EFFECT OF SOIL MOISTURE ON THE EFFICACY OF 2,4-D AND METSULFURON-METHYL ON RUBBER VINE - PRELIMINARY INVESTIGATION

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Summary. In a pot trial metsulfuron-methyl at 0.0045% w/v and 0.009% w/v was more effective in control of rubber vine at all of the four soil moisture levels (ML) imposed (24.2, 38.1 61.2 and 98.5% field capacity (F.C.)) with mortality ranging from 77.8% (24.2% F.C.) to 100% (98.5% F.C.). 2,4-D (0.1% v/v and 0.2% v/v) efficacy was markedly influenced by soil moisture levels with mortality ranging from 0% (24.2% F.C.) to 77.8 (98.5% F.C.). A more complete assessment of the effect of soil moisture content upon the efficacy of herbicide treatment may emerge following the processing of data derived from other components of this work which have yet to be completed.

INTRODUCTION

Rubber vine (*Cryptostegia grandiflora* R.Br) Family: Asclepiodaceae, sub-family: Periplocoideae, is native to Madagascar and is a poisonous woody climber which forms shrubs when unsupported. In Australia, rubber vine is a serious invasive weed of rangeland and native plant communities in North Queensland. It covers an estimated area of 120,000 ha (1), and is spreading at an estimated rate of 1-3% per annum (2).

Dense infestations of rubber vine along watercourses impede access to water for cattle, reduce pasture production, and severely restrict movement of cattle during mustering. Cattle learn to hide in the rubber vine and thus avoid muster.

Estimates of the cost of rubber vine to the North Queensland cattle industry range from five to twenty million dollars per year, and account for the cost of both increased management measures and control measures. The fact that feral and stock animals can hide in rubber vine thickets could have dire consequences through possible outbreak of exotic animal diseases. Where mustering is incomplete, disease control and maintenance of herd quality cannot be achieved.

The efficacy of a range of foliar applied herbicides has been determined in field trials. The level of control is usually less than 100% and is variable. Soil moisture, and thus moisture status of the plants is a factor that is likely to be affecting the efficacy of foliar applied herbicides on rubber vine.

Herbicides shown to be less effective at soil moisture levels below field capacity are: fluzifop (on *Sorgum bicolor* (7)), glyphosate (on *Cirsium arvense* (5)), haloxyfop (on *Sorghum bicolor* (6)), picloram (on *Prosopis glandulosa* (3)) and 2,4-D (on *Phaseolus vulgaris* (6)). However, dicamba (on *Cirsium arvense* (5)), haloxyfop (on *Setaria viridis* (4)), picloram (on *Ulmus alata* (3) and 2,4,5-T (on *Prosopis glandulosa*, *Ulmus alata* (3)) are equally effective over a wide range of moisture levels.

The objective of this project was to measure the effect of soil moisture on the efficacy of 2,4-D (ethyl ester) (Estericide 800) and metsulfuron-methyl (Brush Off) on seedling (17 months) rubber vine.

METHODS

A pot experiment was carried out using black polythene bags (no holes) and an alluvial soil from near Plum Tree Creek, 8km south-east of Charters Towers. The pH (1:5 water) of the soil was 5.8. The field capacity (-0.1 bar) was 29.9% and the wilting point (-15.0 bars) was 9.0%. The soil was sieved through a 2 mm mesh and air dried prior to use. Nine kg of soil was added to each polythene bag (15cm diameter); the soil bulk density was 1.24 g/cm^3.

Rubber vine seedlings (16 months) were transplanted, one to each pot, one month prior to starting the experiment; during this period the pots were watered to 50% field capacity (F.C.) on a daily basis. All pots were placed on outdoor benches with a manually operated rain shelter available to prevent rain falling on the experiment. Four soil moisture regimes (24.2 (ML1), 38.1 (ML2), 61.2 (ML3) and 98.5% (ML4) F.C.) were commenced 30 days before treatment and continued to the end of the experiment (24 months). The fresh weight of each plant was recorded before being placed in each bag as a basis for subsequent weight corrections. Water replenishment of the bags was carried out every 2 to 4 days, after weighing each pot.

The herbicide treatments and the application conditions are shown in Table 1, treatments 1-4 were sprayed in an air conditioned room while treatments 5 and 6 were sprayed in a well ventilated room.

Table 1. Spray treatments.

Treatment Number	Spray Treatment	Rate	Plants[a] per treatment	Application Conditions
1	Control, water only	-	21	
2	Agral 60 only	0.2% v/v	7	25-28°C, 49-67% R.H.
3	2,4-D[b]	0.2% v/v	13	3-7 pm, 21.4.89
4	2,4-D[b]	0.1 % v/v	13	
5	Metsulfuron-methyl[b]	0.009% v/v	13	20-26°C, 65-88% R.H.
6	Metsulfuron-methyl[b]	0.0045% v/v	13	7-11 am, 24.4.89

[a] To allow for destructive sampling.
[b] Agral 60 was added at 0.2% v/v

Immediately after spraying treatments 1 and 2 were removed and placed under the rain-proof shelter. Treatments 3 and 4 were left in the air conditioned room for 5 days so as to minimise any 2,4-D effect on other treatments from the volatility. Nine fluorescent light tubes were used as a supplementary light source during this period. Treatments 5 and 6 were placed on outdoor benches after treatment. All treatments were applied to the point of run-off using a hand held multi-purpose sprayer equipped with a variable spray nozzle.

