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VERTICAL DISPERSION OF TWOSPOTTED SPIDER MITES[1] ON HOPS THROUGHOUT THE GROWING SEASON[2]

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ABSTRACT

Studies were conducted in 1968 and 1982 to determine the vertical dispersion of twospotted spider mites, *Tetranychus urticae* Koch, on hops during the growing season. Data from both years were combined.

Twospotted spider mites were primarily on the lower half of the plants from May, when the plants initiated growth, through early July. By early-to mid-August most of the spider mites were on the upper half of the plants. Since the apical growth of hops is very heavy at this time, conventional, contact spray pesticides cannot reach these mites. However, systemic pesticides may be effective for mite control.

INTRODUCTION

Hops, *Humlus lupulus* L., grown in the dry areas of the Pacific Northwest, are subject to foliage injury by the twospotted spider mite, *Tetranychus urticae* Koch, and the hop aphid, *Phorodon humuli* (Schrank). Both damage the plant by feeding on the leaves, and severe infestations of either pest can potentially result in total crop loss if left uncontrolled. Thus, growers repeatedly apply several pesticides with tractor-drawn, air-blast sprayers or aircraft.

Hops grow from a perennial subterranean crown, wind around and climb strings to a 5.5 m high wire trellis. Crowns are spaced 2.1 x 2.1 m apart in the hop yard. The hop growing season extends from early-May to mid-September when the vines are cut and removed from the yard. By mid-August apical growth becomes extremely dense and pesticides applied with a tractor-drawn, air-blast sprayer or with aircraft do not adequately cover the canopy. If a large pest population continues to exist in the canopy, crop damage will still occur.

Vertical dispersion of spider mites on hops has received little attention. Knowledge of pest dispersion patterns on the plant over time would aid in more effective placement of pesticides, thereby reducing the amount of pesticide needed and, in turn, reducing the residue burden in the hop cones. Therefore, the purpose of this study was to determine the vertical dispersion of twospotted spider mites on hops during the growing season.

MATERIALS AND METHODS

This study was conducted in south-central Washington during the growing seasons (i.e., June-August) of 1968 and 1982. The variety of hops used was "Yakima Valley Clusters." A row of 32 plants was divided into 8-hill plots, replicated 4 times, with 1-hill borders between plots. Plant height intrvals of 0.0-0.9, 0.9-1.8, 1.8-2.7, 2.7-3.7, 3.7-4.6 and 4.6-5.5 m were sampled weekly in 1968 and twice per week in 1982. Ten leaves/ height interval/ plot were collected, placed in plastic bags, and returned to the laboratory. Each plant was sampled. A pruning pole was used to remove leaves from the 3 uppermost height intervals.

Leaves were brushed with a modified Henderson-McBurnie (1943) brushing machine. Leaf surface materials including spider mites, mite eggs, aphids and predators were deposited onto a circular, glass plate covered with a water soluble, sticky substance. A 1/10 subsample was examined using a dissecting microscope, mechanical stage, and backlighting. Mobile forms of *T. urticae*, mite eggs, hop aphids, and miscellaneous predators were counted. From these data we determined the numbers of spider mites/leaf at each interval. The 4

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replications in each year were averaged, the means summed, and the percent of total mites/plant was plotted for each height interval.

RESULTS AND DISCUSSION

The 1982 population of *T. urticae* was suppressed in the early part of the season by the honeydew from an unusually high number of hop aphids. Therefore, diazinon was applied at 0.45 kg a.i./ha with an air-blast sprayer on 26 July to control the aphid population. The decreased aphid population following the diazinon treatment allowed the twospotted spider mite population to increase substantially (Fig. 1). However, since the twospotted spider mite numbers were quite low early in the season, we supplemented the 1982 data with those from a preliminary study conducted in 1968. Since the 1968 and 1982 sampling dates were not always identical, they are listed in the figures as either a range of dates or a single date.

Figure 2 shows the dispersion of *T. urticae* on hops during the growing season. The mean number of mites/leaf increased from 25 (21 June) to 517 (16-17 August), but then declined rapidly to 15 (27 August).

T. urticae overwinters in protected locations in the hop yard, probably around the base of trellis poles or on the subterranean crown. When the plant grew up the strings in May and June, the mites had already emerged and were feeding on basal hop leaves and on various weeds. As the season progressed the mites moved higher on the plant, attaining the greatest percentage of the total mites/leaf in the 0.9-3.7 m height range (Fig. 2a-d).

Late in the season (i.e., early to mid-August) the proportion of mites/leaf in the upper ⅓ to ½ of the plant increased (Fig. 2i-m). Since there were many more leaves and a higher number of mites/leaf in this section of the plant, a very large percentage of mites on the plant was found here.

In late August and early September larger, orange deutogynes developed and initiated a downward migration along the main vines. Once at the bottom of the plant they did not move onto leaves but probably left the vine to find overwintering sites.

