THE EFFECT OF ROOT WEEVILS (COLEOPTERA: CURCULIONIDAE) ON YIELD OF FIVE STRAWBERRY CULTIVARS IN BRITISH COLUMBIA

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ABSTRACT

To determine the effect of root weevils on strawberry yield, 5 strawberry cultivars: Totem, Shuksan, Northwest, Cheam and BC-25 were infested in the field with 2 or 8 adults per plant of 1 of 4 species of root weevils: the black vine weevil, *Otiorhynchus sulcatus* (F.); the strawberry root weevil, *O. ovatus* L.; the obscure strawberry root weevil, *Sciopithes obscurus* Horn; and the woods weevil *Nemocestes incomptus* (Horn). There were no significant differences in yield between weevil infestations in the first cropping season. In the second year plants in the plot infested with 8 *O. sulcatus* per plant produced significantly less fruit than those in all other infestations. Within this plot Totem and Cheam produced significantly more fruit than the other cultivars. In the third year most of the other weevil-infested plots produced significantly less fruit than the uninfested plot. The plot with 2 *N. incomptus* per plant was the most severely damaged in the third season. The cultivars Totem and Cheam were usually the most tolerant to all weevils. Northwest and BC-25 were the most susceptible to all weevils. The tolerance of Totem to attack by the main root weevil species, *O. sulcatus*, is probably related to the ability of the plant to produce and regenerate a large supply of roots.

INTRODUCTION

The criteria for selecting parent plants in a strawberry breeding program include resistance or tolerance to major pests. In British Columbia several species of root weevils attack strawberry plants (Cram and Neilson 1975). This paper presents the results of a 3-year yield study of the 5 strawberry cultivars: Totem, Shuksan, Northwest, Cheam and BC-25 when they were subjected initially to 0, 2 or 8 adults per plant of 1 of the 4 species of root weevils: the black vine weevil, *Otiorhynchus sulcatus* (F.); the strawberry root weevil, *O. ovatus* L.; the obscure strawberry root weevil, *Sciopithes obscurus* Horn; or the woods weevil, *Nemocestes incomptus* (Horn).

METHODS

Nine strawberry plots were planted in May, 1971, 2 plots for each weevil species and 1 for no weevils. For each plot, 5 virus-free plants of each of the 5 cultivars were set out in 5 rows, 50 cm apart within and between rows in a randomized Latin square design. All blossoms were removed during this period of establishment and all runners were removed as they appeared.

To confine the flightless adults of root weevils an effective barrier was devised that utilized 4 mil black polyethylene plastic (Fig. 1A). A 1-m wide strip of the plastic was draped over a 6-mm diameter polyline that had been stretched over and stapled to 15-cm high cedar stakes. The lower edges were covered with soil on each side to anchor the plastic. Both sides of the plastic were then sprayed with polytetrafluorethylene ('Fluon' dispersion GP2). Adults were unable to climb this slippery vertical surface. This barrier was installed immediately after the plants were set out and was effective for the 37 months of this study.

Adult weevils collected from strawberry fields, except *S. obscurus* which were from rhododendron, were placed within the barriers at either 2 or 8 per plant as follows: *O. sulcatus* on July 30, *O. ovatus* on August 6, *S. obscurus* on August 13 and *N. incomptus* on September 3, 1971. Periodic observations indicated that the adults were successfully established. No herbicides, insecticides, fungicides or fertilizers were applied.

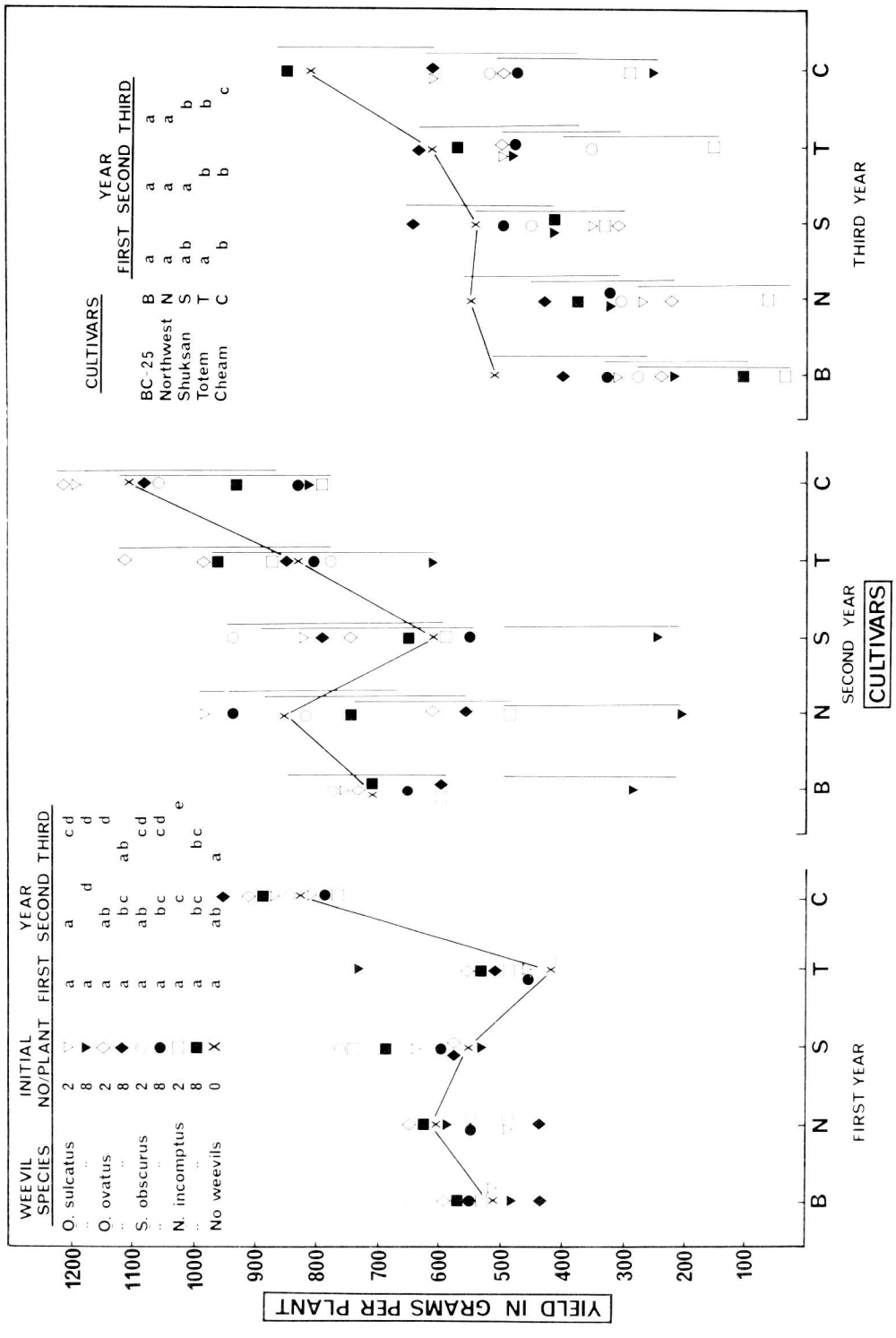
The total yield of all fruit from each plant was recorded for each of 3 years.

