BUDWORMS AND BASKETS: An appraisal of a basket attachment for pole pruners in sampling larval populations of the spruce budworm

by

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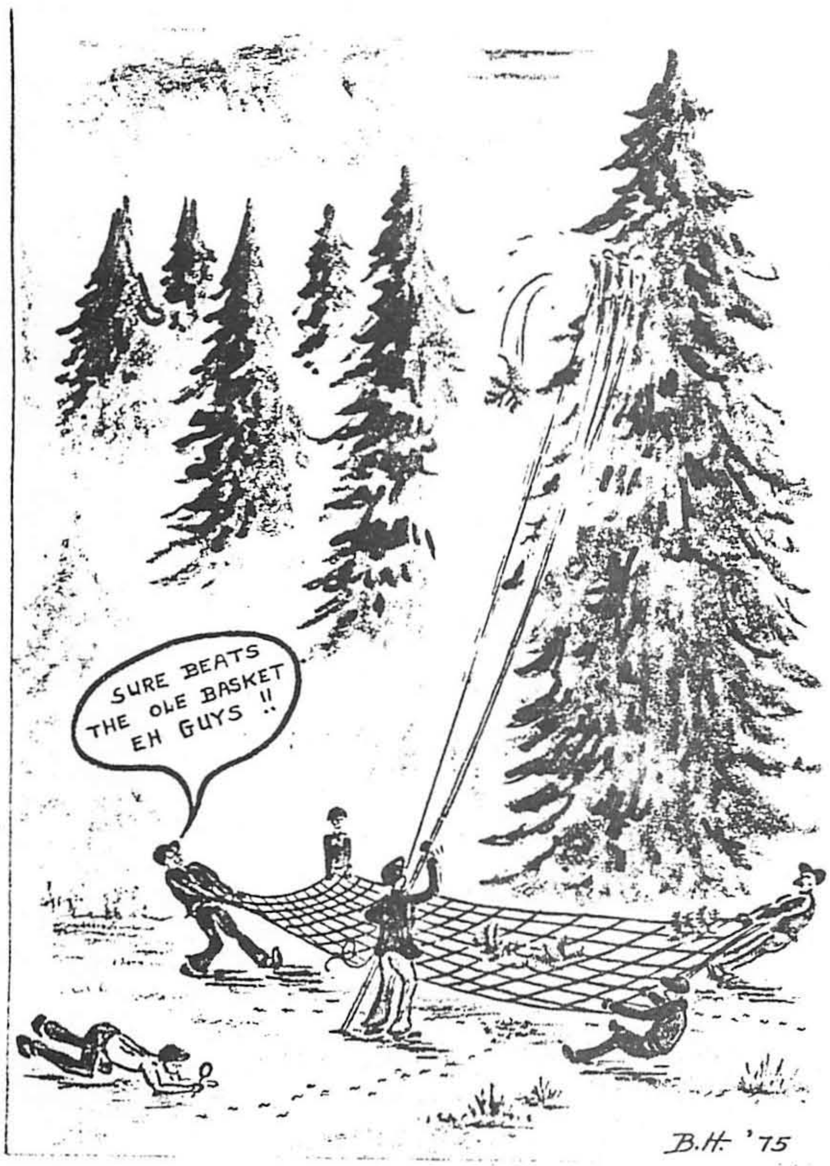
SURE BEATS THE OLE BASKET EH GUYS !!
B.H. '75

INTRODUCTION

A variety of techniques are used to obtain data pertaining to insect population densities on coniferous trees. The most common method, particularly for sampling the larval stage of the spruce budworm (*Choristoneura fumiferana*) and related species, is to count resident specimens on 18-inch branch tips collected from the mid-crown region of representative sample trees (Miller 1974). Usually 10- to 40-ft. lengths of sectional pole pruners are used by sampling crews to acquire these branches.

During the 1974 meetings of the Eastern Spruce Budworm Working Committee in Ottawa, satellite discussions were held to review sampling methods used by various establishments of the Canadian Forestry Service with a major objective being to investigate the possibilities of standardizing techniques for data interpretation and presentation. One area of disagreement was the use of different devices to handle branch tips after severing from trees. As stated by Miller (1974): "It came as a surprise to some that pole-pruners with branch-holding devices (Fig. 1,2) are used by MFRC (Maritimes Forest Research Center) whereas pruners with baskets (Fig. 3,4) are used in Quebec and Ontario. The MFRC assumes that when third (L_3)- and fourth (L_4)-instar larvae are webbed tightly in buds very few will drop from the branch as it is clipped from the tree. Some workers disagree with this assumption and therefore use baskets."

