# CONTROL OF LEMON GRASS (*CYMBOPOGON CITRATUS*) IN AN IMMATURE *HEVEA BRASILIENSIS* PLANTATION

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In an experiment to evaluate the efficacy of different methods of control of lemon grass (*Cymbopogon citratus*) weeds in immature rubber plantation, glyphosate spraying at the rate of 3 L/ha (1.2 kg ai/ha) was the most effective and economical treatment. Both uprooting and slashing of lemon grass were uneconomic. Spraying of paraquat 2.25 L/ha (0.54 kg ai/ha) for up to seven rounds within the experimental period of 280 days was not effective.

Key words: *Cymbopogon citratus,* Herbicide, *Hevea brasiliensis,* Weed control.

The control of weeds in immature rubber (*Hevea brasiliensis*) plantations accounts for more than 34 per cent of the total cost of cultivation during that phase (Pothen *et al.,* 1988). Excessive growth of weeds in the plantations affects the growth of rubber plants and causes serious inconvenience for various estate operations like manuring and plant protection (Mathew *et al.,* 1984). Cover crop establishment is also hindered by excessive weed growth. The increasing cost and scarcity of labour may render the manual control measures unviable in the near future (Mani *et al.,* 1989). The possibility of weed control by the application of herbicides in rubber plantations has been demonstrated (Kalam and Punnoose, 1975; Mathew *et al.,* 1977). Chemical weed control methods have the advantages that they do not disturb the soil surface and expose the soil to erosion, and are less time consuming (Mathew *et al.,* 1984). Glyphosate (N – Phosphomethyl glycine) controls most of the narrow-leaved weeds and some broad-leaved weeds in rubber plantations (Mani *et al.,* 1987).

*Cymbopogon* is an important genus of aromatic grasses with about 120 species, of which nearly 27 occur in India (Kumar *et al.,* 1997). They include cultivated, semi-wild and wild species. The chief constituent of the oil extracted from it is citral, which is the starting material for the preparation of cosmetics, perfumes and synthetic vitamin A. The lemon grasses are hardy, grow under a variety of conditions, spread very fast and have become a threat to immature rubber plantations in many locations. Slashing and uprooting have been the traditional method of control of this weed. However, these methods are very labour intensive and expensive. Therefore, an experiment was laid

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out at the Central Experiment Station of the Rubber Research Institute of India at Chethackal, Kerala, with the objective of developing a suitable weed control measure for effective and economic control of lemon grass.

The trial was laid out during 1997 in a five year old immature rubber plantation where the plants were spaced at 4.9 x 4.9 m constituting a plot size of 96.04 m$^2$. There was uniform (100%) infestation of lemon grass at the initiation of the trial.

The trial consisted of seven treatments in a randomized block design with four replications. The treatments were T1 – Uprooting of lemon grass; T2 – Slashing of lemon grass at 10 cm height, T3 and T5 – spraying Glyphosate at a dose of 3 and 2 L/ha respectively; T4 and T6 – Slashing at 10 cm height followed by spraying glyphosate at 3 and 2 L/ha respectively after 20 days, and T7 – spraying Paraquat at 2.25 L/ha.

Commercial products of glyphosate (40% a.i.) and paraquat (24% a.i.) were used for spraying. The herbicides were sprayed on the entire area of the plot with a knapsack sprayer fitted with a flood jet nozzle. Spraying was undertaken at a constant pressure of 1 kg/cm$^2$. All the herbicide treatments were sprayed using 600 litres of water/ha. The dry weight of lemon grass was evaluated prior to treatment imposition and at 280 days after first spraying (DAFS) by cutting the above ground growth from two randomly selected 0.5m$^2$ quardrets in each plot. The cut clumps were oven dried at 75°C to constant weight, which was recorded as dry weight. Re-imposition of the treatments was undertaken as and when regeneration was above 50 per cent and the spray volume was maintained as 600 litres/ha. The evaluation of coverage with lemon grass was done visually on a subjective scale of 0 to 100 per cent depending on the coverage.

