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DIESEL OIL USED AS A LEUCAENA ERADICANT

Introduction. You are likely to elicit an undesirable response if you tell a gardener in Hawaii you breed vigorous "haole koas" (leucaenas), unless you are producing seedless types. Shrubby *L. leucocephalas* sprout prolifically in some gardens and lawns. When hoed, they quickly coppice back unless chopped off below the crown. Killing unwanted leucaenas is an important procedure in breeding methods utilizing direct seeding of heavy stands and later roguing (Sorensson, 1989), or plantation renovation. Removing mature stands of leucaenas *sans* bulldozer is a daunting task, however. Control may involve ring-barking, or herbicidal injection. Few if any herbicides match the requirements of an "ideal" leucaena herbicide: 1) Consistently kill with a single application, 2) Have low toxicides to humans or animals, 3) Biodegrade quickly in the soil, 4) Do not move in the soil profile or into ground water, and 5) Are inexpensive.

Evensen (1982, 1984) reviewed methods of chemical eradication of leucaenas. Diatloff (1980ca.) and Motooka (1981ca.) both found 2,4,5-T esters were effective in killing leucaenas. Hammerton (1971) and Hilton and Osgood (1970) both killed leucaenas successfully with 2,4,5-T and picloram.

Evensen tested these and other herbicides (silvex, 2,4-D, triclopyr, glyphosate) on stumps cut 5cm above the ground, or on standing trees (foliar or trunk application) in an augmented RCB design (1982, 1984). The trees tested were *L. leucocephalas* K8 at Waimanalo, Hawaii, with basal diameters ranging from 1.5-5.0cm. Although foliarly-sprayed glyphosate and basally-sprayed 2,4,5-T and silvex in a diesel oil carrier killed all test trees, diesel oil alone was equally effective when applied to cut stumps (it was not tested as a foliar herbicide). The toxic action of diesel oil was nonsystemic and did not kill tissue below the area of application. This meant that if not applied liberally to the stump base, branches regrew from buds in the crown.

Over the past few years, diesel oil has been used many times to kill leucaenas at Waimanalo. Success rates were high on stumps cut from mature trees, but poorer on stumps cut from smaller trees, on stumps with coppice regrowth, or on young trees (50-200cm ht.). This study was designed to isolate the conditions under which diesel oil is not effective as an eradicant: 1) Does percentage of stump kill vary with the number and size of basal branches or trunks, 2) Does diesel oil have to be applied immediately to stumps after they have been cut, and 3) Is diesel oil an effective herbicide for seedlings?

Materials and Methods. Two experiments were conducted in the early summer of 1989 under field conditions at the Waimanalo Experiment Station on Oahu, Hawaii:

Experiment 1: Treated Stumps (152 total). Trees tested included *L. leucocephalas* K8, diploid *L. diversifolia* (K480 x K409), and hybrids of *L. diversifolia* K156 x *L. leucocephalas* K8 (KX3). Trees were cut with a chain saw to heights of 5-18cm above the ground. Diesel oil was sprayed liberally (60-80ml/stump) with a backpack sprayer.

Experiment 2: Treated seedlings (181 total), coppiced seedlings and small trees (42 total) and coppiced stumps (8 total). Trees tested included common and giant *L. leucocephalas* grown from open pollinated seed. Young seedlings (3-4 leaf stage) were each sprayed with about 10ml of oil. Larger seedlings were each sprayed with about 25 ml of oil. Most of these had been coppiced two months prior to the study with hand sickles. Stumps with coppice regrowth were each sprayed with 50-200ml oil, depending on the extent of regrowth.
Results and Discussion. Experiment 1. Spraying diesel oil on stumps of mature trees the same day as chainsawing caused high rates of stump mortality (86-98%; Table 1). In the largest group of stumps (58 trees), three of the four remaining live stumps appeared to have been missed with spray; perhaps because it was difficult to locate them under felled trees. It is for this reason that Table 1 lists the mortality rates as minimums. Sprays applied one day late appeared to be less effective (69% kill). Numbers of trunks/tree and trunk diameters do not appear to be positively correlated with the stumps which did not die.

The differences between shoot regrowth from unsprayed (missed) stumps and those treated with oil was striking. Numbers of shoots/stump, and average length of shoot growth of sprayed stumps were less than half that of untreated stumps one month after the date of oil application. Long-term growth rates from these partially killed stumps were not determined, but will probably be less than that of untreated stumps.

Table 1. Leucaena stump mortality rates with diesel oil application. Stumps were sprayed within 3-5 hours of cutting the trees unless asterisked. Ratios of unskilled trees to those believed to have been missed with diesel oil are shown in parentheses.

<table>
<thead>
<tr>
<th>Tree Type</th>
<th>Total No. of Stumps</th>
<th>Tree Age yrs</th>
<th>Trunks/stump Killed mean</th>
<th>Trunks/stump Alive mean</th>
<th>Trunk Diameter Killed cm</th>
<th>Trunk Diameter Alive cm</th>
<th>Minimum Percent Kill</th>
</tr>
</thead>
<tbody>
<tr>
<td>L. diversifolia</td>
<td>32(4/0)</td>
<td>5</td>
<td>1.7</td>
<td>1.0</td>
<td>5.8</td>
<td>3.2</td>
<td>87.5</td>
</tr>
<tr>
<td>DIVxLEU (*&quot;KX3&quot;)</td>
<td>27(5/2)</td>
<td>4</td>
<td>1.4</td>
<td>1.4</td>
<td>10.2</td>
<td>9.3</td>
<td>81.5</td>
</tr>
<tr>
<td>L. leucocephala</td>
<td>22(3/0)</td>
<td>5</td>
<td>1.0</td>
<td>1.0</td>
<td>10.0</td>
<td>6.7</td>
<td>86.4</td>
</tr>
<tr>
<td>L. leucocephala</td>
<td>58(4/3)</td>
<td>3</td>
<td>1.8</td>
<td>3.0</td>
<td>11.0</td>
<td>13.0</td>
<td>98.2</td>
</tr>
<tr>
<td>L. leucocephala*</td>
<td>13(4/1)</td>
<td>3</td>
<td>1.6</td>
<td>1.0</td>
<td>7.1</td>
<td>10.5</td>
<td>69.2</td>
</tr>
</tbody>
</table>

* Sprayed with oil one day after chainsawing.