Field staff of the Chemical Control Research Institute (CCRI) have been among the proponents of the basket attachment for pole pruners starting at about the peak of the L_3 period (ca June 1-5) for the following reasons:

(1) Standardize equipment, particularly for casual employees (e.g. students).

(2) Obtain reliable data for computation of larval mortality curves with minimum variation due to sampling error (e.g. mishandling of branch samples).

(3) Eliminate the uncertainty of when to start using a basket or its equivalent during field programs.

In conjunction with the CFS suggestions for establishing standard sampling techniques, basket "catches" from white spruce branches were recorded separately during population studies of the spruce budworm near Grand'Mère, Québec, in 1974. The major objective was to determine the value of the basket attachment during the early larval stadia sampling periods, and to relate this quantitative basket data to larval development during the month of June. The report to follow, then, is but one small contribution to promote continuing dialogue on sampling methodology and the standardization of equipment and techniques. It is not intended as criticism of regional preferences nor is it proposed that the basket is the panacea for the multitude of problems encountered during attempts to obtain representative indices of population density.

MATERIALS AND METHODS

Approximately 1000 branches from roadside white spruce trees were collected during the course of applied control studies of the spruce budworm infesting plantations near Grand'Mère, Québec. Branches were collected twice before spray treatments and four times after treatment to determine resulting impact on larval population levels. This information, along with foliage analyses, was used for the evaluation and comparison of the effectiveness of different spray treatments.

The branch sampling technique was similar to that previously described by DeBoo and Campbell (1972) and DeBoo et al. (1973): Representative branch samples collected from the mid-crown zone of randomly selected trees were lowered via the basket attachment by disassembling the 20- to 40-ft. of pole sections. The branch was then placed in a plastic bag for later processing, whereas the basket was examined immediately for the presence of dislodged larvae. Separate counts from the basket and branch were thereby attained for each of 446 samples collected during the month of June. These figures were then used for obtaining estimates of:

(1) Larval drop (no. in basket),

(2) Relationship of basket collections to branch collections according to larval stadia present,

(3) Percentages of original branch populations which were collected in the basket, with special reference to collections of stadia at the peak of L_4 (June 9 - 14, the period when 70% or more of the larval population was at L_4),

(4) Sampling error (no. in basket) for branches collected from sprayed trees and from untreated check trees.

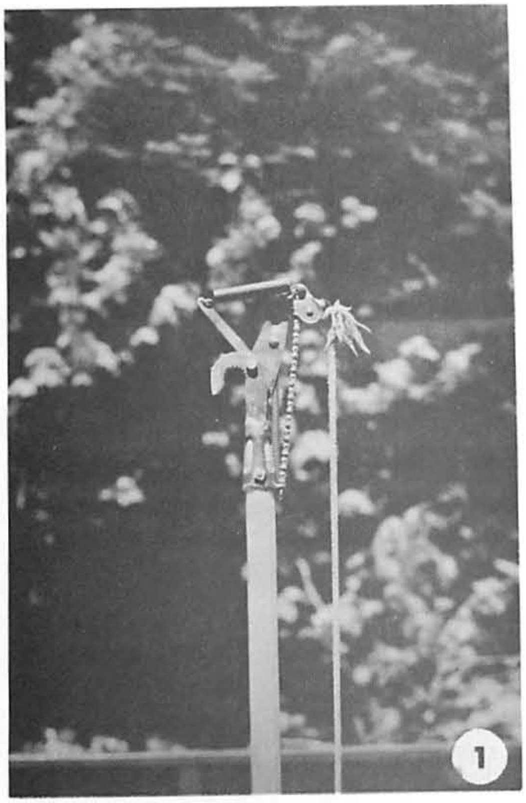

Figure 1. A clamping devise attached to the head of a sectional pole pruner.
Figure 2. A clamped branch sample; sample is released for free-fall to ground.