Statistical analysis of pre-treatment data revealed that there was no significant difference between plots with regard to the number of clumps in unit area (Table 1). However, when the experiment was concluded at 280 days after first spraying, there were significant differences between treatments and it was observed that uprooting (T1), spraying glyphosate at 2 and 3 L/ha (T5 and T3) and slashing at 10 cm height followed by spraying glyphosate 3 L/ha (T4) were on par and gave very good control. Slashing (T2) which is by far the most popular method of weed control, did not reduce

Table 1. **Effect of treatments on infestation of lemon grass (number of clumps/plot)**

| Treatment | Pre-treatment | Post-treatment* |
|---|---|---|
| T1 Uprooting | 61.50 | 4.00 |
| T2 Slashing | 43.25 | 41.00 |
| T3 Glyphosate 3 L/ha | 48.25 | 0.00 |
| T4 Slashing followed by spraying glyphosate 3 L/ha | 40.75 | 0.00 |
| T5 Glyphosate 2 L/ha | 44.50 | 3.25 |
| T6 Slashing followed by spraying glyphosate 2 L/ha | 49.00 | 28.00 |
| T7 Paraquat 2.25 L/ha | 58.00 | 67.75 |
| SE | 8.19 | 6.67 |
| CD ($P \leq 0.01$) | NS | 9.35 |

Plot size: 96.04 m$^2$; NS: Not significant; * after 280 days the number of clumps in unit area significantly. It was observed that spraying paraquat 2.25 L/ha (T7) was ineffective against lemon grass since the number of clumps per plot increased.

Statistical analysis of pre-treatment data on dry weight of lemon grass revealed that there were no significant differences between treatments (Table 2). However, at the conclusion of the experiment, the treatments namely uprooting (T1), spraying glyphosate at 2 and 3 L/ha (T5 and T3) and slashing at 10 cm height followed by spraying glyphosate at 3 L/ha (T4) were on par and gave lower dry weight of lemon grass due to their effectiveness in controlling the grass. Nevertheless it was generally observed that all treatments caused a reduction in the dry weight of lemon grass as compared to the dry weight at the commencement of the experiment. The general reduction in dry weight could be due to the seasonal differences at the initiation and completion of the experiment.

Statistical analysis of the data also revealed that there were significant differences between treatments at 38 days after first spaying with regard to the coverage of the land with lemon grass (Table 3). It has been observed that T1, T3, T4, T5 and T6 were on par and gave very good control at 38 DAFS. At 80 DAFS only T3 gave more than 50 per cent control of lemon grass. At 203 DAFS T1, T3 and T4 were on par and gave very good control of lemon grass. It has been observed that at 233 DAFS T1, T3, T4, T5 and T6 were on par and gave excellent control of lemon grass. Even at 280 DAFS, treatments T1, T3, T4 and T5 gave excellent control of lemon grass and were on par. It may be noted that T3 needed only one round while T4, T5 and T6 needed two rounds of spraying. The systemic weedicide used may be more easily absorbed and translocated when sufficient foliage is present rather than when sprayed on the regrowth after slashing. The treatments T2 and T7 needed six and seven rounds respectively. For effective control of lemon grass by uprooting (T1), a total of three rounds were needed during the 280 days under observation (Table 4). The frequency at which the treatment T1 had to be re-imposed was initially between 45 to 66 days and the average for the entire period was 93 days. Slashing (T2) needed six rounds and the frequency at which it had to be re-imposed was between 23 to 50 days and the average for the entire period was 47

Table 2. **Effect of treatments on dry weight of lemon grass (g/plot)**

| Treatment | Pre-treatment | Dry weight at 280 DAFS |
|---|---|---|
| T1 Uprooting | 542.75 | 21.52 |
| T2 Slashing | 542.00 | 155.00 |
| T3 Glyphosate 3 L/ha | 556.50 | 0.00 |
| T4 Slashing followed by spraying glyphosate 3 L/ha | 520.25 | 0.00 |
| T5 Glyphosate 2 L/ha | 562.25 | 25.00 |
| T6 Slashing followed by spraying glyphosate 2 L/ha | 600.25 | 100.00 |
| T7 Paraquat 2.25 L/ha | 679.75 | 257.50 |
| SE | 52.41 | 16.62 |
| CD ($P \leq 0.01$) | NS | 49.37 |

