

not usually blown long distances, probably because of rains or downward air currents.

In several of the years during which observations have been made there was a close correlation between the first appearance of rust spores on slides exposed over a given area and the first appearance of rust in the grainfields of that area.

By the use of airplanes large areas can be explored and the more general movements of rust spores ascertained by the examination of slides exposed in this manner. At present this is one of the most reliable means of determining the extent of the movement of spores of disease-producing organisms from one locality to another.

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## **B**LISTER-RUST Control Is Aided by Power Devices for Spraying Host Plants

The eradication of *Ribes* (currant and gooseberry plants) by the hand-pulling and grubbing method generally used in work for the control of

white-pine blister rust in the Eastern States has been found to be well adapted to certain forest conditions in both the sugar-pine and western white-pine regions of the West. Approximately 60,000 acres of pine-land in the western white-pine area of the "Inland Empire" (eastern Washington, northern Idaho, and western Montana) have been worked by this method of *Ribes* eradication at an average cost of \$1.94. Similar work performed on 20,000 acres of sugar-pine land in California cost \$1.92 per acre. An average of 81 *Ribes* bushes per acre were destroyed in the "Inland Empire," whereas the average number was 58 in California. The bushes in California were larger, spicier, and more firmly rooted, which largely accounts for the higher cost of 3.3 cents per bush compared with 2.4 cents in the "Inland Empire." These hand methods of eradication are satisfactory on the upland sites in both regions except where the plants are too deeply rooted in rocky areas to permit the proper removal of the crown without undue labor. In the latter case killing the plants by applying a toxic chemical may prove more effective and less costly.

In situations along stream courses, especially in the "Inland Empire," the *Ribes* plants occur abundantly within limited areas, commonly exceeding several hundred bushes per acre, and, as a result of prolific layering, develop such diffuse root systems that it is both difficult and costly to use hand-eradication methods. Considerable experimentation has been done in Idaho to develop an effective chemical method for eradicating *Ribes* in stream-type locations. The stream-type *Ribes* are often partly submerged in water during a greater part of the working season. This obviously limits chemical application to the aerial parts of the plants. In the stream-type areas of Idaho three *Ribes* species are present, *Ribes petiolare*, *R. lacustre*, and *R. inerme*. It has been found that one application of 10 per cent aqueous solution of sodium chlorate sprayed on the leaves and stems will completely kill the first species, while three applications of a stronger solution of the same chemical is required to kill all plants of the other two. It has been demonstrated that where the stream-type *Ribes* growth is composed chiefly of *R. petiolare* this method of treatment is from 49 to 56 per cent less costly than the hand method. In the case

of the two species of *Ribes* that require several applications of the chlorate it has not yet been fully determined whether this chemical method is economical. (Fig. 15.)

For use in applying toxic sprays to *Ribes*, two types of spraying equipment were developed, namely, knapsack and power. The knapsack unit consisted of a 5-gallon tank fitted to a pack frame and held in place by adjustable straps, a double-action hand pump, and a short extension fitted with a suitable nozzle. This type of equipment is designed for general use in all stream-type sites but is most effective where *Ribes* occur in comparatively thin concentrations or in scattered clumps.

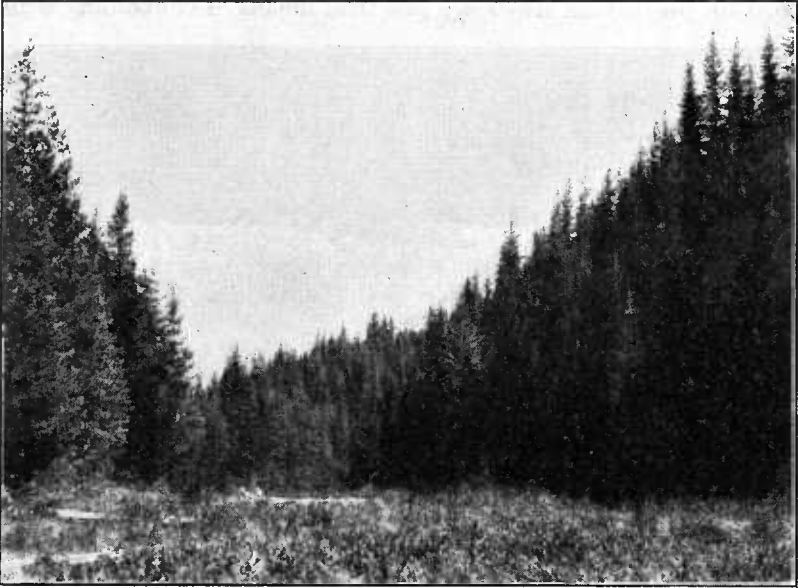


FIGURE 15.—A typical stand of young western white pine (*Pinus monticola*) with stream-type site in the foreground

### Long Series of Tests Made

The adaptation of power equipment to the spraying of wild *Ribes* has necessitated a long series of tests with portable motors, hose, couplings, and nozzles. At the present time power-spraying units have been so organized and equipment so improved that this method of spraying *Ribes* gives greater promise of minimum blister-rust protection costs than does the knapsack-spraying method on extensive areas having heavy or moderately heavy concentrations of *Ribes*. The power plant is a specially adapted, small-capacity, forest-fire pumper with a sufficiently large by-pass to take care of surplus liquid passing through the pump and not needed at the nozzles. One of these motors will maintain sufficient pressure to produce a good film of spray when 20 nozzles are wide open and liquid is being pumped through 2,000 feet of  $\frac{1}{2}$ -inch main line and 3,000 feet of  $\frac{1}{4}$ -inch lateral hose. However, it has been found not economically feasible to employ more than 10 nozzles on any one unit, and future experiments may point to a further reduction. (Fig. 16.)

Still smaller and lighter motors have been extensively used, but with unsatisfactory results. The lighter motors loaded to capacity show the effects of the load and begin to give trouble early. The heavier motors with a relatively easy load run along smoothly day after day and even week after week without giving serious trouble. The success of this type of work is dependent upon continuous operation of the motor.

Where the power unit is employed on heavy concentrations of Ribes, the average area sprayed per man per day is three-fourths of an acre. Where knapsack spraying is done on lighter concentrations the average area sprayed per man per day is  $1\frac{1}{4}$  to 2 acres.

Both the hand-pulling and chemical methods that have been described for destroying Ribes are practical means of controlling white-



FIGURE 16.—A close-up view of a patch of *Ribes petiolare* in its natural habitat. The picture was taken shortly after the bushes had been sprayed in 1929. Note the dead leaves. In June, 1930, all the stems and roots of the sprayed bushes were dead.

pine blister rust in the West. Should a chemical spray or a chemical dust be developed, however, which will be completely effective on the other species of Ribes found in the western white and sugar pine forests, hand pulling may in the future be much less extensively employed, since chemical treatment is generally a quicker and less costly method.

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**B**LISTER-RUST Control  
Is Effective With  
Public's Cooperation

The cooperation of the public in the campaign to control the white-pine blister rust in the Eastern States is primarily responsible for the success of this work. The campaign is led jointly by the States concerned and the United States Department of Agriculture. Labor is fur-