Results of Poisoning Western Hemlock

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UNMERCHANTABLE, DEFECTIVE HEMLOCK in the western white pine type presents a serious problem to the forest manager. It greatly retards the establishment and growth of more valuable trees such as white pine. Because of its shade tolerance, hemlock often reproduces abundantly. Until the time comes when industries can profitably use low-quality timber from the northern Rockies, foresters must at times destroy defective hemlock in order to regenerate white pine, larch, and Douglas fir. The Northern Rocky Mountain Forest and Range Experiment Station is therefore studying methods for cheaply eliminating undesirable trees. This paper describes the results of poisoning defective western hemlock on the Deception Creek Experimental Forest.*

Defective trees may be destroyed by felling, burning, girdling, or poisoning. Probably each of these methods has certain advantages which makes it the best for particular conditions. Felling, if accompanied by debris clean up, eliminates the defective material quickly and completely. This method, however, costs more than the others. Burning involves risks, requires suitable weather and fuel conditions, and cannot be confined to individual trees. Girdling kills trees cheaply but often creates host material in which bark beetle populations can multiply (Robb, 1945). Experiments with poisoning in other regions have shown that it effectively and efficiently kills trees (Herman, 1949; Pearson,

* The early work in this experiment was conducted by Austin E. Helmers of the Northern Rocky Mountain Forest and Range Experiment Station.

1940; Peevy and Campbell, 1949; Pessin, 1942) and that bark beetles do not infest the poisoned trees (Lexen, 1939; Robb, 1945).

Experimental Design

Water solutions containing 10 per cent and 40 per cent by weight of sodium arsenite were applied in holes made by a poisoning axe developed by the Southern Forest Experiment Station (Pessin and Sheperd, 1941), and in auger holes ¾ inch in diameter and 5 inches deep, as used in the Southwest (Pearson, 1940). Holes made with the poisoning axe and the auger had a liquid capacity of about 5 cc. and 33 cc. respectively.

Poisoning-axe holes were punched at about stump height at 4-, 8-, and 12-inch intervals around the circumference of the trees. Auger holes were bored about 3½ feet above ground level at spacing intervals of 8, 16, and 24 inches. The holes were inclined at about 45° to prevent loss of the liquid.

In designing the sodium arsenite experiment, 108 trees were selected, 36 in each of the diameter groups of 7–12 inches, 13–18 inches, and 19–24 inches. Each diameter group was then divided into three equal subgroups, each of which was assigned to a season of application. One group was poisoned in July 1947, one in November 1947, and one in May 1948. Within a subgroup, six trees were paired with the six injection method-spacing treatments to receive the 10 per cent solution, and the other six were used for the 40 per cent solution. Thus, each tree within a diameter group received a different treatment.

The experiment was later expanded to test poisoning with ammonium sulfamate (Dupont's "Ammate"). A group of 40 hemlocks was poisoned in November 1947, with Ammate solutions of 20 per cent and 50 per cent applied in poisoning-axe holes spaced 4 inches and 8 inches apart. As practically none of the trees was affected by the poison during the winter of 1947/48, another group of 40 trees was poisoned in May 1948 with a saturated solution of Ammate and with Ammate crystals. The saturated solution was applied in poisoning-axe holes with a spacing of 4 inches and 8 inches; the crystals were applied in axe cups as in the South (Peevy, 1946). The cups were chopped at about stump height at intervals of 4 inches and 8 inches around the tree. One tablespoon of crystals applied while the cut was fresh was absorbed by the tree in about 24 hours.

In designing the Ammate test, 40 trees, ranging in diameter from 6 to 24 inches, were selected for treatment at each season. Each group of 40 trees was divided into four equal subgroups, and each subgroup received one of the four concentration-spacing treatments. In selecting the trees to be poisoned an effort was made to include a range of diameter classes in each treatment. However, it differed from the sodium arsenite test in that some diameter classes were not represented and others contained more than one tree.

Results

Sodium arsenite.—First effects of poisoning with sodium arsenite were evident in 2 to 3 weeks. Needle fall reached its peak in about 3 weeks. Death occurred in most cases about 12 months after treatment.