The large twospotted spider mite population in the apical regions of the plant is extremely difficult for hop growers to control. Since conventional tractor-drawn, air-blast sprayers cannot deliver

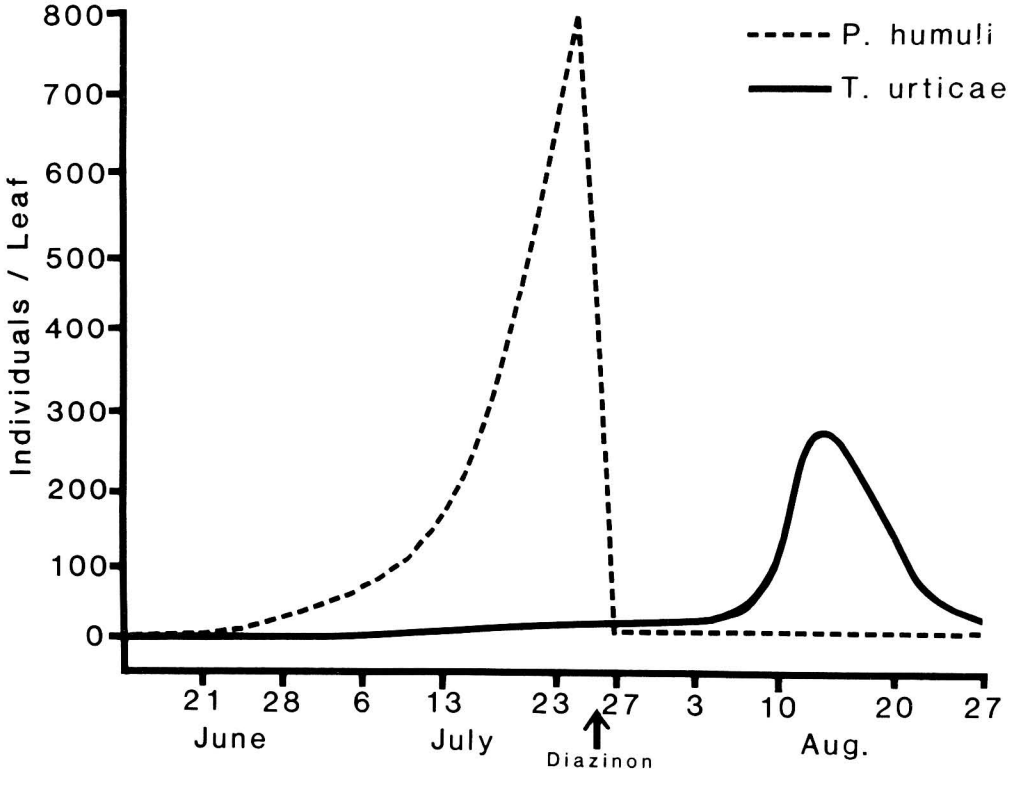

Fig. 1. Population levels of *Phorodon humuli* and *Tetranychus urticae* during the hop growing season.

