EVALUATION OF A NEW TECHNIQUE FOR HERBICIDAL TREATMENT OF MYRICA FAYA TREES

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Among the many exotic plant species occurring within Hawaii Volcanoes National Park, the firetree (Myrica faya Aiton) is well recognized as being among those which pose the greatest threat to the composition of the Park's native ecosystems. Because of its demonstrated ability to quickly and aggressively become established in many Park habitats occurring roughly between 2000 and 4000 feet elevation, and since its current abundance is such that the species threatens to exceed the limits of practical control, high priority has been placed by resource management personnel upon developing efficient eradication methods. The present exotic plant control program, which is directed largely at the firetree, involves direct uprooting of smaller individuals and spraying the stems or trunks of larger plants with a diesel-Kuron (silvex) mixture, often facilitated by cutting into the bark. Large trees are routinely cut down and their stumps treated with the herbicide mixture to prevent resprouting. While herbicide treatment in this manner has proven to be effective in killing trees, certain disadvantages are also inherent in this method:

1) Diesel as a solvent for Kuron is in general more difficult to obtain and to work with in comparison with water. Application equipment is difficult to clean following use as is the protective clothing of the workers themselves. Accidentally spilled material presents greater cleanup problems.

2) Storage of large quantities of diesel presents a potential fire hazard.

3) The herbicide must be sprayed entirely around the lower tree stem for best results, often in combination with stem scoring. Access to the complete circumference of the stem is often limited by bushy lower growth, heavy surrounding vegetation, or rough terrain.

4) The spraying process inevitably results in accidental spray contact with native vegetation types growing close to target trees. Care that must be taken to avoid such contact lessens the efficiency of control work. Firetrees in some habitats are often associated so closely with 'ohi'a trees that effective treatment of the exotic without affecting the native tree is extremely difficult.

5) Although spraying is generally limited to the lower stem as compared to the entire crown, rather large quantities of herbicide solution are required per tree. Transporting such quantities to remote areas of infestation is often costly.

To define and evaluate possible alternate methods of chemical control of M. faya, the herbicide Roundup (a product of the Monsanto Company) was selected for testing. Although at the time experimentation was begun Roundup had not been approved for routine application in a park exotic plant control program, the lack of approval was due to the relatively recent entry of the product on the market rather than to any demonstrated undesirable qualities. Roundup has since received this approval and is in use in the Park's efforts to control infestations of the exotic fountain grass (Pennisetum setaceum).

Qualities of Roundup which led to its consideration were its demonstrated systemic activity in target plants other than M. faya and the relative ease with which it is handled due to its water solubility. The current higher cost of the product compared to diesel-Kuron on an equal volume basis presents a recognized disadvantage to its use. This factor is the basis for the non-use of Roundup by the State of Hawaii Exotic Plant Control Division in M. faya control. Another product, Tordon 22K, which is available for use by the State gives satisfactory control (Walters & Null 1970; Robert Kami, Noxious Weed Specialist, Hawaii State Department of Agriculture, pers. comm.). A mixture of Tordon 212 and 2,4,5-T amine has also proven effective in killing firetree in Hawaiian state forest reserves (Kim 1969).

The above-mentioned ease with which Roundup is taken up and translocated offers potential for use through methods other than those conventionally utilized. The advantages of such techniques may include reduction in time and effort required per treated tree, ability to transport equipment and material to treat trees in difficult to reach areas, and avoidance of damage to other vegetation in the vicinity of the target tree.

MATERIALS AND METHODS

The Byron Ledge area of Hawaii Volcanoes National Park was selected as a suitable study area due to its accessibility and the large number of firetrees growing in a relatively open area unencumbered by heavy undergrowth.

Trees for the preliminary tests fell within a size range from approximately 1.5 m high and 2 cm basal diameter to 2.5 m and 4.5 cm. One branch per tree of approximately 0.75 to 1 cm diameter, depending upon tree size, was clipped off and a small plastic vial containing 20 ml of either 0.5, 1, 2, 5, or 10% aqueous Roundup solution was attached to the cut branch end of each tree such that the cut surface extended through a hole cut

in the vial cap and was immersed in herbicide solution. Actual amounts of solution absorbed by each tree were not determined since initial attempts at sealing the vials upon the branches often allowed leakage to occur. Results of these tests indicated, however, the feasibility of killing firetrees with Roundup through a single application point. In subsequent tests, treatment variables including dosage in relation to tree size, growth form of the tree, and effect of position of application on the tree were considered. Other factors such as influence of phenological or seasonal states upon treatment time were considered, although the observed lack of distinct dormant and growing seasons among trees in the study area resulted in less emphasis being placed upon the latter.

Thirty-two test trees were selected and separated into two size classes: the smaller ranged from 16.3 cm basal circumference to 25 cm and from 2.55 m tall to 5 m; the larger included basitone growth forms (several equally large branches at the base), and heights up to 6.5 m. Crown cover (bushiness) was also visually evaluated as a size class factor.

Four treatment locations upon trees were selected and test trees were further placed into categories accordingly: the upper portion of the crown; the lowest branch of suitable diameter on the mainstem (or of a major branch in a basitone tree); distal from the mainstem (the treatment branch was clipped off no less than 90 cm from the mainstem); proximal (the branch was clipped as near the mainstem as possible). Two herbicide concentrations, 2 and 5%, were superimposed upon the size and treatment location categories. These concentrations were selected on the basis of preliminary test results as reasonable experimental dosages.

