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TECHNICAL MEMORANDUM 229

DEFOLIATION OF OAK, MAPLE, AND OTHER WOODY PLANTS WITH 2-CHLOROETHYLPHOSPHONIC ACID AND POTASSIUM IODIDE

John P. Sterrett
John A. Baden III
Joel T. Davis

FEBRUARY 1971

DEPARTMENT OF THE ARMY
Fort Detrick
Frederick, Maryland

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DEPARTMENT OF THE ARMY
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Plant Physiology Division
PLANT SCIENCES LABORATORIES

Project 1B562605AD28

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ABSTRACT

This investigation determined the defoliation response of red maple (Acer rubrum L.), pin oak (Quercus palustris Muenchh.), and several other actively growing deciduous woody plants to 2-chloroethylphosphonic acid (68-240) and potassium iodide (KI). The chemicals were foliar-applied in water to runoff with an air-pressure sprayer at 12 psi to plants in a clipped grass field.

Applications of 68-240 alone were made at 2,500, 5,000, and 10,000 mg per liter and each concentration in combination with 2.0% KI to 6-year-old red maple and pin oak. Treatments were made in July and included one, two, or three sprays at 1-week intervals. The best defoliation occurred with three sprays of 68-240 alone at 10,000 mg per liter. When 2.0% KI was added to 68-240, complete desiccation occurred before abscission could take place.

When KI was applied alone on 1 August at 0.5, 1.0, and 2.0%, all concentrations caused 100% desiccation on red maple. With pin oak, 1.0% KI was needed to obtain 100% desiccation.

Ten woody plant species from 5 to 10 feet tall were sprayed in early July with 5,000 mg per liter of 68-240. During a period of 3 weeks, black locust, tree of heaven, sycamore, and sweet gum were almost completely defoliated (80 to 100%); six other species were defoliated to a lesser extent in descending order from 60 to 20%.

I. INTRODUCTION

Doubt[1] proved in 1917 that the ethylene contained in illuminating gas caused leaf fall. Strong evidence supports the hypothesis that ethylene is involved in abscission by accelerating senescence.[2] Several species of woody plants have been defoliated with as little as 2 to 5 ppm of ethylene.[3] The chemical 2-chloroethylphosphonic acid is a defoliant that gives off ethylene gas as a result of a chemical decomposition described as a base-catalyzed elimination reaction.[4] Except for Morgan, Myer, and Merkle,[5] who observed that 73% defoliation occurred on honey mesquite [Prosopis juliflora var. glandulosa (Torr.) Cockerell] with 2-chloroethylphosphonic acid applied at 4 lb./acre, little information is available regarding its effect as a defoliant on woody plants. Plants that approach the dormant stage of growth respond to 2-chloroethylphosphonic acid more readily than those that are actively growing.* Abeles** suggested that defoliation during the active growth stage might be more effective if several applications of 2-chloroethylphosphonic acid were made in succession, which would result in a greater acceleration of senescence.

Potassium iodide (KI) has been found to be an effective defoliant on some deciduous woody nursery plants.[6,7] However, the applications were made in the fall prior to natural abscission, not when the plants were in an active state of growth.

The objective of the present investigation was to determine the defoliation response of certain actively growing deciduous woody plants to 2-chloroethylphosphonic acid and KI.

II. MATERIALS AND METHODS

The study, divided into three experiments, used deciduous woody plants that were planted 10 by 10 feet apart in a clipped grass field near Frederick, Maryland. The chemicals were foliar-applied in water to runoff with a portable air-pressure sprayer at 12 psi.

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* Amchem Products, Inc., Ambler, Pa. 1970. Personal communication.

