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EVALUATION OF HERBICIDAL ACTIVITY OF GLYPHOSATE WITH LOW COST ADDITIVES

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ABSTRACT

Four additives – kaolin, ammonium sulphate, urea and muriate of potash were tried as additives to glyphosate (N-phosphonomethyl glycine) to enhance its herbicidal efficacy in rubber plantations. Kaolin and ammonium sulphate increased the efficacy of glyphosate, while urea and muriate of potash did not show any pronounced effect. Results showed that glyphosate can be used at a lower dose of 0.62 kg ai/ha compared to the currently recommended rate of 0.82 kg ai/ha if additives, kaolin and ammonium sulphate are used at 2.25 and 1.25 kg/ha respectively resulting in considerable saving of 150 to 175 Rs./ha on cost of herbicide and indirectly helping to reduce the herbicidal load in environment.

INTRODUCTION

Glyphosate (N–Phosphonomethyl glycine) at 0.82 kg a.i./ha controls most of the narrow leaved weeds and some broad leaved weeds in rubber plantations (Mani Jacob et al., 1987) and has been recommended for weed control in rubber plantations from 1987 onwards (Anonymous, 1987). However, because of the high unit cost of Glyphosate formulations currently available, several studies on the feasibility of reducing Glyphosate dosage with additives for effective weed control and thereby also lowering the herbicide load in the environment are made. The effect of several low cost additives like kaolin, ammonium sulphate, urea and muriate of potash in enhancing the herbicidal activity of Glyphosate has been reported by various workers (Blair, 1975; Costa and Appleby, 1986; Purea, 1985; Sharma and Sundar, 1981; Wills and Mc Worther, 1985). Results of one such study on weed control in rubber plantations are reported in this paper.

MATERIALS AND METHODS

A field experiment with 12 treatments replicated thrice in R.B.D. was laid out in the interrow spaces of rubber at the Chittady Estate in Kottayam District in 1986. The individual plot size was $20m^2$. The experimental area was predominantly infested with narrow leaved weeds like *Axonopus compressus* (SW), Beauv, and *Paspalum congutam* Berg. The broad leaved weed spectra consisted of mainly *Borreria ocymoides* DL *Mimosa pudica* (L), *Chromolaena odorata* (L) and *Sida rohmbifolia* (L).

The treatments consisted of Glyphosate alone at 0.82 kg a.i./ha, 0.62 kg a.i./ha, and 0.31 kg a.i./ha. The lower rates of Glyphosate namely 0.62 and 0.31 kg a.i./ha were sprayed in combination with medical grade kaolin at 2.5 kg/ha and fertilizer grades of ammonium sulphate, urea and muriate of potash at 1.25 kg, 2 kg and 0.75 kg/ha respectively. The herbicides were sprayed with an Aspee Knapsack sprayer fitted with a WFN 40 flood jet nozzle at a constant pressure of 1 kg/cm^2 in September, 1986. All the treatments were imposed in 400 litres of water/ha.

The weed flora was evaluated prior to treatment imposition and afterwards at 29

and 64 days after spraying. The evaluation was done visually on a subjective scale of 0 to 100 per cent. Zero denotes complete absence of weeds and 100 denotes complete coverage of weeds.

The data on percentage weed canopy coverage recorded were statistically analysed after transforming the percentage values to values of angles.

RESULTS

The statistical analysis of the pre treatment weed flora distribution showed no significant differences. Weed canopy coverage at 29 days after spraying (DAS) showed significant differences between treatments on statistical analysis. All the herbicide treatments gave significantly better overall weed control as compared to control (Table I). The overall

Table I. *Overall weed canopy coverage after herbicide treatment – Mean per cent*

