The Effect of Paraquat, Dinoseb and 2,4-D on Filbert (*Corylus avellana* L.) Suckers[1,2]

J. E. Reich[3] and H. B. Lagerstedt[4]
Oregon State University, Corvallis

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-11-26 via Open Access. This is an open access article distributed under the CC BY-NC-ND license (https://creativecommons.org/licenses/by-nc-nd/4.0/). https://creativecommons.org/licenses/by-nc-nd/4.0/

Abstract. Foliar sprays of paraquat, dinoseb, and (2,4-dichlorophenoxy) acetic acid (2,4-D) each provided satisfactory control of filbert suckers. Paraquat and 2,4-D controlled vegetative regrowth to a greater extent than dinoseb. Use of oil with dinoseb increased its phytotoxicity towards filbert suckers.

Suckers should be treated when less than 1 foot in height and thoroughly wetted with spray. The herbicide 2,4-D controlled large suckers better than either paraquat or dinoseb. There was no evidence of injury to the mature trees following the use of these materials.

The European filbert (*Corylus avellana* L.) is a shallow-rooted, multi-stemmed shrub 15 to 20 ft in height. Each growing season suckers arise from buds at the base of the trunk. These suckers provide a natural replacement for the old stems as they deteriorate.

To facilitate mechanization of orchard practices, growers in the United States train filbert trees to a single trunk. This training system makes it necessary to eliminate the continually appearing suckers several times during the growing season.

Traditionally, filbert suckers are removed by hand, a laborious and time-consuming practice (5,6,13). This is done with a hoe and frequently injures the trunk and roots.

An early attempt to control filbert suckers by chemical means was reported in 1953 when isopropyl-*m*-chlorocarbanilate (chloropropham) and 2 2-*sec*-butyl-4,6-dinitrophenol (dinoseb) were used (9). These treatments burned foliage and sucker terminals but did not injure portions of suckers occurring below the soil surface. In the same year, the herbicide (2,4-dichlorophenoxy) acetic acid (2,4-D) was reported to be used for several years in a young filbert orchard (11). Successful control of suckers was obtained without injury to the trees. Injury to small filbert trees was reported when they had bark wounds or blight lesions on their trunks, and after they were treated with a spray of dinoseb in diesel oil (10). Sprays of 2,4-D amine, [(4-chloro-o-toyl) oxy] acetic acid (MCPA) and ammonium sulphamate also controlled suckers (12). In these early reports, no injury to the trees occurred with 2,4-D or MCPA.

No herbicides have been registered for use on filbert suckers, but grower applications have established their feasibility in replacing removal by hand. Since only empirical information was available, experiments were designed to screen suitable herbicides and determine their safest, yet lowest effective concentration for sucker control. This investigation was divided into 3 stages: 1) preliminary screening trials in the greenhouse; 2) an experiment to summarize the greenhouse screening, and 3) orchard application to field test the results obtained in the greenhouse.

Materials and Methods

Screening trials. Screening trials were established to determine the relative phytotoxicity of 9 herbicides upon filbert shoots. The materials used were:

1,1'-dimethyl-4,4-bipyridylium ion 2 lb. cation/gal chloride salt	paraquat
6,7-dihydrodipyrido [1,2-*a*:2',1'-c] pyrazinedinium ion 2 lb. cation/gal bromide salt	diquat
2-*sec*-butyl-4,6-dinitrophenol 5 lb. active ingredient/gal	dinoseb
3',4'-dichlorocyclopropanecarboxanilide 2 lb. active ingredient/gal	cypromid
Hydroxydimethylarsine oxide 2.48 lb. active ingredient/gal	cacodylic acid
(2,4-dichlorophenoxy) acetic acid 4 lb. acid equivalent/gal heptylamine salt	2,4-D
(2,4,5-trichlorophenoxy) acetic acid 4 lb. acid equivalent/gal n-oleyl 1,3-propylenediamine salt	2,4,5-T
3,6-dichloro-o-anisic acid 4 lb. active ingredient/gal dimethylamine salt	dicamba
4-amino-3,5,6-trichloropicolinic acid 2 lb. active ingredient/gal potassium salt	picloram

The surfactant X-77[5] was used throughout these experiments.

Screening trials were conducted in the greenhouse on 1- and 2-year-old filbert trees grown in containers and having actively growing shoots resembling typical filbert suckers. The herbicide solutions were applied as a drench to thoroughly wet the foliage. The screening trials were evaluated visually over succeeding days and weeks depending upon speed of herbicide action. Acceptable shoot kill was noted as death of the treated leaves and dieback of the shoots by one-third or more of their length without damage to stem portions 1-year-old or older. Regrowth from unkilled lateral buds was also noted. Each of 270 separate screening tests employed from 1 to 3 single plant replicates for each herbicide or concentration.

