multi-row release plot in February and 1 six-spotted thrips adult in the single-row plot in March. This scarcity of predators was considerably different from that observed in late 1964 and early 1965 (Table 1). Apparently, absence of sufficient prey was responsible for the long period in which few predators were found. Unavoidably, the experiment was terminated between May 2 and 9 when the grower unexpectedly severed all plants at the soil surface and removed them, leaving the field almost free of plant debris.

One of the principal objectives of the study was to establish *P. persimilis* permanently, since rhubarb is a perennial plant which might provide a favorable environment for the predator to maintain itself on the two-spotted spider mite. Although the experiment was terminated in May 1966 the predaceous mite still had not been recovered since Aug. 19, 1965, even though the spider mite population had again increased to substantial numbers. However, the data do indicate that *P. persimilis* can be integrated successfully with native mite predators to suppress the two-spotted spider mite population on rhubarb, as occurred on strawberry during the 1965–66 growing season (Oatman et al. 1967).

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Length of Effectiveness of Lindane Against Attacks by *Dendroctonus brevicomis* and *D. ponderosae* in California[1,2]

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ABSTRACT

As a 2% diesel oil solution spray, lindane prevented attack by both the western pine beetle, *Dendroctonus brevicomis* LeConte, and the mountain pine beetle, *D. ponderosae* Hopkins, for 36 months; as a 2% aqueous emulsion it was effective for 22 months.

In a recent study, lindane in diesel oil was applied to infested logs 1–4 months before the emergence of western pine beetle, *Dendroctonus brevicomis* LeConte (Lyon and Swain 1968). A 1% spray reduced emergence by 67% and reduced the total number alive after 3 days by 84%; a 1.5% spray was 84 and 95% effective for the respective categories. Swain[3] found that a 1.5% aqueous emulsion protected fire-damaged trees from western pine beetle attack for at least 1 year, in a pilot-scale field test. Smith (1967) reported 2% lindane in diesel oil to be effective for at least 1 year in preventing attacks of the western pine beetle on ponderosa pine, *Pinus ponderosa* Lawson.

A study was made to determine the length of effectiveness of lindane as 2% aqueous emulsion and as 2% diesel oil solution in preventing attacks of both the western pine beetle and the mountain pine beetle, *D. ponderosae* Hopkins, on ponderosa pine in California.

Each ponderosa pine tree was treated in one of two ways: (1) 2% lindane in diesel oil applied by brush to a 3-ft section at about an 18-ft height in August 1965, (2) either 2% lindane in diesel oil or 2% lindane aqueous emulsion applied to the basal 9 ft by pressure sprayer in November 1966. All treatments were at the approximate rate of 1 gal/50 ft^2 of bark surface to 40-year trees in a dense plantation at the Institute of Forest Genetics near Placerville, Calif. Trees ranged from 12 to 14 in. DBH. The bark was dry at time of all applications, and it remained dry for about 3 months on trees that had been lindane brushed. A heavy rainstorm occurred 3 days after trees had been treated by pressure sprayer.

At designated months after treatment (Table 1), trees were felled and the treated portions were cut into 1½- to 2-ft lengths. An equal number of similar size bolts was cut from the untreated portion of each tree. Nearby untreated trees were felled and sectioned for additional controls. Thus there were both intra- and intertree untreated controls.

One end of each bolt was covered with fine-mesh plastic screening and the other end was placed in sand. Thus the attacking beetle had to bore through the bark surface to reach the phloem-cambium area. Each bolt was enclosed individually by a cylindrical wire-mesh cage.

Beetles, reared from naturally infested trees, were introduced into each cage at a fixed rate per square foot of bark surface; i.e., *D. brevicomis* at 50 and *D. ponderosae* at 25.

Three to 4 weeks after beetles were introduced into the cages, the bolts were examined for beetle attacks by stripping away all the bark. The degree of success of the attacks was noted, and the number of inches of egg galleries per square foot of bark was

[1] Received for publication Oct. 27, 1969.

[2] Coleoptera: Scolytidae.