Treatment	29th day after spraying	64th day after spraying
Glyphosate – 0.82 kg a.i.ha^{-1}	34.15 (31.7)	90.00
Glyphosate – 0.62 kg a.i.ha^{-1}	52.97 (63.3)	90.00
Glyphosate – 0.31 kg a.i.ha^{-1}	65.19 (81.7)	90.00
Glyphosate – 0.62 kg a.i.ha^{-1}+Kaolin 2.5 kg ha^{-1}	36.24 (35.0)	90.00
Glyphosate – 0.31 kg a.i.ha^{-1}+Kaolin 2.5 kg ha^{-1}	49.83 (58.3)	90.00
Glyphosate – 0.62 kg a.i.ha^{-1}+Ammonium sulphate 1.25 kg ha^{-1}	37.12 (36.7)	90.00
Glyphosate – 0.31 kg a.i.ha^{-1}+Ammonium sulphate–1.25 kg ha^{-1}	50.88 (60.0)	90.00
Glyphosate – 0.62 kg a.i.ha^{-1}+Urea 2 kg ha^{-1}	50.97 (60.0)	90.00
Glyphosate – 0.31 kg a.i.ha^{-1}+Urea–2 kg.ha^{-1}	62.40 (78.3)	81.15
Glyphosate – 0.62 kg a.i.ha^{-1}+Muriate of potash–0.75 kg ha^{-1}	56.84 (70.0)	90.00
Glyphosate – 0.31 kg a.i.ha^{-1}+Muriate of potash–0.75 kg ha^{-1}	59.06 (73.3)	90.00
Control – Slash weeding	59.06 (100)	90.00
S. E.	3.55*	2.56
C. D. at 5%	10.41*	..

S. E. & C. D. are for the transformed values *viz*; angles.
Data in parenthesis are the actual percentages.

weed control obtained by Glyphosate at 0.02 kg a.i/ha in combination with 1.25 kg/ha ammonium sulphate and Glyphosate at 0.62 kg a.i/ha in combination with 2.5 kg/ha kaolin were at par. The above two herbicide treatments gave similar overall weed control to that obtained by the highest dose of Glyphosate alone (0.82 kg a.i/ha) and were significantly superior to all other treatments. Glyphosate alone at 0.62 kg a.i/ha was superior to the lowest dose of Glyphosate alone (0.31 kg a.i/ha). The lowest dose of Glyphosate (0.31 kg a.i/ha) with 1.25 kg/ha ammonium sulphate and 2.5 kg kaolin/ha respectively were at par with Glyphosate at 0.62 kg a.i/ha + 2 kg urea. These treatments were significantly superior to Glyphosate alone at 0.311 kg a.i/ha and Glyphosate at 0.31 kg a.i/ha + 2 kg urea in overall weed control. Both the doses of Glyphosate (0.62 kg a.i/ha and 0.31 kg a.i/ha) with 0.75 kg/ha of muriate of potash were at par with the similar doses of Glyphosate alone. However, at 64 DAS no significant differences were obtained in the overall weed canopy coverage by any of the treatments.

DISCUSSION

The relatively lower weed control observed in this experiment with Glyphosate was probably due to the cloudy weather and light showers after the herbicide application. However, the herbicidal activity of Glyphosate was evidently enhanced by the addition of two of the additives namely kaolin and ammonium sulphate. Costa and Appleby (1986) reported that ammonium sulphate could to some extent compensate for the loss in efficacy of Glyphosate spray by immediate rainfall and Suwunnamek and Parker (1975) reported the beneficial effect of ammonium sulphate as additive to Glyphosate in the control of *Cyperus rotundus*. The absorption, retention and release of Glyphosate from the anionic exchange sites of kaolin as postulated by Sharma and Sundar (1981) and abrasive action of kaolin on leaf surfaces (Eveling and Elisa 1976) could be reasons for the enhanced activity of Glyphosate when sprayed with kaolin as an additive. The addition of these low cost additives could reduce the effective dosage of Glyphosate from 0.82 kg a.i/ha to 0.62 kg a.i./ha. Thus saving Rs. 150–175/ha (Table II) is possible when Glyphosate is used for controlling weeds in rubber plantations. The beneficial effect of additives was seen even in the lowest doses of Glyphosate, although overall weed control was not satisfactory at this level. In this experiment, urea did not appreciably increase the activity of Glyophosate contrary to the findings of Purea(1985). Wills and Mc Worther (1985) reported increased efficacy of Glyphosate with potassium ions though this

Table II. *Economics of using additives to enhance the efficacy of Glyphosate*

Treatment	Cost Rs. ha^{-1}	Amount saved Rs. ha^{-1}	Saving on cost (%)	Quantity of herbicide saved kg ha^{-1}	Glyphosate saved in %
Glyphosate 0.82 kg a.i.	720.00*				
Glyphosate 0.62 kg a. i. + Ammonium sulphate - 1.25 kg	545.00*	175.00	24*	0.20	24
Glyphosate 0.62 kg a. i. + Kaolin - 2.5 kg	570.00*	150.00	21	0.20	24

* Approximate cost, subject to change based on prevailing market prices

was not observed in the present experiment. Effect of the two additives, urea and muriate of potash in enhancing the herbicidal efficacy of Glyphosate was not pronounced and the reasons are to be further investigated.

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