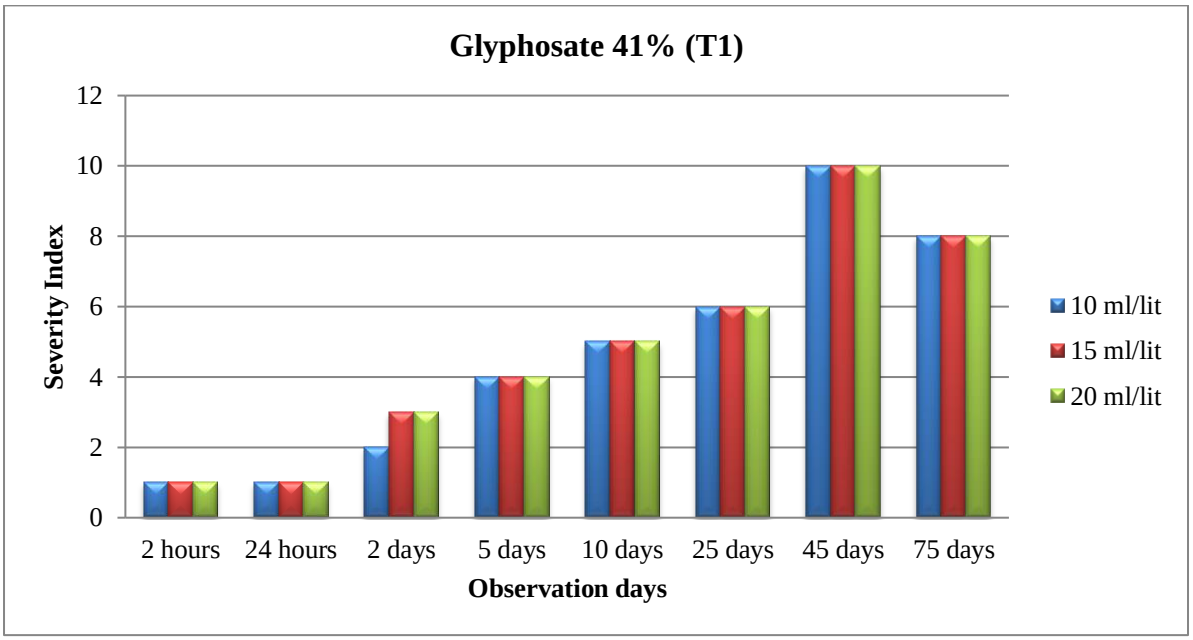

Figure 2.Treatment 1 - Glyphosate (41%) 10ml/L, 15ml/L and 20ml/L severity index in open field area consisting Subabul population. **Note:**1 - No effect and Little Effect on young foliage; 2 - 25 % yellowing; 3 - 50% leaves turn yellow; 4 - 95% leaf yellowing ; few started drying; 5 - Complete (95%) foliage dried; stem still green; 6 - 100% leaves & Terminal branches dried; 10 % stem dried; 8 - 100% leaves &25% stem dried ; no new leaf & 5% new weeds on ground; 10 - 100% leaves &25% stem dried ; no new leaf & no weeds on ground