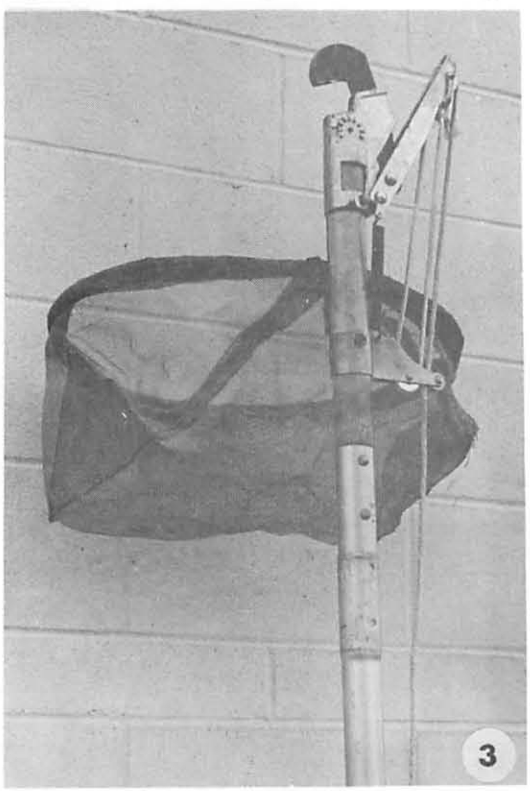

Figure 3. A see-through basket attached to the head of a pole pruner.
Figure 4. Lowering of sample in basket is by disassembly of 6 ft. pole sections.

RESULTS AND DISCUSSION

Approximately 16% ($\frac{1623}{10282}$x 100) of the total number of spruce budworm larvae collected at Grand'Mère were from the pole-pruner basket. The period during which samples were taken spanned the most injurious period of larval attack, where detailed information was required to determine impact of spray treatments on population densities of the budworm. As expected, the largest basket catches occurred after the peak of the L_4 period (Fig. 5, 6; Tables I - IV).

The increase in basket catch of the larval population samples (Fig. 6) was related to both larval and shoot development. As larvae increased in size and changed feeding habits to severing needles on expanded new shoots, a larger proportion of the branch sample was dislodged during the pole-pruning exercise. Basket counts indicated that during the peak of L_3 less than 2% of the branch population will be dislodged. The sample loss (basket count) will be about 10% at peak L_4, 15% at peak L_5, and 25% or more at peak L_6.

Very few early-instar larvae (L_2= 0, L_3= 4, L_4= 240) were found in the basket, however, (Table I). These observations confirm Miller's (1974) statement on feeding habits and phenological development of new shoots previously stated. The basket larvae were not uniformly of the same stadium, however, and it should never be interpreted that only a single stadium is present during the peak periods. On June 1, for example, the population mix was approximately 65% L_2 and 35% L_3 (Fig. 5). Five days later the composition was about 7% L_2, 65% L_3 and 28% L_4. At the peak of the L_4 period, six days later (June 12), the population was composed of 8% L_3, 79% L_4, 10% L_5, and 3% L_6. Thus, during the timespan of about the first two weeks of June, the proportion of larvae feeding in needles and buds dropped rapidly so that by June 15 about 10% of all larvae collected were from the basket (Fig. 6). At that time, only three days after the peak of L_4, the population was composed of 2% L_3, 55% L_4, 24% L_5, and 19% L_6, approximately.

The basket count data from key sampling periods (Tables II, III) indicated that judgement for initiating basket use (vs. no basket) would be difficult. As found, the greatest deviations occurred when branch samples contained more L_5 and L_6. At Grand'Mère this period was June 15-30. At Shawville, Quebec (Ottawa Valley), however, the peak of L_4 was June 3-5 for populations on white spruce (Fig. 7), and on June 15 development of the larval stage was mostly L_5 and L_6. Similarly, data for larval development in southern Manitoba during 1973 (Fig. 8) indicated that accelerated feeding and moulting may occur (compared to development at Grand'Mère during 1974) so that by June 15 L_6 was the most abundant stadium found. Differentials in development trends as influenced by annual or geographical weather conditions then, must be followed carefully to minimize loss of larvae should the basket not be in use.

Basket counts from branches taken from treated and untreated trees were noticeably different, particularly during the first post-spray sample when the proportion of L_3 and L_4 was high. Nearly twice as many of these small larvae were collected from sprayed trees (Table IV). Accordingly, basket catch differentials would undoubtedly be important with regard to studies on insecticide effectiveness[1]. Any loss of larvae would tend to

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[1] Note: Information for spruce budworm basket/branch counts from balsam fir was unavailable as data were not recorded separately. It is suspected however, that catch would be similar (if not greater) for all larval stadia.

