THE EFFECTIVENESS
OF BACILLUS THURINGIENSIS FORMULATIONS
FOR THE CONTROL OF LARVAE OF SCHIZURA CONCINNA
ON CERCIS OCCIDENTALIS TREES IN CALIFORNIA

BY

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Five commercial formulations of Bacillus thuringiensis (BERLINER) were found to be effective for control of larvae of the red-humped caterpillar, Schizura concinna (SMITH & ABBOT), an important defoliator of broad-leaved trees in California. The formulations tested were Biotrol* BTB 183 25 W, Biotrol* KK, Dipel*, Thuricide* HPC, and Thuricide* 90TS 550T. As a result of these trials, B. thuringiensis replaced chemical insecticides for the control of this pest in 1970, and has provided effective control as part of an operational pest management programme for four years.

In central California the red-humped caterpillar, Schizura concinna (SMITH & ABBOT) (Lepidoptera: Notodontidae) is the most important defoliator of walnut orchards and highway plantings of red-bud, Cercis occidentalis Torr, and liquidambar, Liquidambar styraciflua L., trees. Although some mortality is due to predation of eggs and young larvae by the lacewing Chrysopa carnea, the major natural mortality factors affecting S. concinna are the larval parasites Apanteles schizurae ASHMEAD and Hyposoter jugitivus (SAY). In California S. concinna has several overlapping generations per year, and each female moth may lay over 200 eggs. Consequently, this insect has the capability of rapid resurgence following the application of broad-spectrum insecticides.

Laboratory bioassays indicated that Bacillus thuringiensis BERLINER was highly pathogenic to larvae of S. concinna. Field trials were therefore conducted in landscaped areas along highways in Sacramento, Arbuckle, and Auburn, California during the summers of 1970 and 1971 to determine the effectiveness of five commercial B. thuringiensis formulations for control of S. concinna on red-bud trees, C. occidentalis.

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Materials and methods

Red-bud trees in each area were individually coded so that populations of *S. concinna* larvae could be monitored on a tree-by-tree basis. At each observation time, total larval counts classified by instar were recorded for each tree by pooling results for all broods found on that tree.

The *B. thuringiensis* formulations tested included the wettable powders Biotrol® BTB 183 25W (serotype I, variety *thuringiensis*), Biotrol® XK (serotype III, variety *kurstaki*), and Dipel® (serotype III, variety *kurstaki*); and the emulsions Thuricide® HPC (serotype III, variety *kurstaki*) and Thuricide® 90TS (serotype V, variety *galleriae*). With the exception of Thuricide® 90TS, the potency of each formulation was determined by the manufacturer and expressed in International Units (I.U.), using *Trichoplusia ni* as the test insect and the international standard E61, or a national standard based on E61, as the reference material. The I.U. value of Thuricide® 90TS was determined indirectly by extrapolation. For each formulation, the I.U. value applied is given in tables 1 and 2. Nu-film®Bt®, a spreader-sticker, was added to give a final concentration of 0.0013 % in the preparations used in the June, 1970 field trials. Water was used as the suspending medium in all cases.

The sprays were applied when the majority of the *S. concinna* population was in the first to third larval instar. In these stages the larvae are gregarious and easily detectable, and the defoliation sustained by the host tree is kept to a minimum. All applications were made with knapsack sprayers, except the 1971 applications of Biotrol® XK at Auburn and Thuricide® HPC at Arbuckle, where a conventional high-pressure hydraulic tree sprayer was used. All formulations were applied to the point of runoff, the volume applied per tree (3-16 litres) depending on the surface area of foliage treated.

Results and discussion

Tables 1 and 2 provide a summary of the results of five field trials. *Schizura concinna* larval counts totaled over trees, broods and larval stage are given for each treatment at each observation time. The initial counts of larvae present at the time of spraying are in italics; counts made subsequent to the initial count are expressed as percentages of initial counts to facilitate comparisons, and are enclosed in parentheses. Shifting patterns of observation times, which occurred in some trials due to staff shortages, are indicated by the position of the initial and subsequent larval counts in the table.