Experiment 2. Applying diesel oil to seedlings of various ages, with or without management, resulted in a range of mortality rates (27-75%; Table 2). Most young seedlings (3-5 true leaf stage) were killed (96%); the few remaining live seedlings had weak regrowth from their bases. Most larger seedlings cut off at the base and treated with oil were killed (96%). Mortality rates were lower in unmanaged larger seedlings (61%) and in unmanaged small trees (27%). Both groups of unmanaged seedlings had live cambium but relatively few leaves 40 days after spraying. The trend of poor effectiveness of diesel oil when applied to uncut seedlings was largely reversed (75% kill) when stumps with coppice regrowth were treated. This was surprising considering the vigor and number of shoots regrowing from some of the stumps (Figure 1). Forty days after spraying, growth of resprouting leucaena seedlings next to oil-treated stumps looked normal, suggesting the long-term effect of oil on soil fertility was low. The relatively high volatility of diesel oil compared to most other oils probably contributed to its minimal impact on soil fertility. Potential problems caused by high volatility include the applicator breathing oil fumes during spraying, and the oil volatilizing off plant tissues before reaching its full toxic effect.

Conclusions. Diesel oil was an effective eradicant on leucaena seedlings at the 3-5 leaf stage (96% kill), as well as for freshly cut leucaena stumps whose basal diameters ranged from less than 1cm to over 20cm (82-98% kill). A one-day delay in spraying stumps reduced kill rates by 16%; however, the sample population was small (13 trees).
Diesel oil was a surprisingly effective eradicant when applied to stumps with coppice regrowth, even to stumps with vigorous and extensive regrowth (Figure 1). Even so, it is probably inefficient and dangerous to apply diesel oil foliarly to coppice regrowth due to the large spray volumes used and to spray drift. Further tests should be made to determine if applying diesel oil only at the base of such stumps will cause the stumps to die.

Figure 1. Leucaenas which are difficult to kill with diesel oil. Seedlings like the one shown at the left (20cm ht.) appear to be two times more difficult to kill with diesel oil than the coppiced stump shown on the right (45 cm ht.). Psyllid attacks to the stump shoots have caused the leaves to deform.

Table 2. Percentage kill of leucaenas varying in age and management when sprayed with diesel oil. Seedlings cut off near ground level were sprayed within one-half hour after the seedlings were cut. Numbers of trees believed to have been missed with diesel oil are shown in parentheses.

<table>
<thead>
<tr>
<th>Tree Type</th>
<th>Mean Basal Dia. (mm)</th>
<th>#Killed</th>
<th>#Alive</th>
<th>Minimum Kill %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seedling (3-5 true leaf stage)</td>
<td>3</td>
<td>48</td>
<td>2 (1)</td>
<td>95.7</td>
</tr>
<tr>
<td>Seedling cut 2cm above ground level</td>
<td>10</td>
<td>96</td>
<td>4 (1)</td>
<td>96.0</td>
</tr>
<tr>
<td>Seedlings (25cm ht.) with foliage</td>
<td>10</td>
<td>19</td>
<td>12 (0)</td>
<td>61.3</td>
</tr>
<tr>
<td>Small trees (50-120cm ht.) with foliage</td>
<td>17</td>
<td>3</td>
<td>8 (1)</td>
<td>27.3</td>
</tr>
<tr>
<td>Stumps with regrowth to 40-100cm ht.</td>
<td>80</td>
<td>6</td>
<td>2 (1)</td>
<td>75.0</td>
</tr>
</tbody>
</table>

Mortality rates were fair (61%) when diesel oil was applied to above-ground parts of medium-sized
(25cm ht.) seedlings, and poor (27%) when similarly applied to larger (50-120cm ht.) trees. Although leaves could have prevented some oil from reaching the trunk and branches of these seedlings, the oil was probably applied too liberally for this to account for the low kill rates. Probably the reason for poor kill rates of large unmanaged seedlings is that the bark of these seedlings is alive and rather oil repellent. Bark of older trees, and that of the bases of cut seedlings, soaks up and retains the oil which probably enhances the toxic effect.

Diesel oil is effective for eradicating freshly cut stumps. Oil is cheaper and less dangerous to applicators than most tree herbicides, although its application is not free of health hazards. Kill rates approach 100% when stumps are liberally sprayed soon after chainsawing. The biggest reason for the failure of this method may be due to the difficulty in locating stumps or completely spraying stumps which are obscured by felled trees or matted weeds.

Stumps with light coppice regrowth can probably be effectively killed with a second application of diesel oil. Heavy regrowth, however, is probably best controlled with glyphosate ("Roundup", 1.5% V/V water) sprayed foliarly (Evensen, 1982).

References:


Hammerton, J.L. 1971. Weed control work in progress at the Univ. of the West Indies. Control of woody shrubs. PANS 12(2):229.