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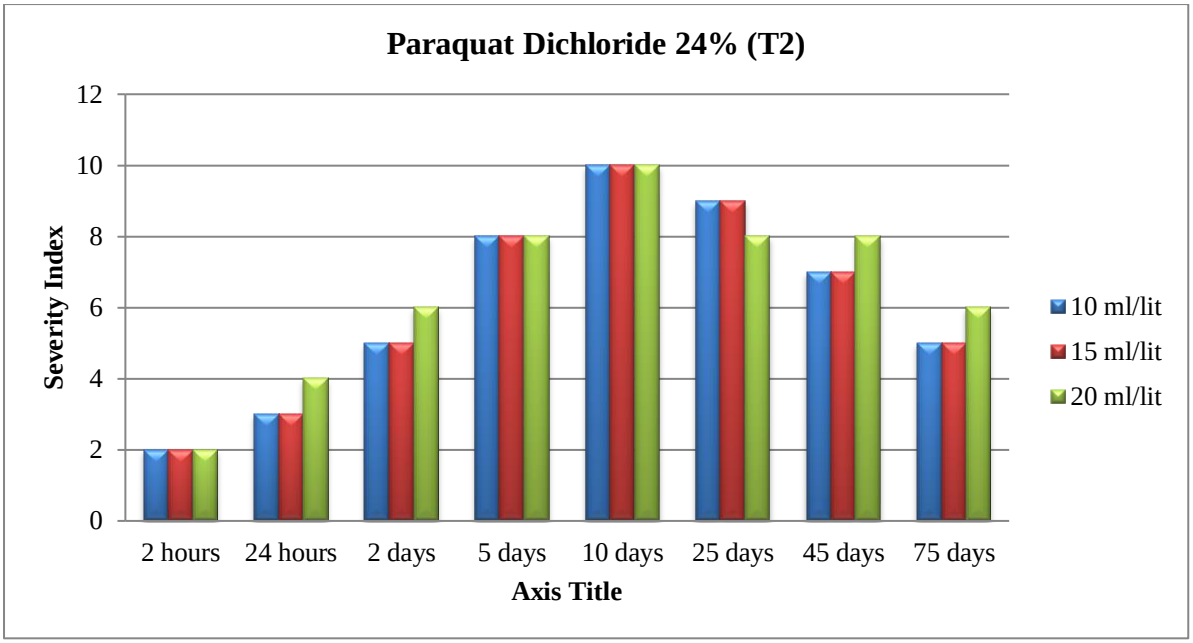

Figure 3. Treatment 2 - Paraquat Dichloride 24% (T2) 10ml/L, 15ml/L and 20ml/L severity index in open field areaconsisting Subabul population. Note: 1 - No effect and Little Effect on young foliage; 2 - 25 % yellowing; 3 - 50% leaves turn yellow; 4 - 95% leaf yellowing ; few started drying; 5 - Complete (95%) foliage dried; stem still green; 6 - 100% leaves & Terminal branches dried; 10 % stem dried; 8 - 100% leaves &25% stem dried ; no new leaf & 5% new weeds on ground; 10 - 100% leaves &25% stem dried ; no new leaf & no weeds on ground