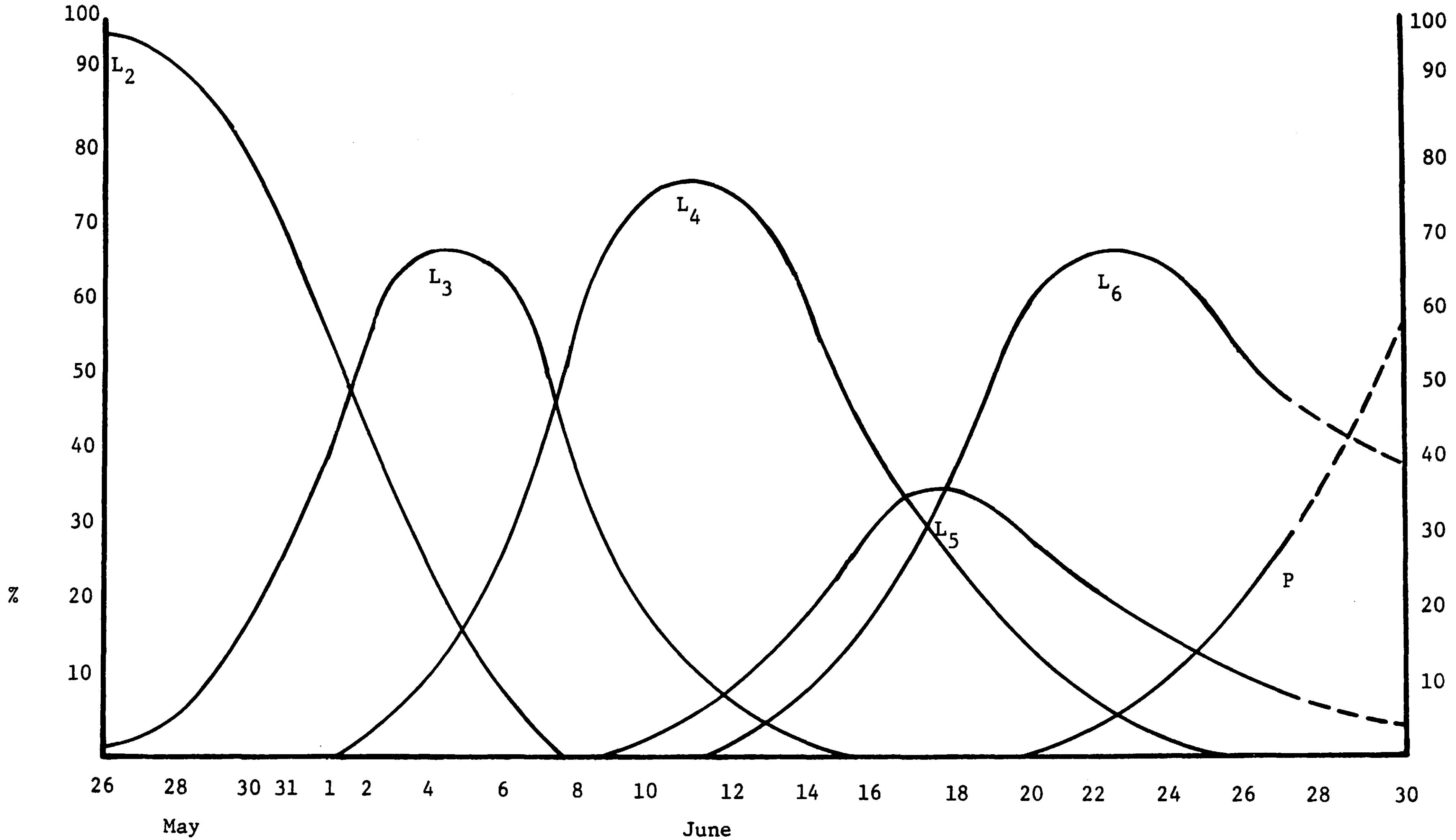

Figure 5. Larval development patterns for the spruce budworm at Grand'Mère, Quebec during 1974.

