Chemical Control of Anabiong in Forest Plantations

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A weed is a plant that is out of place, a plant growing where it is desired that something else should grow, or a plant whose potentialities for harm is more than its potentialities for good. It can be a grass, vine, shrub, tree or any plant (Ahlgreen, Klingman and Wolf, 1961.) In Forestry, a weed tree is one that has no known value or it may be a useful tree but growing in a place where it is not supposed to grow.

Anabiong (*Trema orientalis* Linn. Blume) is in that category. The wood can be used for wallboards (Lopez, 1953) and for pulp but this tree usually grows in the plantations, competing with the favored species. In many instances, it dominates the planted trees. It grows and reproduces very fast. It is surprising indeed how fast and thickly it grows even if there are no mother trees in the vicinity (Figure 1).

No previous studies have, as yet, been made on how to control this species. Consequently, something should be done. There should be a way by which this species can be controlled. This study was conducted to determine its response to 2, 4 -- Dichlorophenoxyacetic acid, popularly known as "2, 4-D".

REVIEW OF LITERATURE

"2, 4-D" is widely used in the United States and other countries as a tree poison (Brinkman, 1959; Grano, 1956; Halls and Burton, 1951; Jemison, 1949; McQuilkin, 1957; Peevy, 1951; Stephenson and Gibbs, 1959; Walters, 1959).

In the Philippines, 2, 4-D as a tree poison was first tested in 1959 when the study reported in this paper was made. It was also in 1959 when it was first tested as a vine poison. Between 1959 and at this writing (September, 1964), a few experiments have already been conducted on the use of 2, 4-D in the control of weed tree species. The results are briefly discussed below:

Busa (1959) tested the effectivity of 2, 4-D on Uoko (*Mikamia scandens* Willd.), which is a weed vine that is both a creeper and a climber, using three concentrations, *i.e.*, 1/2, 1, and 2 ounces per gallon of water. The solutions were sprayed over several plots at the rate of 1/4 to 1/3 gallon. All the solutions were effective although the killing period varied with the concentration. The 1/2 ounce concentration exterminated the vines on the 10th day after application and the 1- and 2- ounce concentrations on the fifth and third day, respectively. There was no regrowth of the vines.

Bikal stems (*Schizostachyum diffusum* Blanco, Merr.) were affected when treated with four different concentrations (1, 2, 3, and 4 ounces per gallon of diesel oil) of 2, 4-D (isoproyl ester). All the affected bikal stems, however, recovered. This suggested that 2, 4-D was effective on bikal but a higher concentration was needed (Baniqued, 1960).

A few species of *Ficus* were also treated with 2, 4-D and 2, 4, 5- Trichlorophenoxyacetic acid (2, 4, 5-T) by Seguritan (1960) in a few studies conducted in the Makiling Forest. The main study involved treatment of hagimit [*Ficus minahassae* (Teijsm,. & De Vr.)] of various sizes with 1% (by weight) solutions of 2, 4-D (isopropyl ester, 3.34 lbs. acid equivalent per gallon) and 1% (also by weight) of 2, 4, 5-T (butoxy ethanol ester, 4 lbs. acid equivalent per gallon), using diesel oil as carrier. These solutions were applied in frills and in basal sprays. He found out that after 22 weeks, 2, 4, 5-T at 1% concentration was effective (90% kill) but 2, 4-D with the same concentration was not (only 3% kill). For hagimit, the frill method of application was more effective (100% kill) than the basal spray method (80% kill).

Seguritan's supplementary studies showed very promising results: (1) 2, 4-D was effective as a basal spray on hagimit when the concentration was raised to 8 per cent; (2) 1 per cent solution of 2, 4, 5-T was effective as a basal spray on malatibig (*Ficus congesta* Roxb.) and (3) small-and large-leaved balete trees (*Ficus* spp.) of small or medium sizes could be killed using 2, 4-D and 2, 4, 5-T in diesel oil solutions at 1 per cent and

2 per cent concentrations but concentrations higher than 2 per cent seemed necessary for very big trees.

For a detailed review of literature and an annotated bibliography on chemical control of vegetation in Forestry (as of 1959), Gerardo's work (1959) is very useful.

No studies have yet been made on the control of anabiong in forest plantations or in other areas.

MATERIALS AND METHODS

Materials

Description of 2, 4-D. — 2, 4-D is a synthetic plant hormone capable of killing or greatly retarding growth of some plants. It is usually absorbed into the leaves or stems but also enters through the roots. It tends to accumulate at places like the growing tips or roots where sugar is being used or stored. Once inside the plant, it is translocated to all parts of the plants. Physiological processes are also interrupted (Dahms and James, 1950; Frear, 1948).