Fifty-ml syringe barrels from which the plungers had been removed were fitted to lengths of bicycle inner tubing such that the rubber was stretched over the larger barrel opening. The cut branch end of each treated tree was inserted into the syringe barrel through the tube section immediately following clipping and the rubber was tightened securely around the branch with a screw-clamp. Petroleum jelly was also applied around the clamped area to insure the seal. The combined volume of the syringe barrel and rubber tubing was approximately 60 ml after displacement by the approximately 1 cm diameter cut branch.

The syringe barrel attached to each tree was filled with the appropriate Roundup concentration immediately upon the attachment of the latter to the cut branch. The herbicide was introduced with a 50-ml syringe provided with an 18-gauge needle. All trees of this experiment were treated in February 1978.

A test to determine the effectiveness of undiluted Roundup relative to that of 2 or 5% aqueous dilutions was conducted simultaneously with the latter. Smaller (12-ml) syringe barrels were sealed to freshly cut branch ends of trees with waterproof silicone rubber caulking compound. Trees of similar size range to those described above were selected. Proximal or distal

treatment locations were again chosen for each tree and the position of application along the mainstem axis was again considered.

Trees were treated with either 1.2 or 3 ml of undiluted herbicide, the equivalent amount of 60 ml of 2 and 5% dilutions, respectively. Periodic observations were conducted and treatment results were recorded in May 1978.

RESULTS AND DISCUSSION

Reactions to treatment of firetrees with Roundup by the above-described methods varied from slight effects to complete death of trees. The results of the 2 and 5% dilution treatments are summarized in Table 1.

Although variation existed among individual trees, these results indicate a trend toward increased effectiveness among those trees treated through a lower branch cut near the mainstem. The latter treatment resulted in general death of the tree with most branches being affected, whereas treatment in an upper distal location usually resulted only in localized death. Movement of the herbicide throughout the tree was evident only through limited terminal dieback of other branches. Basitone trees were more difficult to treat effectively through single-site herbicide introduction than were trees with dominant mainstem growth forms since the former required substantial downward movement of the herbicide through the treated branch to reach the vascular system of the other major branches. The apparent greater efficiency of herbicide distribution in an upward direction indicated a close correlation with xylem transport of water and in some instances a high degree of early selection for individual branches along the mainstem.

Variation in rates of diluted herbicide absorption was noted among individual trees. Complete absorption of the entire 60 ml quantity occurred among some trees within 2 days, although most required somewhat longer for complete uptake. A few trees (Table 1) never completely absorbed the available amount during the test period. Dosage comparisons involving the latter trees are therefore difficult to make, although effects of the solution amounts actually taken up were noted.

Trees treated with small quantities of undiluted Roundup reacted in a manner comparable to that described for Roundup dilution treatments. Again, herbicide introductions proximal to the mainstem and in the lowermost possible position tended to be most effective, although variation in percentage of death among individual trees was again noted, presumably resulting largely from inconsistencies in effectiveness of internal vascular connections. Complete absorption of undiluted Roundup quantities into fresh cut branch ends was markedly and uniformly rapid,

usually requiring only a few minutes. In contrast to tests utilizing Roundup dilutions, in no case did undiluted Roundup remain unabsorbed.

To discover the extent to which firetrees were able to absorb undiluted Roundup, 12-ml syringe barrels or sections of half-inch inside diameter rigid-walled plastic tubing were sealed to cut branch ends of smaller and larger trees, respectively, with caulking compound. These containers were regularly replenished with quantities of herbicide such that during a 45-day period in excess of 100 ml of Roundup were absorbed by each smaller tree and in excess of 300 ml by each larger tree over a 32-day period. Rapid uptake continued even after portions of trees near treatment areas had developed severe visual signs of poisoning. These results dispel former concerns that attempts to introduce concentrated Roundup through a single cut branch may cause immediate death of the branch with subsequent inhibition of further uptake, resulting in ineffectiveness of the treatment method.

Treatment with undiluted Roundup therefore offers no apparent disadvantage compared to the use of various dilutions, whereas the relatively small quantities required per tree and rapid absorption of the former through a single treatment site present obvious advantages. In no case was a tree killed or severely affected by either a diluted or an undiluted Roundup treatment observed to show any regenerative activity through root or lower stem sprouting.

Further experimentation emphasizes determination of effective treatment methods and herbicide quantities for trees larger than those here described and for those growing in other Park elevations and habitats. Also, alternate methods for effective treatment of trees unsuitable for the cut branch method are under investigation.

LITERATURE CITED

Kim, J. Y. 1969. Myrica faya control in Hawaii. Down to Earth 25(3): 23-25.

Walters, G. A., and W. S. Null. 1970. Controlling firetree in Hawaii by injection of Tordon 22K. USDA Forest Service Res. Note PSW-217.

TABLE 1. Effects of Roundup absorbed through cut branch ends of firetrees.

Tree size class & herbicide concentration	Lower Proximal	Lower Distal	Upper Proximal	Upper Distal
Large				
2%	4, 7[a]	4, 3	3, 1	1, 3
5%	8, 9	6, (5)[b]	3, (2)	1, (2)
Small				
2%	10, 2	4, 3	1, (2)	2, 1
5%	9, 10	9, 4	2, 4	2, 9

[a] a number scale from 0 (unaffected) to 10 (completely dead) indicates the approximate degree to which each tree was affected.

[b] parentheses indicate a lack of complete absorption of herbicide solution from the container. In all other cases the solution (approx. 60 ml) was completely taken in by the tree.