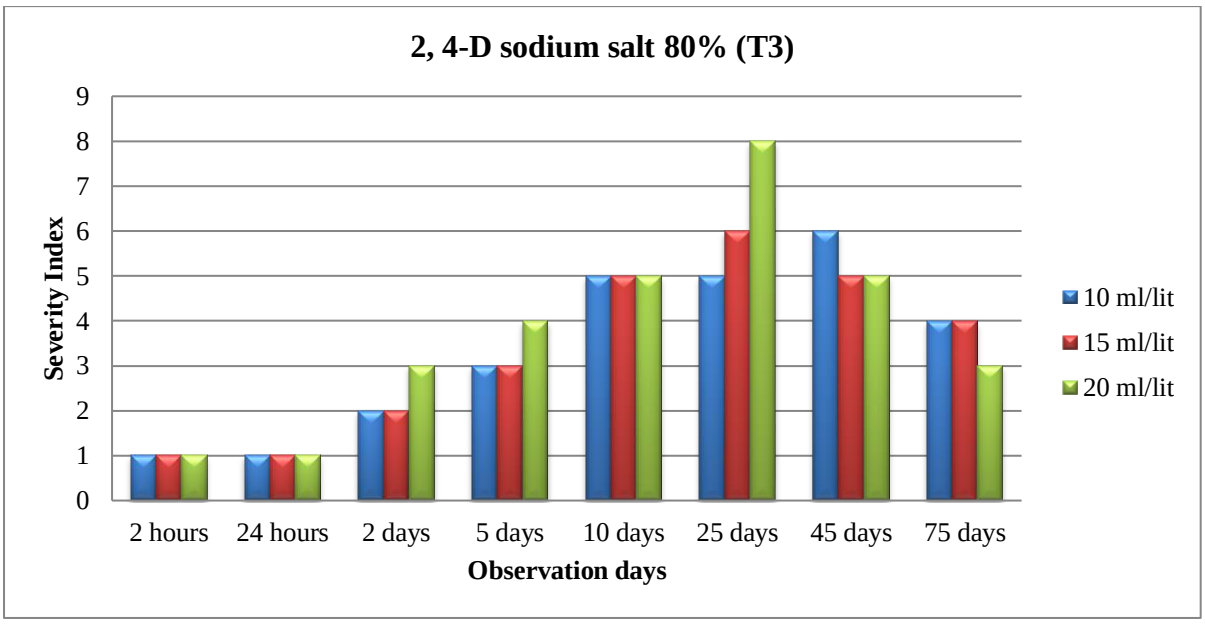

Figure 4. Treatment 3 - 2, 4-D sodium salt 80% (T3) 10ml/L, 15ml/L and 20ml/L severity index in open field areaconsisting Subabul population. Note: 1 - No effect and Little Effect on young foliage; 2 - 25 % yellowing; 3 - 50% leaves turn yellow; 4 - 95% leaf yellowing ;

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few started drying; 5 - Complete (95%) foliage dried; stem still green; 6 - 100% leaves & Terminal branches dried; 10 % stem dried; 8 - 100% leaves &25% stem dried ; no new leaf & 5% new weeds on ground; 10 - 100% leaves &25% stem dried ; no new leaf & no weeds on ground

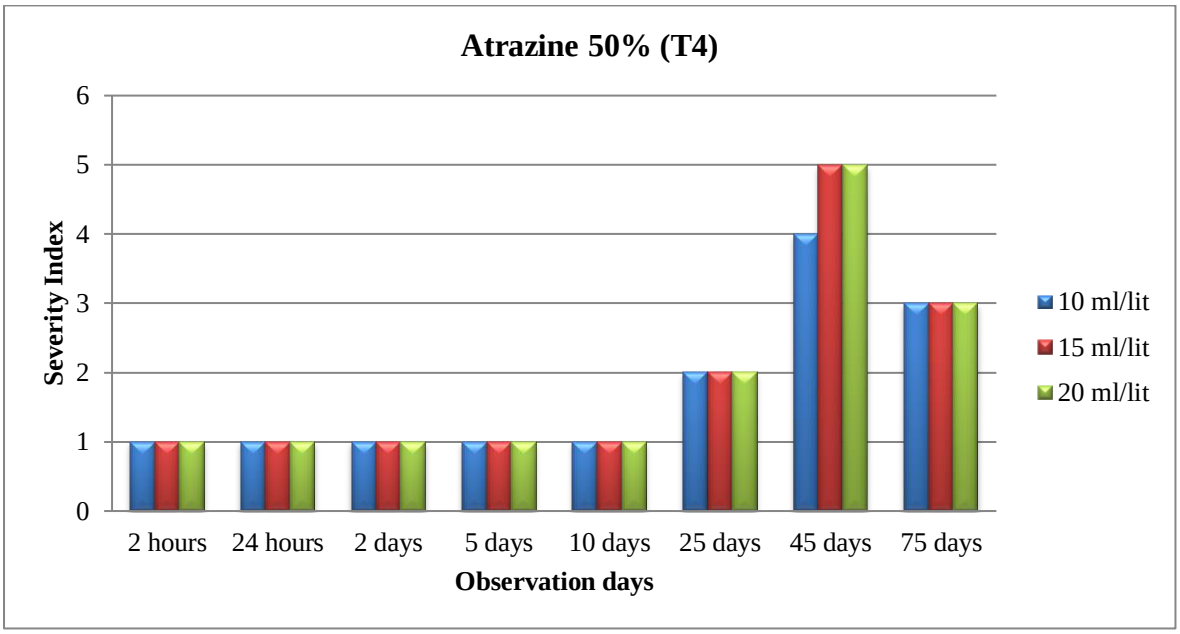

Figure 5. Treatment 4 - Atrazine 50% (T4) 10ml/L, 15ml/L and 20ml/L severity index in open field areaconsisting Subabul population. Note: 1 - No effect and Little Effect on young foliage; 2 - 25 % yellowing; 3 - 50% leaves turn yellow; 4 - 95% leaf yellowing ; few started drying; 5 - Complete (95%) foliage dried; stem still green; 6 - 100% leaves & Terminal branches dried; 10 % stem dried; 8 - 100% leaves &25% stem dried ; no new leaf & 5% new weeds on ground; 10 - 100% leaves &25% stem dried ; no new leaf & no weeds on ground