** Abeles, F.B., Fort Detrick, Frederick, Maryland. Personal communication.

In the first experiment, 2-chloroethylphosphonic acid (Ethrel 68-240, propylene glycol base, referred to here as 68-240) was applied alone at 2,500, 5,000, and 10,000 mg per liter and each concentration in combination with 2.0% KI to 6-year-old red maple (Acer rubrum L.) and pin oak (Quercus palustris Muenchh). Treatments were made in July and included one, two, or three applications at 1-week intervals. Each treatment consisted of one tree per species and was replicated three times in randomized blocks. Observations of defoliation, desiccation, and refoliation were made at weekly intervals for the first 4 weeks and at the end of August, 55 days after the first application.

In the second experiment, KI at 0.5, 1.0, and 2.0% with a pH of 2.5 or 5.0 was applied on 1 August to 6-year-old red maple and pin oak. The pH was lowered with phosphoric acid. The experimental design was similar to that of the first experiment and plant response was determined four times after treatment at 6-day intervals.

In the third experiment, ten woody plant species, as listed in Table 3, from 5 to 10 feet tall were sprayed in early July with 5,000 mg per liter of 68-240 and observed for 2 months for defoliation and refoliation.

III. RESULTS AND DISCUSSION

In the first experiment with three foliar sprays, 68-240 alone at 10,000 mg per liter caused complete defoliation of red maple and 60% defoliation of pin oak (Table 1). Two and three sprays of 68-240 at 5,000 mg per liter on red maple resulted in at least 80% defoliation, and two sprays at 10,000 mg per liter caused 90% defoliation. Apparently, two or three sprays of 68-240 at weekly intervals accelerated senescence because the red maple leaves, in particular, were not desiccated when they abscised and showed only slight cuticular damage. Red maple was easier to defoliate than pin oak with any level of 68-240 applied alone. When 2.0% KI was added to 68-240, complete desiccation occurred before abscission could take place on both red maple and pin oak, and 2.0% KI alone caused complete desiccation followed by considerable refoliation. Potassium iodide was added to 68-240 in the first experiment with the hope that it would enhance the defoliation effect of 68-240 by accelerating the formation of an abscission layer. Although this did not occur, KI did contribute toward leaf drop, especially on pin oak, because the petioles of the leaves became dry and brittle as a result of desiccation and broke away readily in the wind.

TABLE 1. HIGHEST DEFOLIATION AND DESICCATION OF RED MAPLE AND PIN OAK OVER A 55-DAY PERIOD AFTER BEING SPRAYED IN JULY AT WEEKLY INTERVALS

68-240,[a] mg per liter	KI, %	Defoliation/Desiccation[b] Number of Foliar Sprays					
		Red Maple			Pin Oak		
		1	2	3	1	2	3
2,500	0	4/2	4/5	6/7	1/1	1/1	2/1
5,000	0	5/8	8/10	9/10	1/1	1/2	2/1
10,000	0	7/5	9/8	10/-	2/3	3/4	6/7
2,500	2.0	2/10	2/10	5/10	5/10	5/10	7/10
5,000	2.0	4/10	3/10	4/10	2/10	3/10	2/10
10,000	2.0	3/10	3/10	2/10	2/10	6/10	4/10
0	2.0	3/10R	7/10	6/10	4/10R	6/10	8/10

a. 2-Chloroethylphosphonic acid (propylene glycol base).
b. Figures to the left of the virgule represent defoliation response and those to the right, desiccation. 0 = no effect; 10 = 100% response; R = over 50% refoliation.

Since KI proved to be a strong desiccant at 2.0%, we tried lower percentages of KI alone in the second experiment (Table 2). On red maple, all of the concentrations of KI regardless of pH caused 100% desiccation and from 40 to 60% defoliation over a 25-day period. Also, 0.5 and 1.0% KI at pH 5.0 did less permanent damage to red maple in that over 50% of each tree refoliated. With pin oak, 1.0% KI was needed to obtain 100% desiccation and no difference was observed due to pH.