Seedlings were assessed for herbicide damage using a rating system currently in operation at the Tropical Weeds Research Centre (T.W.R.C., unpublished report). The plants were individually assessed at approximately 30 day intervals. The assessment method relates to a scoring system of 1 to 10; the numbers do not correspond to a uniform numerical increase. Mortality is based on the number of plants receiving a scoring system of 10. The scoring system is as follows:

(1) No effect
(2) Leaf yellowing, up to 50% leaf drop
(3) 50% - 75% leaf drop
(4) 75% - 100% leaf drop
(5) 100% leaf drop, fruit destroyed, twigs damaged
(6) Twigs dead, mid trunk still alive
(7) Mid trunk dead, main trunk still alive
(8) Main trunk damaged, probably will die
(9) Main trunk appears dead
(10)Completely dead, trunk rotted, no reshooting

At each harvest the soil was washed through a 4 and 2 mm sieve (to trap the fine roots) and the number of leaves, leaf area, stem diameter and root length recorded. Each plant was then divided into 3 sections (leaves, stem and roots) and the fresh weight/dry weight of each part determined.

RESULTS AND DISCUSSION

The efficacy of 2,4-D on rubber vine was significantly affected by soil moisture level (Fig. 1). Mortality declined from 77.8% (ML4) to 0% (ML1) as soil moisture level approached permanent wilting point, after 2,4-D application.

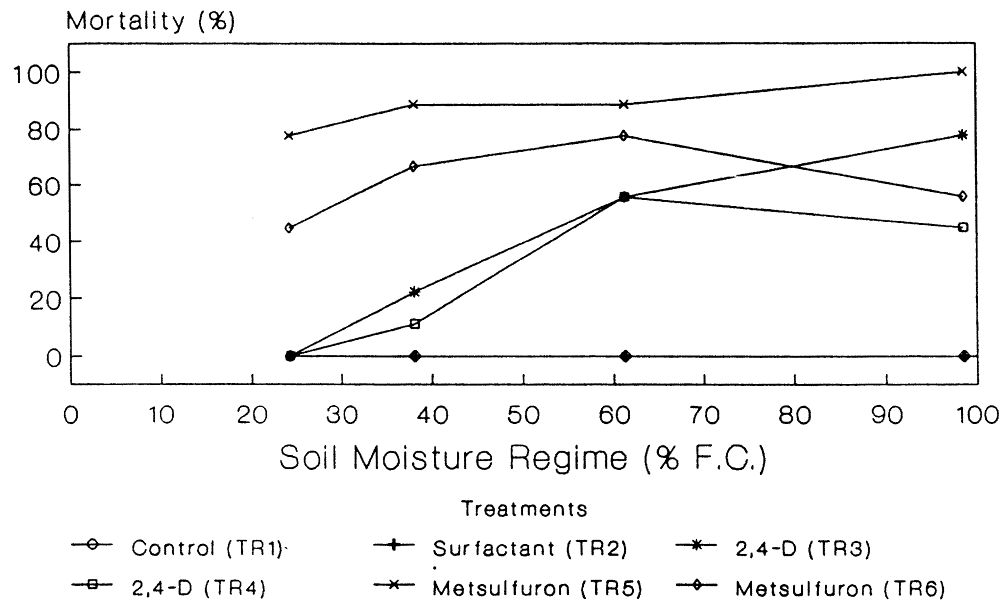

Figure 1. Relationship between mortality and soil moisture regime for all treatments, 187 DAT on *C. grandiflora*.

Metsulfuron-methyl was not strongly influenced in its effectiveness as a herbicide by the soil moisture content. Mortality values of 77.8% and 100% were recorded for the higher concentration of metsulfuron (0.009% w/v), at ML1 and ML4 respectively (Fig. 1). Metsulfuron was more potent as a herbicide compared with 2,4-D. Treatment with surfactant had no significant effect (compared with control) upon the plants, as no mortality occurred at any soil moisture level.

Soil moisture stress has been related to a reduction in efficacy for 2,4-D, 2,4,5-T, picloram, prometryn, and bentazon in a number of herbacious and woody plant species (8, 9). Different species respond differently to herbicide treatment under different moisture regimes and changes in the effectiveness of different herbicides in response to different moisture levels may also vary. From the data presented here, 2,4-D efficacy is more affected by reduced soil moisture than metsulfuron efficacy on rubber vine.

A more complete assessment of the effect of soil moisture content upon the efficacy of herbicide treatment may emerge following the processing of data derived from other components of this work which have yet to be completed. These include:-

1. Leaf area as a possible variable under different soil moisture levels, and possible effects on herbicide uptake.
2. Rates of transpiration under different soil moisture levels and possible effects on herbicide uptake (and translocation).

3. Anatomical differences between leaves under different moisture regimes, with special reference to the cuticle and possible effects on herbicide uptake.
4. Studies of uptake and translocation of herbicides under different soil moisture regimes.
5. Diurnal changes in herbicide uptake and translocation under different soil moisture regimes.

All the above aspects of the work are either under way or planned. The results obtained, when considered in relation to the data presented in this paper, will contribute to a better understanding of the variation in performance of different herbicide treatments used to combat rubber vine. Such understanding is necessry to maximise the effectiveness of the treatment and so offer some hope of eradicating this troublesome weed of grazing lands.

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