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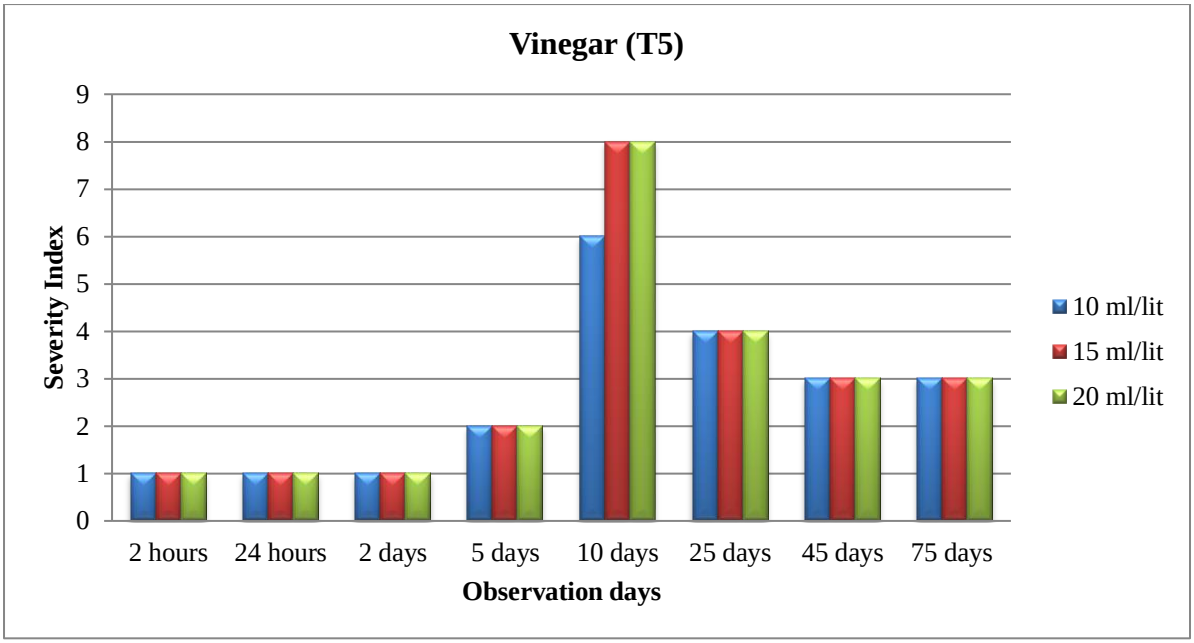

Figure 6. Treatment 5 - Vinegar (T5) 10ml/L, 15ml/L and 20ml/L severity index in open field areaconsisting Subabul population. Note: 1 - No effect and Little Effect on young foliage; 2 - 25 % yellowing; 3 - 50% leaves turn yellow; 4 - 95% leaf yellowing ; few started drying; 5 - Complete (95%) foliage dried; stem still green; 6 - 100% leaves & Terminal branches dried; 10 % stem dried; 8 - 100% leaves &25% stem dried ; no new leaf & 5% new weeds on ground; 10 - 100% leaves & 25% stem dried ; no new leaf & no weeds on ground.

CONCLUSION

The present study aimed to assess the herbicide control and management efficiency of *Leucaena leucocephala*. Markedly available herbicides of Glyphosate, Paraquat Dichloride, (2,4-D), Viniger and Atrazine were employed throughout the study time with various concentrations in R&D estates at KanchanBagh,Hyderabad. Finally, the study showed better Subabul controlling ability with a lower concentration of Glyphosate (41%) in the Randomized Block Design. The HPLC analysis not found any residues of glyphosate. So, near future, we will come up with marketable efficient natural herbicides from the recent output.

Conflict of Interest

There is no conflict between authors.

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