The pure 2, 4-D acid is only slightly soluble in water and in petroleum oils. It should, therefore, be changed into a salt formulation. The following are its most common formulations: sodium salts, amine salts, ammonium salts, ester formulations and dusts. The ester formulations are generally considered the most toxic to plants. These formulations are usually sold as liquids which form emulsions with water and other carriers. They are synthesized by the reaction between 2, 4-D acid and an alcohol, with the elimination of one molecule of water. The name of the formulation is identified by the name of the alcohol, *i.e.*, methyl ester, isopropyl ester, etc. (Ahlgreen, Klingman, and Wolf, 1951).

Methods

Selection and preparation of materials.—Healthy anabiong trees used in the study were selected in the plantations in the Makiling Forest. They were within four diameter classes, with mid-points of 10, 20, 30, and 40 cms. Each diameter class was represented by 30 trees making a total of 120 trees. Every tree was marked with two numbers, one for the diameter class and below it was the number of the tree in that diameter class.

Three clean gasoline cans were each filled with a gallon of diesel oil. Then, by the use of a graduated cylinder, three measurements of an emulsible concentrate of isopropyl ester of 2, 4-D containing 3.34 lbs. 2, 4-D acid equivalent per gallon were made, *i.e.*, 1, 2, and 3 ounces. Each of these was mixed with the diesel oil contained in each of the cans. These were the solutions with different concentrations that were used in the study.

Experimental Design. — The study was a two-factor experiment with tree size (diameter) as the main factor and concentration of solutions as the other factor.

The 30 trees of the 10 cm. diameter class were divided into three groups of 10 each. One group was treated with the solution having the first concentration, another group with the second concentration, and the last group with the third concentration. The same was true with the trees belonging to the other three diameter classes. To avoid biased results, the allocation of the trees to each of the concentrations was done by drawing lots to attain randomness.

Application of solutions. — The frill method of application was used in this sutdy. The tree was encircled with a single row of overlapping bolo cuts deep enough to penetrate a short distance into the wood. The frills had about 45° angle from the axis of the tree and were made as uniform as possible in depth by exerting a uniform force to every stroke of the bolo. The solution was introduced into the wood through these frills by means of a tin can oiler with a spout. The spout was inserted a little in a frill, then pressure was applied at the back of the can and stopped only when the frill was saturated and the solution was about to drip. The amount of solution applied to each tree was, therefore, about the same per unit tree circumference.

Data Collection. — The trees were visited once a week after application of the solution until the 24th week when all the trees were already dead.

For each tree, the date at which the effect of the poison was first noticed, like wilting of a few leaves of twigs on the bole or in the crown, and turning of the bark of the trunk or roots to red, was recorded. A tree was said to be completely killed when all the leaves, the bark of the trunk and roots had become dried. The roots examined were those exposed on the soil surface. The number of weeks the solution took to affect each tree (pre-killing period) and the number of weeks it took to completely kill each tree (killing period) were the data gathered for analysis.

Data analysis. — The data were analyzed by the analysis of variance method. The degrees of freedom for each variable were partitioned into their components to allow orthogonal comparisons of treatments within each variable.

FIG. 1. Natural stand of young anabiong trees in an open area where there were no other trees around.

FIG. 2. Anabiong trees, 16 weeks after treatment with 2, 4-D showing the conditions of the crowns of the 10 cms. and 40 cm. diameter trees.

FIG. 3. The frilled trunk of a 10 cm. diameter tree showing the condition of the bark at 16 weeks after treatment with 2, 4-D.

FIG. 4. The frilled trunk of a 20 cm. diameter tree, 16 weeks after treatment with 2, 4-D.

FIG. 5. The frilled trunk of a 40 cm. diameter tree, 16 weeks after treatment with 2, 4-D.

RESULTS AND DISCUSSIONS

The results of this study are summarized in Tables 1 and 2. The analyses of variances are summarized in Tables 3 and 4.

a. *Effects of 2, 4-D.* — The trees took an average of 5.57 weeks (39 days) to be affected by the poison (Table 1).

Table 1. Average number of weeks between date of application of 2, 4-D and date of occurrence of first damage to trees (pre-killing period). Bases of means: 10 trees for each combination of diameter class and concentration, 30 trees for each concentration, and 40 trees for each diameter class.