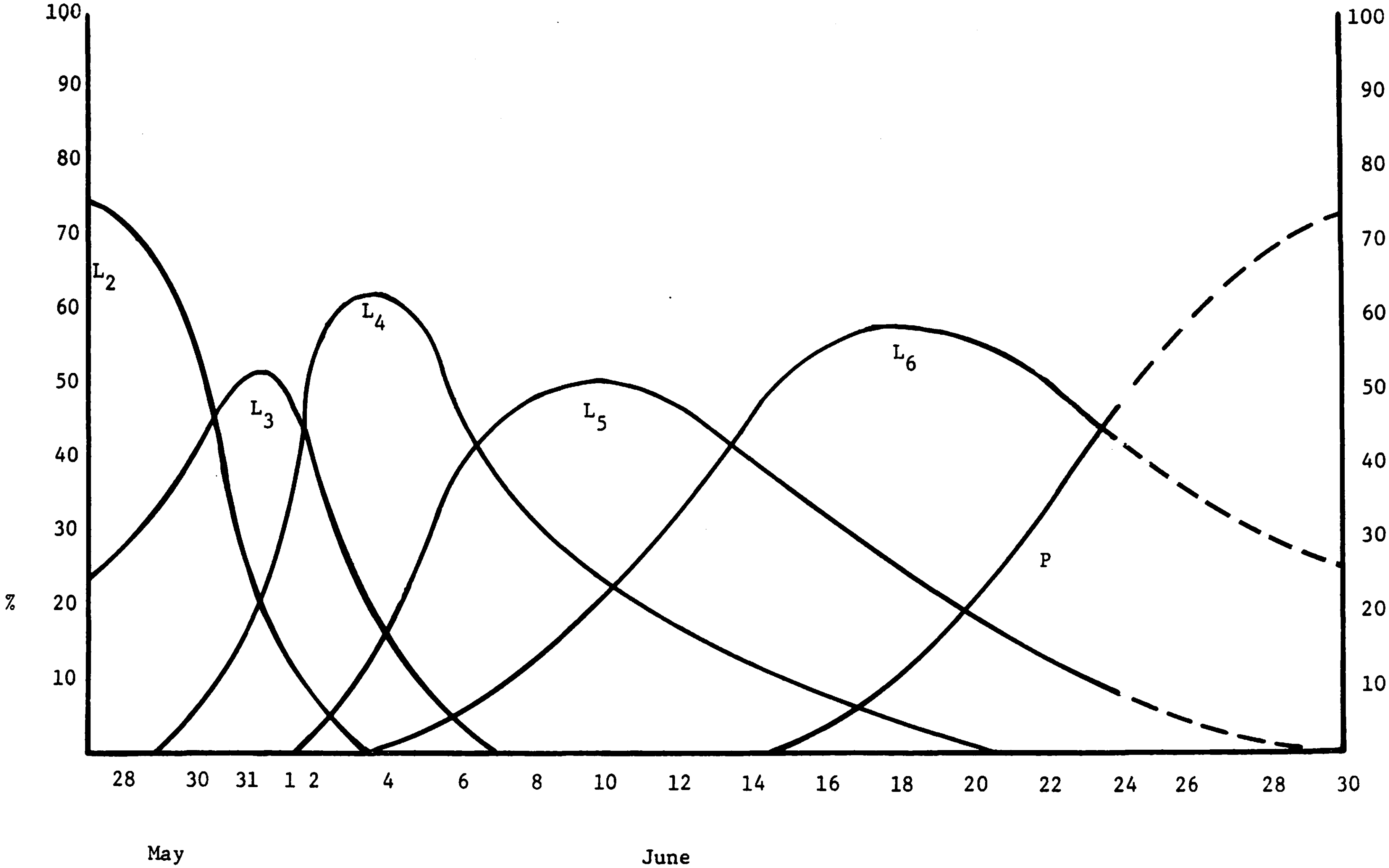

Figure 6. Larval development patterns for the spruce budworm at Shawville, Quebec, during 1974.