The 10 per cent solution of sodium arsenite applied in poisoning-axe holes spaced at 4 inches killed 67 per cent, at 8 inches killed 33 per cent, and at 12 inches killed none of the trees poisoned (Table 1). The 10 per cent solution

*Table 1.—Effect of sodium arsenite on western hemlocks**

D.b.h.† range	10 per cent solution						40 per cent solution					
	Poisoning-axe holes, spaced:			Auger holes, spaced:			Poisoning-axe holes, spaced:			Auger holes, spaced:		
	4 in.	8 in.	12 in.	8 in.	16 in.	24 in.	4 in.	8 in.	12 in.	8 in.	16 in.	24 in.
inches					July 1947 series							
7–12	D‡	d	a	D	D	d	D	D	d	D	D	D
13–18	D	D	A	D–	a	a	D	d	d	D	D	D
19–24	a	A	A–	D	D	a	D	d	a	D	D	D
					November 1947 series							
7–12	D	D–	A	D	D	a	D	D	a	D	D	D
13–18	D	A–	A	D	d	a	D	D	a	D	D	D
19–24	a	A–	A–	D	a	a	D	D	d	D	D	D
					May 1948 series							
7–12	D	a	a	D	D	d	D	d	d	D	D	d
13–18	a	A–	A–	D	d	A	D	D	d	D	a	D
19–24	D	A–	A–	D	d	A	D	D	A–	D	d	d

* Observations made Sept. 16, 1949.

† Diameter breast height.

‡ *D,* trees that have died due to sodium arsenite poisoning, *D–,* trees on which only one branch remained alive, *d,* trees with 10 or fewer live branches (i.e., crowns mostly dead), *a,* trees with part of the crown dead but with more than 10 branches alive, *A–,* trees slightly affected by the poison but showing no loss of needles or dying of branches, *A,* trees unaffected by the injection of poison.

in auger holes spaced 8, 16, and 24 inches apart killed 100 per cent, 78 per cent, and 22 per cent respectively.

The 40 per cent solution applied in poisoning-axe holes with a spacing of 4 inches and 8 inches killed, or badly damaged, all the trees tested. The 12-inch spacing badly damaged 56 per cent of the trees. Forty per cent solution in auger holes killed or badly damaged all but one of the trees poisoned.

Ammonium sulfamate.—Ammate reacted more slowly than sodium arsenite; effect of poisoning was evident in 4–8 weeks and the period of heavy needle fall occurred 3–4 months after treatment. Death occurred generally in 12–16 months.

Ammate crystals applied in axe cups were very effective. Observations taken 16 months after treatment showed a complete crown kill on 85 per cent of the trees poisoned and only a few live branches remaining on the rest of them (Table 2).

A saturated solution of Ammate in poisoning-axe holes spaced 4 inches apart killed all the trees tested. Eight-inch spacing with the saturated solution killed only one-half the trees poisoned. The 50 per cent and 20 per cent Ammate solutions killed or badly damaged some trees up to 12 inches in diameter but were not effective on large trees.

*Table 2.—Effect of ammonium sulfamate on western hemlock**

D.b.h.	Nov. 1947 poisoning				May 1948 poisoning			
	20% solution in poisoning-axe holes, spaced:		50% solution in poisoning-axe holes, spaced:		Saturated solution in poisoning-axe holes, spaced:		Crystals in axe cups, spaced:	
	4 in.	8 in.	4 in.	8 in.	4 in.	8 in.	4 in.	8 in
inches								
6	D,d†	a	D	D				
8	D	a,A	D,a	d	D	D	D	D
10	A–	A	D	d	D	a	D	D–,D
12	A–,d,A–	A–,A	D,D	A–,A–,A–	D,D	D,d	D,D	D
14	A–,a	A,a	d,a	A–,a	D,D	D,a	D,D	D,D
16					D,D	a,d	D,D	d,D
18	A	A–,A–	a	a	D	a	D	d
20					D			
22				A			D	
24			A			a		d

* Observations made Sept. 16, 1949.