Summary herbicide experiment. Four herbicide treatments from the screening trials appeared promising for use in filbert sucker control:

paraquat	1/2 lb./100 gal solution
2,4-D	1 lb./100 gal solution
dinoseb	1.87 lb./100 gal solution
dinoseb + diesel oil	1.87 lb. + 8 gal/100 gal solution

The summary experiment was designed to quantitatively evaluate data on foliar and shoot kill and subsequent vegetative regrowth. The plants treated were 2-year-old trees, 4 to 6 ft tall. The randomized-block design was used with 4, 4-tree replications in each treatment. Shoot lengths of each tree were

[1]Received for publication January 5, 1971. Technical Paper No. 2928, Oregon Agricultural Experiment Station.

[2]This is a report on the current status of research involving use of certain chemicals that require registration under the Federal Insecticide, Fungicide, and Rodenticide Act. It does not contain recommendations for the use of such chemicals, nor does it imply that the uses discussed have been registered. All uses of these chemicals must be registered by the appropriate State and Federal agencies before they can be recommended.

[3]Present address: New York State Agricultural Experiment Station, Geneva.

[4]Research Horticulturist, Plant Science Research Division, Agricultural Research Service, United States Department of Agriculture, Oregon State University, Corvallis.

[5]Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by the U. S. Department of Agriculture, and does not imply its approval to the exclusion of other products that may also be suitable.

measured prior to and 3 weeks after treatment to determine the amount of dieback. Growth of new shoots was counted and measured 6 weeks after treatment.

Orchard trial. Selected concentrations of paraquat, dinoseb, and 2,4-D were tested in a mature filbert orchard with trees bearing large numbers of vigorous suckers ranging from 1/2 inch to 7 ft in height. Ten trees were used for each treatment and the foliage of the suckers was thoroughly wetted to a height of 12 to 18 inches. After 5 weeks, new suckers and new growth, sprouting from unkilled portions of suckers, were measured and counted.

Results

Screening trials. The screening trials indicated that dicamba and 2,4,5-T were no more effective than 2,4-D. Picloram caused growth distortions of stems and killed some 1-year-old seedlings at concentrations as low as 1 oz picloram/100 gal of solution. Diquat, cacodylic acid and cypromid were not as effective as paraquat or dinoseb and were also discontinued. The effect of dinoseb was noticeably increased by the addition of diesel oil in amounts of 4 gal or more per 100 gal of solution.

The best herbicides for sprout control in the screening trials were paraquat, dinoseb and 2,4-D. The contact herbicides paraquat at 1/2 lb. and dinoseb at 1.87 lb./100 gal of solution produced a burning effect on young leaves and terminal shoots. Dinoseb produced the effect more rapidly than paraquat. Old leaves treated with paraquat were killed in irregular patches, leaving living green portions that persisted for several weeks; but no such effect occurred with dinoseb. Terminal shoot kill by the 2 herbicides was comparable, with one-fourth to one-third or more of a given shoot being killed. Regrowth from lateral buds appeared very slowly or not at all on paraquat-treated plants, but appeared rapidly from dinoseb-treated plants. The older basal stem portions appeared resistant to injury by paraquat and dinoseb at the rates used.

The effect of 2,4-D at 1 lb./100 gal of solution was less rapid than that of the contact herbicides. Nastic responses were visible on actively growing stem terminals within 24-48 hours after application, but actual death of leaves and terminals did not occur for several weeks. The 2,4-D treatments caused more injury than did paraquat or dinoseb to stem tissue 1-year-old or older. Regrowth, when it occurred, was generally weak and occurred far below killed portions.

Summary herbicide experiment. Single concentrations of paraquat, 2,4-D, dinoseb and dinoseb plus diesel oil were applied to trees in the greenhouse where maximum temperatures ranged from 74° - 105°F. Temperatures over 100°F occurred only on 3 separate days and were of brief duration.

Paraquat-treated plants showed some injury 24 hr after treatment. Killing of leaves and stem terminals was essentially complete after 4 days, although scattered portions of leaf tissue in many older leaves remained alive for several weeks. Lateral bud growth from paraquat-treated trees was noted 3 weeks after treatment. These new shoots were weak and chlorotic as compared to normal healthy shoots or the regrowth from dinoseb-treated trees.