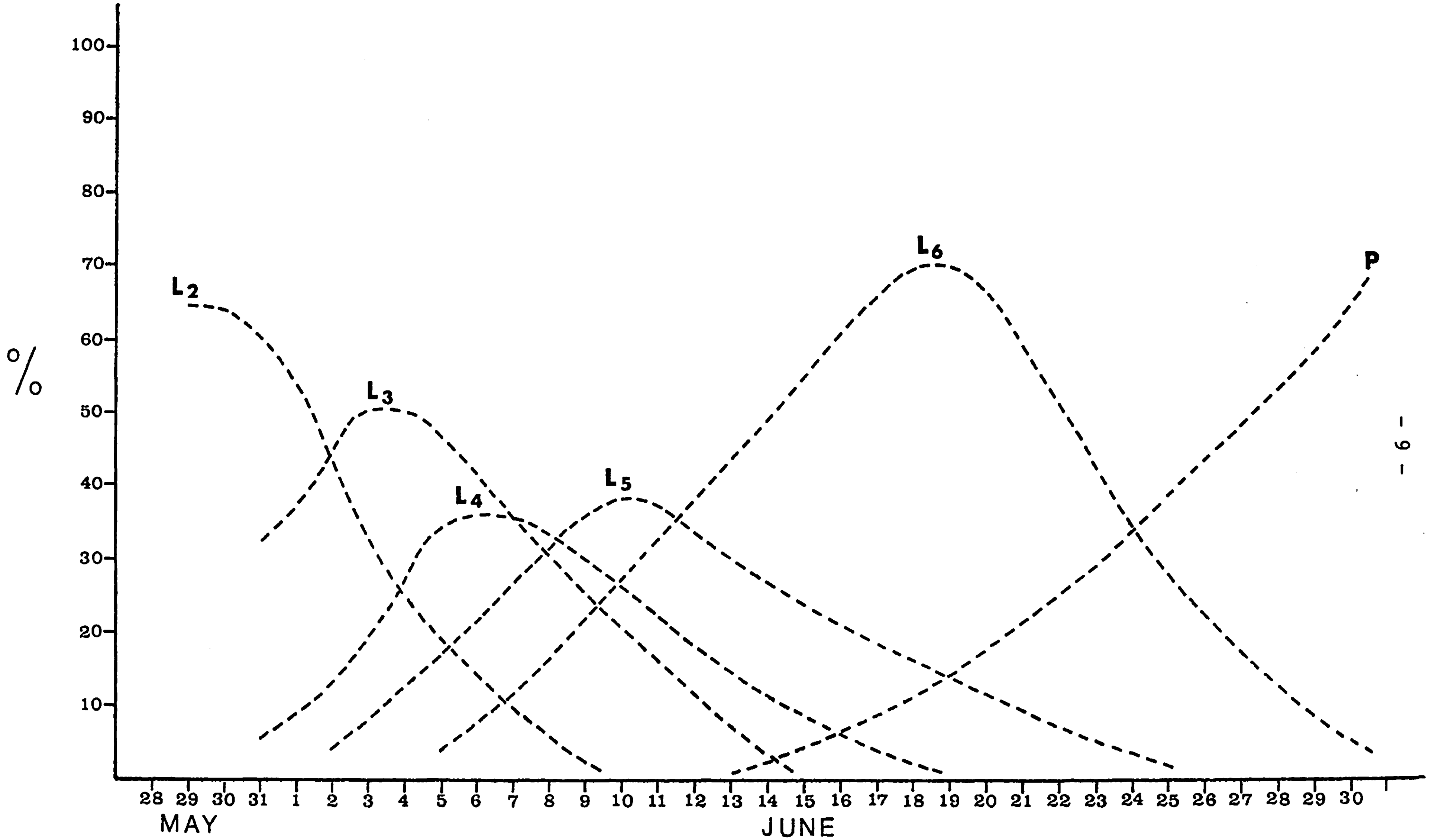

Figure 7. Larval development patterns for the spruce budworm at the Spruce Woods, Manitoba, 1973.