Fig. 1A. Construction of plastic barriers to contain and exclude flightless root weevil adults. B. Damage to strawberry cultivars during the second picking season when plants were initially infested with 8 **O. sulcatus** adults per plant. The plot with no weevils is in the immediate background.

RESULTS AND DISCUSSION

In the first cropping season the plants grew luxuriously. There were no significant yield differences between plots but there were significant differences between cultivars. Cheam significantly outyielded Totem, Northwest and BC-25, but not Shuksan (Fig. 2). However, Cheam was highly susceptible to fruit rot and had 24 percent rot; the other cultivars had only 10-12 percent rot.

In the second year the effect of *O. sulcatus* was evident. Where 8 *O. sulcatus* per plant had been added all the plants were smaller than normal and showed signs typical of weevil larval damage to their roots (Fig. 1B). The yields from all other infested plots were not significantly reduced. In the plot with 8 *O. sulcatus* per plant, the yield of the cultivars Totem and Cheam were not significantly reduced but BC-25, Northwest and Shuksan were signifi-


WEEVIL SPECIES
INITIAL NO/PLANT
YEAR FIRST SECOND THIRD
O. sulcatus 2 a a cd
" " 8 ▼ a d d
O. ovatus 2 ◇ a ab d
" " 8 ◆ a bc ab
S. obscurus 2 ○ a ab cd
" " 8 ● a bc cd
N. incomptus 2 □ a c e
" " 8 ■ a bc bc
No weevils 0 X a ab a
CULTIVARS
YEAR FIRST SECOND THIRD
BC-25 B a a a
Northwest N a a a
Shuksan S a b a b
Totem T a b b
Cheam C b b c
YIELD IN GRAMS PER PLANT
1200
1100
1000
900
800
700
600
500
400
300
200
100
B N S T C
FIRST YEAR
SECOND YEAR
CULTIVARS
THIRD YEAR

cantly reduced over plants with no weevils (Fig. 2). In the same year the effect of 2 *N. incomptus* per plant became evident on BC-25, Northwest and Shuksan. In fact, all cultivars were more severely damaged by 2 *N. incomptus* per plant than by 8. Possibly the larger number of adults resulted in crowding that induced the weevils to leave the shelter of the plants and succumb to attempts at escape from the barriered plot, whereas, with only 2 per plant they may have settled under the plants and oviposited normally.

In the third year the trend to lower yields in plots with initially lower populations of adults was even more pronounced. The effect of 2 *N. incomptus* per plant was striking, causing severe damage on all cultivars. *O. ovatus* and *S. obscurus* at either level did not usually reduce yields significantly even by the third season. There were only 3 cases where yield of cultivars in infested plots exceeded the yield in the plot with no weevils (Fig. 2) and there were several cases where weevil damage significantly lowered yields.

The overall yield of Cheam was significantly higher than for Shuksan or Totem, which were in turn significantly higher than BC-25 and Northwest. Since Cheam is very susceptible to fruit rot, the choice of preferred parentage for breeding for weevil tolerance is between Totem or Shuksan. Totem could be judged superior to Shuksan on the basis of its second crop performance when subjected to a high population of *O. sulcatus* which is the most prevalent and most damaging species in this area. The ability of Totem to withstand attack may be related to its ability to produce a prolific root system.

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REFERENCES

Cram, W. T. and C. L. Neilson. 1975. Recognition and life history of the major insect and mite pests of berry crops in British Columbia. B.C. Dept. of Agric. publ'n.

Fig. 2. Yields for 3 years from 5 strawberry cultivars grown together in each of 9 barriered plots infested initially with 0, 2 or 8 adults per plant of 4 different species of root weevils. For each year the yields from the plot with no weevils are joined. Treatments enclosed by the same vertical line are not significantly different. In the legends, treatments or cultivars that have the same letter are not significantly different according to Duncan's multiple range test at P = .05.