DAFS: Days after first spraying; NS: Not significant

Table 3. **Effect of treatments on per cent coverage of land by lemon grass**

| Treatment | Days after first spraying | | | | | |
|---|---|---|---|---|---|---|
| | 38 | 80 | 203 | 233 | 251 | 288 |
| T1 Uprooting | 3.75 | 97.50 | 18.00 | 1.00 | 1.00 | 2.00 |
| T2 Slashing | 78.75 | 100.00 | 58.75 | 62.50 | 40.00 | 57.50 |
| T3 Glyphosate 3 L/ha | 0.00 | 42.50 | 2.00 | 0.00 | 0.00 | 0.00 |
| T4 Slashing followed by spraying glyphosate 3 L/ha | 2.50 | 85.00 | 13.75 | 0.00 | 0.00 | 0.00 |
| T5 Glyphosate 2 L/ha | 30.00 | 95.00 | 28.75 | 5.00 | 1.00 | 3.50 |
| T6 Slashing followed by spraying glyphosate 2 L/ha | 20.00 | 85.00 | 52.50 | 10.00 | 18.75 | 16.25 |
| T7 Paraquat 2.25 L/ha | 100.00 | 85.00 | 72.50 | 70.00 | 60.00 | 68.75 |
| SE | 9.43 | 3.84 | 8.14 | 6.69 | 4.82 | 4.09 |
| CD ($P \leq 0.01$) | 28.01 | 11.42 | 24.17 | 19.89 | 14.32 | 12.14 |

Table 4. **Schedule of re-imposition of treatments**

| Treatment | Days after first treatment imposition (Rounds) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 46 | 90 | 203 | 221 | 235 | 251 | 280 | Total rounds | Average frequency (Days) |
| T1 Uprooting | | II | III | - | - | - | - | 3 | 93 |
| T2 Slashing | II | III | IV | | V | | VI | 6 | 47 |
| T3 Glyphosate 3 L/ha | - | - | - | - | - | - | - | 1 | - |
| T4 Slashing followed by spraying glyphosate 3 L/ha | - | - | II* | II** | - | - | - | 2 | 140 |
| T5 Glyphosate 2 L/ha | - | II | - | - | - | - | - | 2 | 140 |
| T6 Slashing followed by spraying glyphosate 2 L/ha | - | - | II* | II** | - | - | - | 2 | 140 |
| T7 Paraquat 2.25 L/ha | II | III | IV | - | V | VI | VII | 7 | 40 |

* slash ** spray

days. Glyphosate 3 L/ha (T3) needed one round only, while all other glyphosate treatments (T4, T5 and T6) needed two rounds for effective control. Paraquat 2.25 L/ha (T7), even after seven rounds of spraying, was not effective in controlling *C. citratus.*

Economic analysis of the treatments revealed that slashing (T2) incurred a total cost of Rs.9031 for six rounds and was the most expensive treatment (Table 5). Uprooting (T1) incurred a total cost of Rs.7451/ha for three rounds during the 280 days of observation and was the second most expensive of all the treatments. The glyphosate treatments at 3 and 2 L/ha without slashing (T3 and T5) incurred a total expenditure of Rs.1352 and Rs.2103 respectively, while the same doses (T4 and T6)

Table 5. **Economics of different treatments**

| Treatment | No. of rounds of slashing / spraying | No. of mandays / ha / round | Total labour cost (Rs.)* | Cost of chemicals (Rs.)** | Total cost (Rs.) |
|---|---|---|---|---|---|
| T1 Uprooting | 3 | 33 | 7450.74 | - | 7450.74 |
| T2 Slashing | 6 | 20 | 9031.20 | - | 9031.20 |
| T3 Glyphosate 3 L/ha | 1 | 6 | 451.56 | 900 | 1351.56 |
| T4 Slashing followed by spraying glyphosate 3 L/ha | 2 | 26 | 3913.52 | 1800 | 5713.52 |
| T5 Glyphosate 2 L/ha | 2 | 6 | 903.12 | 1200 | 2103.12 |
| T6 Slashing followed by spraying glyphosate 2 L/ha | 2 | 26 | 3913.52 | 1200 | 5113.52 |
| T7 Paraquat 2.25 L/ha | 7 | 6 | 3160.92 | 3087 | 6247.92 |

* At the rate of Rs.75.26/manday; ** Glyphosate : Rs.300/L; Paraquat : Rs.196/L

sprayed after slashing at 10 cm height incurred an expenditure of Rs.5714 to Rs.5114. Paraquat 2.25 L/ha (T7) needed seven rounds of spraying incurring an expenditure of Rs.6248. Glyphosate at 3 L/ha without slashing (T3) was the most economical treatment, which incurred a total cost of Rs.1352 for one round for a period of 280 days.

It can be concluded that *C. citratus* can be controlled in immature rubber plantations economically and efficiently by spraying glyphosate at 3 L/ha. Uprooting and slashing are very expensive and uneconomical methods for controlling *C. citratus* and could be almost 6-7 times more expensive than chemical control.

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