† *D*, trees that have died due to Ammate poisoning, *D–*, trees on which only one branch remained alive, *d*, trees with 10 or fewer live branches (i.e., crowns mostly dead), *a*, trees with part of crown dead but with more than 10 branches alive, *A–*, trees slightly affected by the poison but showing no loss of needles or dying of branches, *A*, trees unaffected by the injection of poison.

Discussion

Poison concentrations and spacing.—The 40 per cent solution of sodium arsenite was more effective than the 10 per cent solution, all other factors being equal. The 10 per cent solution killed effectively only when applied in auger holes with a spacing of 8 inches. The labor cost of boring holes for this treatment would be high.

The most satisfactory application of sodium arsenite was a 40 per cent solution in poisoning-axe holes punched at intervals of 8 inches around the tree. All the trees receiving this treatment were dead or nearly dead in September 1949. The 40 per cent solution in auger holes with a spacing of 24 inches also poisoned effectively.

It must be remembered that sodium arsenite is a powerful skin irritant and a deadly poison. Extreme care must be taken in handling this poison. Ammate is a less objectionable poison than sodium arsenite because in small quantities it is not poisonous to men or to livestock and it is easy to handle.

The 20 per cent and 50 per cent solutions of Ammate killed only trees of small diameter. The saturated solution of Ammate in poisoning-axe holes with a spacing of 4 inches poisoned effectively, but with 8-inch spacing it failed to kill any trees over 16 inches in diameter. Ammate crystals in axe cups with 4- or 8-inch spacing poisoned effectively. Axe cups spaced 8 inches apart should be sufficient although closer spacing or heavier dosage may be desirable for some trees above 16 inches in diameter.

Injection method.—Sodium arsenite applied in auger holes gave slightly better results than when applied in holes made by the poisoning axe. The auger method is not generally recommended, however, because of the time required to bore the holes. The poisoning-axe method proved to be a quick and easy means of applying sodium arsenite.

Ammate crystals applied in axe cups and concentrated solution of Ammate applied in poisoning-axe holes with a 4-inch spacing killed effectively. The poisoning-axe method is faster than the axe-cup method, but it requires the purchase and care of a specialized tool. The axe-cup method requires only tools already on hand and allows larger dosages of poison.

Seasons.—Poisoning with 40 per cent solution of sodium arsenite in auger holes spaced 24 inches apart or closer and in poisoning-axe holes with a spacing of 8 inches or closer killed effectively in spring, summer, or fall. Trees poisoned in the spring or summer were affected more quickly; trees poisoned in the fall

showed little effect until the beginning of the growing season the following year. The final results, however, were nearly the same for all three seasons. Poisoning in the winter was not tested. Working in deep snow, combined with punching holes in frozen trees, would make winter poisoning slow and difficult.

Diameter.—Large trees proved to be more difficult to kill than small ones. For example, a 50 per cent solution of Ammate in poisoning-axe holes with a spacing of 4 inches killed nearly all the trees below 14 inches in diameter but killed none of the trees above 14 inches. A saturated solution of Ammate with a hole spacing of 4 inches killed trees of all diameters tested. Thus, in general, stronger concentrations of poison or closer spacing are required as the diameter of trees to be poisoned increases.

Conclusions and Recommendations

The results of this experiment show that poisoning with either sodium arsenite or ammonium sulfamate effectively kills unmerchantable western hemlock trees in the northern Rocky Mountains. The trees can be poisoned effectively in spring, summer, or fall.

Sodium arsenite should be applied as a 40 per cent solution in poisoning-axe holes punched at a convenient height at 8-inch intervals around the circumference of the tree, or in auger holes with a 24-inch spacing. Extreme care must be exercised in handling this poison.

Ammonium sulfamate applied as crystals in axe cups notched at a convenient height at 8-inch intervals around the tree or as a saturated solution in poisoning-axe holes punched at 4-inch intervals is an effective poison that is safe and easy to handle.

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