The dinoseb treatment exhibited rapid injury to stem terminals and immature leaves. Addition of the diesel oil to the dinoseb spray accelerated the development of injury symptoms and increased the extent of injury to the stems (Table 1). Leaf and shoot kill was essentially complete after 2 days in the dinoseb plus oil treatment and in 4 days with dinoseb alone. Regrowth from lateral buds was visible after 2 weeks with both dinoseb treatments. Fewer shoots developed on the trees sprayed with dinoseb plus oil than on those treated with dinoseb alone (Table 1).

Stem terminals of the 2,4-D treated plants displayed nastic symptoms within 24 hr of treatment. By the second day, immature leaves exhibited epinasty. Little evidence of necrosis was seen until the 9th day, when the majority of the leaves began dying, and after 14 days most of the foliage was dead. No regrowth ever occurred. When stem dieback was measured all 16 trees were dead; therefore, in terms of shoot kill, 2,4-D had the greatest effect (Table 1).

Table 1. Summary herbicide experiment. Evaluation of shoot dieback and subsequent regrowth from living portions of treated stems.

Treatment	Avg inches of shoot dieback after 3 weeks	Avg no. of new shoots after 6 weeks
Paraquat	3.6	6.8
2,4-D	17.5	0.0
Dinoseb	4.6	11.4
Dinoseb + oil	9.7	2.7
LSD	.05 = 3.0 .01 = 4.3	.05 = 2.0 .01 = 2.8

Treatment means significant at the 1% level.

After 6 weeks the paraquat-treated trees averaged about twice as many new shoots as those treated with dinoseb plus oil, but only about half as many as those treated with dinoseb alone. However, new shoots from paraquat-treated trees were much shorter and chlorotic than those in either dinoseb treatment.

Orchard trial. Paraquat, dinoseb and 2,4-D were applied to suckers of mature filbert trees in the orchard during July 1969. Daily maximum temperatures during the 5 weeks following treatment ranged from 72°F to 94°F. Paraquat and dinoseb treatments exhibited symptoms of severe injury 3 days after treatment. After the first week, nearly all sprayed leaves and terminal portions of suckers were dead.

The 2,4-D treatment took from 2 to 4 weeks to kill sucker terminals and old leaves. Untreated terminals of suckers and immature leaves exhibited 2,4-D symptoms. No such translocation effect was seen where tall suckers had been treated with paraquat or dinoseb. There were no visible signs of injury to the parent trees in any treatment.

The number of new suckers which occurred after 5 weeks is shown in Table 2. Production of suckers varies greatly between trees, so significant differences were only obtained for the 2,4-D treatment. Average heights of new suckers in these treatments did not differ significantly.

Regrowth from incompletely killed suckers was much greater in the 2 dinoseb treatments than in the paraquat or 2,4-D treatments (Table 2). This table also shows the average lengths of the new shoots from those incompletely killed suckers. The average shoot lengths in the paraquat and 2,4-D treatments were significantly shorter than those in the dinoseb-only treatment.

Discussion and Conclusions

Filbert suckers can be satisfactorily controlled by either 1/2 lb. of paraquat, 1.87 lb. of dinoseb, or 1 lb. of 2,4-D/100 gal of solution. Responses to these herbicides and concentrations were consistent throughout the screening, summary and orchard trials. The speed with which these responses were obtained varied with the season, the growing conditions of the plants and the temperature during and following application.

Part of this variation may be related to herbicide penetration of the waxy leaf cuticle. Suckers in the orchard were shaded, but growing much more vigorously than shoots of container-grown trees in the greenhouse. There is proportionately less cuticle on rapidly growing shoots and leaves, and they are therefore more easily penetrated. The same is true for young versus old leaves as indicated by the spotting effect occasionally observed when paraquat was used on old leaves.

Paraquat is strongly water-soluble, so that its ability to penetrate the cuticle may be limited to cracks and punctures

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-11-26 via Open Access. This is an open access article distributed under the CC BY-NC-ND license (https://creativecommons.org/licenses/by-nc-nd/4.0/). https://creativecommons.org/licenses/by-nc-nd/4.0/

Table 2. Orchard Experiment. Evaluations of regrowth from trees 5 weeks after herbicide treatment.

Treatment	Avg no. of new suckers per tree	Avg no. of new shoots arising from living portions of treated suckers	Avg length of new shoots arising from living portions of treated suckers
Paraquat	17.8	0.4	0.7**
2, 4-D	9.8*	0.2	0.2**
Dinoseb	23.8	37.0	3.4
Dinoseb + oil	41.8	31.0	2.3
LSD	.05 = 27.7 .01 = 38.1	.05 = 38.9 .01 = 53.7	.05 = 1.7 .01 = 2.3

*Significant at the 5% level.
**Significant at the 1% level.