Concentration (oz./gal.)	Diameter classes, cms. 10	20	30	40	All diameter classes
1	5.5	5.1	5.7	8.9	6.3
2	3.4	5.6	4.6	11.5	6.3
3	1.3	3.4	3.7	8.1	4.1
All Concentrations	3.4	4.7	4.7	9.5	5.57

The first sign of the effect of the poison was the wilting and dropping of the leaves of the small twigs at the bole of the trees. Then the crown became less dense. In some cases, there was a gradual decrease in crown density until all the leaves dropped. In other cases, shortly after crown density decreased, all the remaining leaves had wilted and dropped at about the same time. Sometime after the effect of the poison on the leaves was noticeable, the bark and/or the roots began to be affected by first turning to a red color inside and eventually had become dried and haa peeled off (Figures 3 and 5).

In cases where the treated trees were not affected early, the diameter of the tree above the frills became larger than the diameter below the frills (Figure 4). This is logical considering the passage of food materials in the tree. The raw food materials from the roots pass through the xylem to the leaves and the manufactured foods pass through the phloem from the leaves to all parts of the tree. Since the solution was not injected or introduced completely into the sapwood and the bark (at the frills) was completely saturated with the solution, it is logical to assume that at the early period of killing, the raw materials from the roots were able to pass to the leaves and the manufactured foods could not go down bleow the frills. As a result, the base below the frills was starved so that it had ceased to grow while the trunk above the frills continued to grow because it had the manufactured foods to use.

In a few cases, sprouting occurred below the frills near the ground during the middle part of the observation period. However, in all sprouting cases, all the sprouts had died shortly after the roots began to be affected by the poison by turning red.

After application, the poison took an average of 19.3 weeks (135 days) to kill the trees (Table 2). At the end of the 24th week after application, all the treated trees were already dead.

Table 2. Average number of weeks between date of application of 2, 4-D and date of complete killing of trees (killing period). Bases of means: 10 trees for each combination of concentration and diameter class, 30 trees for each concentration, and 40 trees for each diameter class.

Concentration (oz./gal.)	Diameter classes, cms. 10	20	30	40	All diameter classes
1	16.7	19.4	21.1	22.2	19.8
2	17.2	19.0	20.0	21.0	19.3
3	14.2	18.1	20.5	21.1	18.5
All Concentrations	16.0	18.8	20.5	21.4	19.3

b. *Effect of tree size.* — The mean pre-killing period or the date of application to date of occurrence of first damage for the 10 cm. diameter class (3.4 weeks) was significantly shorter than either of the 20 and 30 cm. diameter classes (4.7 weeks each) or of the 40 cm. diameter class (9.5 weeks). The pre-killing period for the 40 cm. diameter class was the longest. The pre-killing periods of the 20 and 30 cm. diameter classes were intermediate (Tables 1 and 3).

Table 3. Analysis of variance of pre-killing period data.

Source of Variation	d.f.	SS	MS	F
Treatments	11	849.87	77.26	5.10**
Diameter, D	3	651.80	217.27	14.35**
10 vs. rest	1	187.78	187.78	12.40**
40 vs. 20 & 30	1	464.00	464.00	30.65**
....20 vs. 30	1	0.02	0.02	— n.s.
Concentration, C	2	124.72	62.36	4.12*
3 vs. 1 & 2	1	124.71	124.71	8.24**
1 vs. 2	1	0.01	0.01	— n.s.
D x C	6	73.35	12.22	0.81 n.s.
Error	108	1635.60	15.14	
Total	119	2485.47		

* — Significant at the 5 percent Level.
** — Significant at the 1 percent Level.
n.s.—Not significant.

The killing period, or the date of application to the date of complete killing for diameter classes and concentrations, followed the same trend as the per-killing period (Tables 2 and 4). Therefore, it can be said that the smaller trees were affected and killed earlier than the bigger trees. The resistance of the tree to the effect of the poison increased with increase in tree size. This conforms to the findings of McQuilkin (1957).

Table 4. Analysis of variance of killing data.

Source of Variation	d.f.	SS	MS	F
Treatments	11	583.29	53.03	6.75**
Diameter, D	3	507.82	169.27	21.50**
10 vs. rest	1	403.22	403.22	51.30**
20 vs. 30 & 40	1	92.45	92.45	11.76**
30 vs. 40	1	12.15	12.15	1.56 n.s.
Concentration, C	2	38.31	19.16	2.44 n.s.
3 vs. 1 & 2	1	32.26	32.26	4.10*
1 vs. 2	1	6.05	6.05	0.77 n.s.
D x C	6	37.16	6.19	0.79 n.s.
Error	108	848.50	7.86	
Total	119	1431.79		

* Significant at the 5 per cent level
** Significant at hte 1 per cent level.
n.s.—Not significant.

c. *Effect of Concentration.* — Pre-killing period for the 3-ounce concentration (4.1 weeks) was significantly shorter than either of the 1-ounce or 2-ounce concentrations (both 6.3 weeks). The latter two are the same and, therefore, not significantly different (Table 1 and 3).