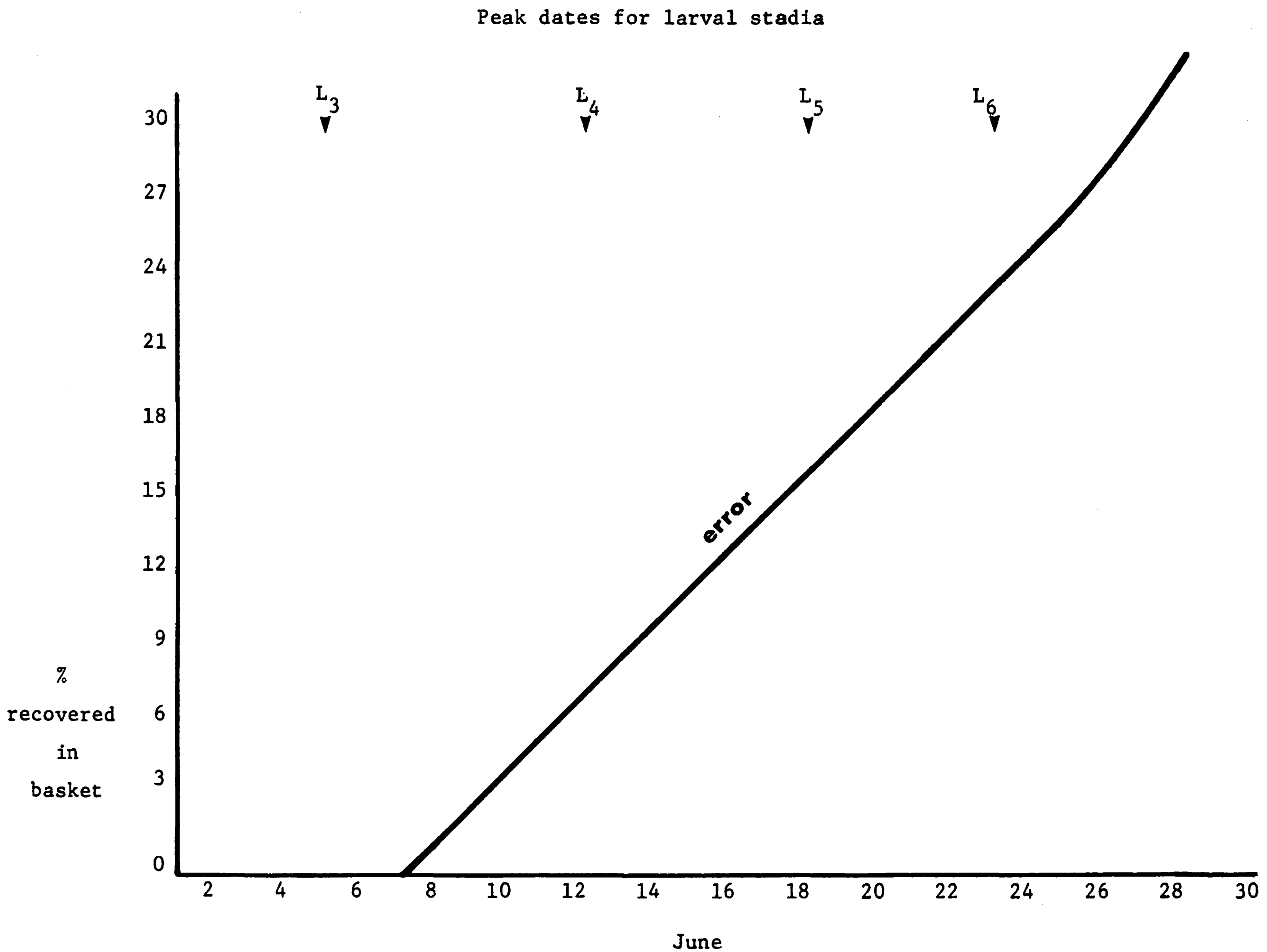

Figure 8. Proportion (%) of total larval population collected in basket according to time of sampling and larval development.

Table I. Recovery of live larvae from 18-inch white spruce branch tips, Grand'Mère, Québec, June 2-28, 1974.

Larval Stadium	Insecticide Treated Plots[1]		Untreated Check Plots[2]		Combined Total	
	Branch	Basket	Branch	Basket	Branch	Basket
L_2	0	0	7	0	7	0
L_3	178	3	155	1	333	4
L_4	1895	187	998	53	2893	240
L_5	1062	199	583	141	1645	340
L_6	992	430	523	207	1515	637
$\sum$	4127	819	2266	402	6393	1221

[1] 350 branches

[2] 96 branches

Table II. Recovery of live larvae from all collections during key development periods, Grand'Mere, Quebec, 1974[1]

Larvae recovered from	Peak L_3 (June 3 - 7)		Peak L_4 (June 9 - 14)		Peak L_5 (June 16 - 19)		Peak L_6 (June 21 - 24)	
	%	$\bar{x}$ ± S.D.	%	$\bar{x}$ ± S.D.	%	$\bar{x}$ ± S.D.	%	$\bar{x}$ ± S.D.
Branch[1]	n.a.		93.7	154. ±84.9	81.9	128.5±36.5	75.6	78.8±42.0
Basket	n.a.		6.3	10.4±10.2	18.1	28.3±19.2	24.4	25.2±21.5

1 - Using the beating technique (DeBoo et al. 1973) and drum apparatus (Martineau and Benoit 1974); branches processed in groups of 5.

n.a. - Basket data not recorded separately; very few larvae collected in basket, however.