(7). Addition of a surfactant could aid uniform penetration of the cuticle by such a herbicide (4). Oil-soluble herbicides like dinoseb and the heptylamine form of 2,4-D should penetrate the cuticle more uniformly and not be limited to entry through mechanical injuries or stomata. Oils are known to solubilize the cuticle and improve herbicide penetration. The use of oil with dinoseb consistently accelerated the appearance of injury symptoms and increased the extent of shoot dieback.

Temperature, light intensity and extent of coverage also influence the phytotoxicity and rate of response to herbicides. In comparing greenhouse experiments throughout the year, the most rapid responses were obtained in late spring when high temperatures were most common. Orchard temperatures in July were cooler than those in the greenhouse in June, and response rates were slower. This was especially evident in the case of 2,4-D since the rate of plant growth processes, and consequently the activity of 2,4-D, are directly affected by temperature.

Temperature also influences the rate of translocation of herbicides in plants. Once within the plant, 2,4-D moves into the phloem and is translocated with the flow of carbohydrate materials out of the leaves and towards sites of active cell division (1,2). This would explain the excellent results obtained with 2,4-D in controlling regrowth from lateral buds (Table 2). An additional advantage obtained through the translocation of 2,4-D is that below ground portions of suckers are killed. Paraquat and dinoseb are unable to translocate to this extent.

It has been determined that paraquat may enter the xylem vessels and move in the transpiration stream, particularly when a period of darkness or low light intensity follows application (14). The poor regrowth from paraquat-treated trees in the greenhouse summary experiment indicates that some paraquat translocation occurred. In the orchard experiment a reduction in new sucker numbers and regrowth was evident with paraquat.

Dinoseb apparently does not translocate at all in plants. Residues of dinoseb in portions of plants remote from points of foliar or root application have not been detected (8). In our experiments injury to bud scales was noted but not to the growing points of these buds.

Observations throughout the experiments indicate that filbert suckers should be treated when less than 12 inches in height. At this young, non-woody stage, they are most susceptible to herbicides. Taller suckers, even when killed, will remain to interfere, with subsequent weed and sucker control treatments and nut harvest.

It was also observed that thorough spray coverage, to the point of run-off, was essential to obtain satisfactory response to the herbicide concentrations used. One reason for tree injury in the past was the use of highly concentrated, low-volume sprays. When used at the rates described, it appears that paraquat, dinoseb or 2,4-D will control suckers without injuring the mature filbert tree.

Literature Cited

1. Audus, L. J. 1964. The physiology and biochemistry of herbicides. Academic Press, New York, p. 81, 388-390, and 55.
2. Crafts, A. S. 1961. The chemistry and mode of action of herbicides. Interscience Publishers, New York p. 40.
3. ———, and W. W. Robbins. 1962. Weed control, 3rd Ed. McGraw-Hill Book Company, Inc., New York, p. 206.
4. Currier, H. B. 1959. Pathways of foliar penetration *Proc. Calif. Weed Conf.* 11:53-55.
5. Dorris, G. A. 1926. Current filbert problems. *Proc. Western Nut Growers Assoc.* 12:199-210.
6. ———. 1927. Pruning the filbert. *Proc. Western Nut Growers Assoc.* 13:189-195.
7. Freed, V. H., and R. O. Morris. 1967. Environmental and other factors in the response of plants to herbicides. *Ore. Agr. Expt. Sta. Tech. Bul.* No. 100.
8. Herbicide Handbook of the Weed Society of America. 1967. W. F. Humphrey Press, New York, 293 p.
9. Kerr, R. E. 1953. A machine and chemical sprays to control filbert sprouts. *Proc. Nut Growers Soc. Ore. and Wash.* 39:187-189.
10. ———. 1954. Filbert sprout control with sprays. *Proc. Nut Growers Soc. Ore. and Wash.* 40:197-198.
11. Marnach, Carl. 1953. Controlling filbert sprouts with chemical sprays. *Proc. Nut Growers Soc. Ore. and Wash.* 39:189.
12. Roberts, W. W. 1954. Filbert sprout control with sprays. *Proc. Nut Growers Soc. Ore. and Wash.* 40:198-200.
13. Schuster, C. E. 1942. Wartime measures in walnut and filbert orchards. *Proc. Western Nut Growers Assoc.* 28:118-123.
14. Slade, P., and E. G. Bell. 1966. The movement of paraquat in plants. *Weed Res.* 6:267-274.

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-11-26 via Open Access. This is an open access article distributed under the CC BY-NC-ND license (https://creativecommons.org/licenses/by-nc-nd/4.0/). https://creativecommons.org/licenses/by-nc-nd/4.0/