The same was true for the killing period. The killing period for the 3-ounce concentration (18.5 weeks) was significantly shorter than either of the 1-ounce (19.8 weeks) or of the 2-ounce (19.3 weeks) concentrations. Again there was no significant difference between the killing periods for the 1-ounce and 2-ounce concentrations.

The result of this study means that the effectiveness of the poison was the same whether the concentration was 1-ounce or 2-ounces per gallon of diesel oil. When the concentration was increased to 3-ounces per gallon, however, there was an advantage both in the length of time required for beginning of damage and the length of time required for complete killing over the two lower concentrations. It is recommended, therefore, that the 1-ounce concentration be used if there is no hurry in killing but the 3-ounce concentration should be used if fast killing is desired especially for big trees.

d. *Interaction.* — The interaction of tree size and concentration, if any, was not great enough to be significant. Therefore, the effect of tree size on both pre-killing and killing periods and of concentration on pre-killing period are independent of each other, meaning, the effect of tree size does not depend on concentration and *vice versa.*

SUMMARY

This study was conducted to test the effectiveness of 2, 4-D diesel oil solutions on anabiong trees which have been observed to be a problem in plantations and in second growth forests. In addition, the effects of concentrations (1, 2, and 3 ounces per gallon of diesel oil) and of tree size (diameter) were determined.

The results showed that 2, 4-D was effective in killing anabiong trees, all treated trees being killed at the end of the 24th week after application. Resistance to the poison increased with increase in tree size. The 2-ounce concentration had no advantage over the 1-ounce concentration but the 3-ounce concentration had a definite advantage both in the length of time required for beginning of damage and the length of time required for complete killing over the two lower concentrations.

LITERATURE CITED

AHLGREEN, G. H., G. C. Klingman, and D. E. Wolf. 1951. *Principles of weed control.* John Wiley & Sons, Inc. New York.

BANIQUED, J. O. 1960. "Response of bikal (*Schizostachyum diffusum* Blanco, Merr.) to 2, 4-D tree poison." Unpublished BSF Thesis, Collegė of Foresrty Library.

BRINKMAN, K. A. 1959. Killing oak brush a tricky business. USDA Central States Forest Experiment Station, Tech Paper 165.

BUSA, N. D. 1959. "The effect of 2, 4-Dicholorophenoxyacetic acid in the control of Uoko (*Mikamia scandens* Willd.) in plantations." Unpublished BSF Thesis, College of Forestry Library.

DAHMS, W. G. and G. A. James. 1950. Brush conrtol of forest lands. USDA Agricultural Research Paper No. 13.

FREAR, D. E. 1948. *Chemistry of insecticides, fungicides and herbicides.* 2nd ed. D. Van Nostrand Co., Inc.

GERARDO, J. A. 1959. "Chemical control of vegetation in Forestry, review of literature and annotated bibliography." Unpublished BSF Thesis, College of Forestry Library.

GRANO, C. X. 1956. "Growing loblolly and shortleaf pines in the Mid-South." *USDA Farmers Bull.* 2102.

HALLS, L. K. and G. W. Burton. 1951. "Effect of 2, 4-D, 2, 4, 5-T and sodium trichloroacetate on gallberry." *Jour. Forestry* 49: 895-897.

JEMISON, G. M. 1949. "Timber stand improvement in the Southern Appalachian region." *USDA Forest Service Misc. Publ. No.* 693.

LOPEZ, M. 1953. "Study of some factors controlling germination of anabiong (*Trema orientalis* Linn. Blume) seeds." *Phil. Jour. Forestry* 9(1-4).

McQUILKIN, W. 1957. "Frill treatment with 2, 4, 5-T and 2, 4-D effective for killing Northern hardwoods." *USDA Northeastern Forest Experiment Station, Station Paper No.* 97.

PEEVY, F. A. 1951. "New poisons for undesirable hardwoods." *Jour. Forestry* 49:450.

SEGURITAN, E. V. 1960. "Response of hagimit (*Ficus minahassae* Teijsm. & De Vr. Miq.) to 2, 4-D and 2, 4, 5-T arboricides." Unpublished BSF Thesis. College of Forestry Library.

STEPHENSON, G. K. and C. B. Gibbs. 1959. "Selective control of cull hardwoods in East Texas." *USDA Southern Forest Experiment Station, Occasional Paper* 175.

WALTERS, R. S. 1959. "Conversion planting on poor hardwood sites shows promise in Ohio." *USDA Central States Forest Experiment Station, Tech Paper* 168.