In the third experiment, black locust, tree of heaven, sycamore, and sweet gum were defoliated more effectively than the other species listed in Table 3 with 5,000 mg per liter of 68-240. In each case abscission of the petiole appeared to take place within 3 weeks after treatment with little or no desiccation. By the end of 55 days, black locust, sweet gum, and sycamore were almost completely refoliated, but tree of heaven was still without leaves and appeared to be completely dead.-

TABLE 2. HIGHEST DEFOLIATION AND DESICCATION OF RED MAPLE AND PIN OAK OVER A 25-DAY PERIOD AFTER BEING SPRAYED 3 AUGUST 1970

KI, %	pH[a]	Defoliation/Desiccation[b]	
		Red Maple	Pin Oak
0.5	5.0	4/10R	2/7
1.0	5.0	6/10R	2/10
2.0	5.0	6/10	6/10
0.5	2.5	6/10	5/7
1.0	2.5	6/10	4/10
2.0	2.5	5/10	5/10
0	2.5	0	0

a. pH lowered from 5.0 to 2.5 with phosphoric acid.
b. Figures to the left of the virgule represent defoliation response and those to the right, desiccation. 0 = no effect; 10 = 100% response; R = refoliation.

TABLE 3. HIGHEST DEFOLIATION WITH 68-240[a] APPLIED AT 5,000 MG PER LITER IN WATER OVER A 55-DAY PERIOD AFTER BEING SPRAYED 7 JULY 1970

Species	Defoliation, %
Tree of heaven [*Ailanthus altissima* (Mill.)] Swingle	100
Black Locust (*Robinia pseudoacacia* L.)	100R[b]
American sycamore (*Platanus occidentalis* L.)	80R
Sweet gum (*Liquidambar styraciflua* L.)	80R
California privet (*Ligustrum ovalifolium* Hassk.)	60
Flowering dogwood (*Cornus florida* L.)	50
Chinese elm (*Ulmus parvifolia* Jacq.)	40
Yellow poplar (*Liriodendron tulipifera* L.)	30
Lombardy poplar (*Populus nigra* L. var. *italica* Muenchh.)	20
Green ash (*Fraxinus pennsylvanica* Marsh.)	20

a. 2-Chloroethylphosphonic acid (propylene glycol base).
b. R = over 50% refoliation.

It seems apparent that if actively growing woody plants are exposed to enough ethylene gas from 2-chloroethylphosphonic acid, senescence can be maintained long enough to induce defoliation with a minimum amount of damage to the plant. The methods used in this study are obviously impractical. However, a carrier that could be sprayed on the foliage once that would allow only a slow release of ethylene gas from 2-chloroethylphosphonic acid should be desirable. If desiccation is not a deterrent, KI, at the highest level used in this study, will probably cause eventual defoliation of most deciduous woody plants.

LITERATURE CITED

1. Doubt, S. L. 1917. The response of plants to illuminating gas. Bot. Gaz. 63:209-224.

2. Burg, Stanley P. 1968. Ethylene, plant senescence and abcission. Plant Physiol. 43:1503-1511.

3. Heck, Walter W.; Pires, E. Gerald. 1962. Effect of ethylene on horticultural and agronomic plants. Texas Agr. Exp. Sta. Misc. Publ. 613. 12 p.

4. Amchem Products, Inc. 1969. Ethrel. Technical Service Data Sheet. Amchem Products, Inc., Ambler, Pa. 64 p.

5. Morgan, Page W.; Myer, Robert E.; Merkle, Morris G. 1969. Chemical stimulation of ethylene evolution and bud growth. Weed Sci. 17:353-355.

6. Larsen, Fenton E. 1966. Potassium iodide induced leaf abscission of deciduous woody plants. Proc. Amer. Soc. Hort. Sci. 88:690-697.

7. Larsen, Fenton E. 1967. Stimulation of leaf abscission of woody plants by potassium iodide and alanine. Hort. Sci. 2:19-20.

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Pin oak						
Trees						
Ethylene						