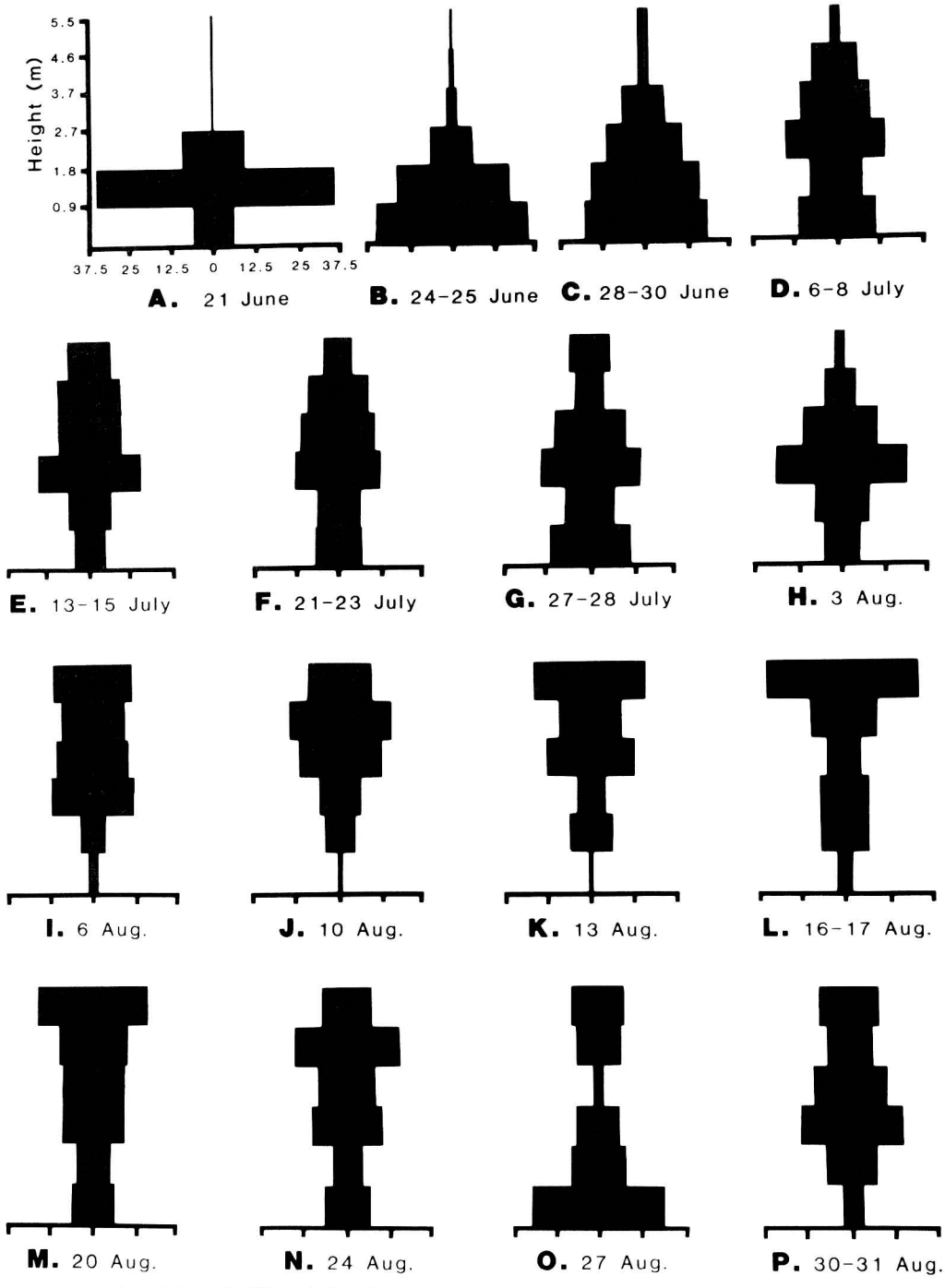

Fig. 2. Combined data of 1968 and 1982 showing percent of total twospotted spider mites/leaf at six heights on hop plants, from 21 June-31 August. The figure is sequentially arranged so that the change in dispersion from the lower leaves early in the season to the upper leaves later in the season may be readily seen.

enough pesticide into the upper regions of the plant and aircraft-applied material cannot descent through the canopy to reach the middle and lower regions of the plant, systemic pesticides may prove to be an essential control strategy. Although disulfoton is currently registered at 0.89 kg a.i./ha, no systemic pesticide is currently registered at a high enough rate to effect satisfactory control of twospotted spider mites. However, several are currently being evaluated for this use.

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PRE-EMERGENCE INSECTICIDE APPLICATIONS FOR CONTROL OF THE MOUNTAIN PINE BEETLE, *DENDROCTONUS PONDEROSAE* (COLEOPTERA:SCOLYTIDAE).[1]

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ABSTRACT

An experiment was set up near Princeton, British Columbia to investigate the efficacy of carbaryl (Sevin SL) and chlorpyrifos and (Dursban 4E) at 1% and 2% a.i. in water, to prevent the successful emergence of mountain pine beetles, *Dendroctonus ponderosae* Hopkins, from infested lodgepole pines, *Pinus contorta* var. *latifolia* Engelmann. All treatments were effective in killing the emerging beetles outright. Mortality ranged from 83.3% for 1% Sevin to 94.9% for 2% Dursban, compared with 6.1% mortality of beetles emerging from water-treated control trees. Living emergent beetles from all treatments suffered >50 and >90% mortality after 1 and 5 days, respectively, compared with 5 and 10 days, respectively, for beetles from control treatments.

INTRODUCTION

Various insecticides applied to the bark of infested trees are effective in preventing or reducing the successful emergence of bark beetles. Examples are: lindane against the western pine beetle, *Dendroctonus brevicomis* LeConte (Swezey and Dahlsten 1983), and lindane, chlorpyrifos, fenitrothion (and several other insecticides) against the southern pine beetle, *Dendroctonus frontalis* Zimmerman (Brady *et al.* 1980; Jones *et al.* 1980).

As lindane is in disfavor because of environmental concerns, it was judged necessary to evaluate additional materials for remedial use on the mountain pine beetle, *Dendroctonus ponderosae* Hopkins. Integrated pest management using semiochemicals (Conn *et al.* 1983; Borden *et al.* 1983) and insecticides for the eradication of small infestations from lodgepole pine, *Pinus contorta* var. *latifolia* Engelmann is of particular concern. Toward this end, this paper describes the evaluation of 2 insecticides, Sevin SL[3] (carbaryl) and Dursban 4E[4] (chlorpyrifos).

MATERIALS AND METHODS

Thirty lodgepole pines infested by *D. ponderosae* in 1981 were selected in the spring of 1982 and in the Summers Creek area approximately 25 km NE of Princeton, B.C. The timber type and the ecological classification is uniform throughout the area. All trees were >26 cm diameter at breast height (dbh) ($\bar{x}$ = 32.3 cm) and the mean dbh's between treatment groups did not differ significantly (F test, $p > 0.05$). To minimize potential problems with insecticide drift and contamination, 6 replicates (trees) for each of 5 insecticide treatments were randomly chosen as same-treatment groups. The control group was located approximately 400 m away from the nearest insecticide-treated trees.

On 6 July, 1982, the trees were sprayed to the drip point with 2-3 L of water or insecticide for-

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