[3] K. M. Swain. Protecting ponderosa pine from bark beetle attack by use of a lindane-water emulsion spray. USDA Forest Serv., San Francisco, Calif. 1968. Unpublished.

measured. During the examination of the treated bolts, it was found that many beetles had attempted to bore through the bark; most of them died within the bark, and some withdrew to die outside the bark. Gallery extension and oviposition progressed in a somewhat parallel manner. If a beetle could extend the gallery for an inch or two, there was usually oviposition. Therefore, length of galleries with eggs is a valid criterion of the success of the beetle attack.

The results (Table 1) show the 2% aqueous emulsion was fully effective in preventing attacks of both *D. brevicomis* and *D. ponderosae* for 10 months, and only slightly less than fully effective for 22 months. It is doubtful whether these very few and very limited attacks could have caused any serious injury to growing trees. The 2% diesel oil solution was fully effective for 36 months against both species of beetle except for 1 isolated and limited attack on 1 bolt. These spray formulations could help protect high-value trees where attacks by either bark beetle are possible.

Table 1.—Residual effectiveness of lindane, by preparation, against attacks of *D. brevicomis* and *D. ponderosae* on ponderosa pine in California.

Residual age of spray	Bectle species[a]	Untreated: Bolts used[b]	Untreated: Length of egg gallery per sq ft of bark[c]	Treated: Bolts used	Treated: Length of egg gallery per sq ft of bark	Effectiveness[d]
Months		Number	Inches	Number	Inches	Percent
		2% aqueous emulsion				
10	*D.b.*	8	87	6	0.0	100
	D.p.	8	54	6	.1	100
22	*D.b.*	3	109	2	1.0	99
	D.p.	3	59	2	5.5	91
		2% diesel oil solution				
22	*D.b.*	3	119	2	.0	100
	D.p.	3	50	2	.0	100
24	*D.b.*	2	81	2	.0	100
	D.p.	2	70	2	.0	100
36	*D.b.*	2	106	2	.8	99
	D.p.	2	55	2	.0	100

[a] *D.b.* = *D. brevicomis*; *D.p.* = *D. ponderosae*.
[b] Ranged from 1½ to 2 ft long and 10–14 in. diam.
[c] Intra- and intertree checks were pooled.
[d] [(Length egg galleries untreated — treated) ÷ untreated] × 100.

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An Automatic Data Processing System for the Documentation of Forest-Insect Survey Information[1]

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ABSTRACT

An automatic data processing system (ADP) that will permit storage and rapid retrieval of forest-insect survey information is described. Although designed specifically for use within the 20 States of the Northeastern Area, consideration for nationwide use was given in its development.

The ADP system described is based on an open-ended numerical code in which IBM punch cards or magnetic tape are used for data storage. Two programs have been written in Fortran IV for retrieval of the stored information and for preparation of specific reports for field distribution.

Protection of forest resources from insect pests is an important function of forest resource management. However, to do this effectively requires an accurate and comprehensive knowledge of the presence, abundance, distribution, and fluctuations of forest insect populations. This knowledge is gained through field surveys from which biological and ecological data may be accumulated. These data, when analyzed, form the basis for future action by the resource manager.

Over the past 25 years Federal, State, and private agencies have been developing greater awareness of the need to protect our forest resources from forest insects. This awareness has evolved into a variety of survey systems designed to detect the presence of forest-insect problems and to determine their trend and probable impact upon the forest resources. Since 1954, forest-survey programs have been greatly expanded through Federal technical and financial assistance to cooperating States. Today nearly all commercial forest areas are under some degree of surveillance aimed to detect forest-pest problems before they become epidemic.

This activity has greatly increased the quantity and quality of forest-insect survey information that is being gathered by the various State and Federal agencies concerned. The accumulation of this information has created, and still is creating, an increasing problem in storage and retrieval. The need has become more pressing for an efficient, easily operated, and flexible system for handling this information in a manner that would make it quickly available in a usable form. The large number of different organizations currently involved in collecting and using forest-insect survey information adds to the pressure.

In 1962, the author undertook to develop a procedure for meeting this problem. The automatic data processing (ADP) system used by the Forest Insect and Disease Survey, Forestry Branch, Canadian De-

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