Table III. Recovery of live larvae (by instar) during key development periods, Grand'Mere, Quebec, 1974[1].

Larvae recovered from	Instar	Peak L_3 (June 3-7) Avg. No.	Peak L_3 (June 3-7) Range	Peak L_4 (June 9-14) Avg. No.	Peak L_4 (June 9-14) Range	Peak L_5 (June 16-19) Avg. No.	Peak L_5 (June 16-19) Range	Peak L_6 (June 21-24) Avg. No.	Peak L_6 (June 21-24) Range
	L_2	38.5	1-132	0	0	0	0	0	0
	L_3	15.8	0-94	14.5	0-42	1.8	1-22	0	0
Branch[1]	L_4	2.5	0-56	106.5	15-246	55.1	22-116	7.8	0-46
	L_5	0	0	26.9	0-68	47.6	9-137	13.8	0-42
	L_6	0	0	5.4	0-41	36.6	0-125	27.3	6-109
	L_2			0	0	0	0	0	0
	L_3			0.1	0-1	0.1	0-1	0	0
Basket	L_4	n.a.		4.9	0-14	7.1	1-16	0.7	0-3
	L_5			1.7	0-7	12.5	0-42	3.1	0-16
	L_6			0.6	0-6	8.7	0-27	18.3	0-74

1 - Using the beating technique and drum apparatus; branches processed in groups of 5.

Table IV. Basket recovery of live larvae from white spruce branches, Grand'Mere, Quebec, 1974: Insecticide treated plots vs. untreated check plots.

Larval Stadium	Relationship Basket Catch to Total Collection (%)[1]		Relationship Basket Catch to Total Basket Collection (%)[2]		Basket Catch Composition (%)[3]	
	Treated	Check	Treated	Check	Treated	Check
L_2	0	0	0	0	0	0
L_3	0.06	0.04	1.7	0.6	0.3	0.2
L_4	3.8	2.0	9.0	5.0	18.6	13.2
L_5	4.0	5.3	15.8	19.5	19.8	35.1
L_6	8.7	7.8	30.2	28.4	42.3	51.5

1 - example calculation for L_4 Treated: $\frac{\text{No. } L_4 \text{ Larvae in Basket}}{\text{Total No. All Larvae Collected}} = \frac{187}{(819 + 4127)} \times 100 = 3.8\%$

2 - example calculation for L_4 Treated: $\frac{\text{No. } L_4 \text{ Larvae in Basket}}{\text{Total No. } L_4 \text{ Larvae Collected}} = \frac{187}{(187 + 1895)} \times 100 = 9.0\%$

3 - example calculation for L_4 Treated: $\frac{\text{No. } L_4 \text{ Larvae in Basket}}{\text{Total No. All Larvae in Basket}} = \frac{187}{(187 + 819)} \times 100 = 18.6\%$

bias the actual effect of the treatment. With the compounding impact of greater stadia mix (per Shawville and Manitoba), sampling without a basket at peak L_4 and later could be disastrous and, in fact, a useless exercise.

SUMMARY AND CONCLUSIONS

The use of the basket attachment for pole pruning representative budworm-infested branch samples has been a standard practice of CCRI and other establishments for the procurement of population data. A study of basket catches during the month of June at Grand'Mère, Quebec, indicated that:

(1) An important portion of the population may be missed during pole-pruning through jarring larvae from branches.

(2) Although larger larvae (L_5, L_6) are most easily dislodged, some L_3 and L_4 larvae were found in basket samples prior to June 15.

(3) Larval development rate may vary due to annual and/or geographical weather differentials so that markedly different composition of stadia during the peak L_3 - L_5 period may occur to influence sampling reliability. A basket attachment is recommended ca. June 1-5, i.e. soon after the first L_4 has been recorded, to eliminate the possibility of unnecessary error.

(4) Young larvae (L_3, L_4) from insecticide-treated trees were more numerous in basket collections than from collections in unsprayed areas. This difference is most likely due to the the fumigation and/or contact effect of the insecticides which results in temporary unnatural movement of sick individuals from conventional feeding sites. Loss of these individuals can be prevented by using the basket.

ACKNOWLEDGEMENTS

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