Rocky Mountains Southwest Great Plains

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Cydia youngana (Kearfott) (Lepidoptera:Tortricidae) and Associates in Engelmann Spruce Cones, Fraser Experimental Forest, Colorado 1974-1977

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Insect-caused seed loss in Engelmann spruce (*Picea engelmannii* Parry) varied from 13% to 33% between 1974 and 1977. The primary seed-eating insects were a spruce seedworm, *Cydia* (= *Laspeyresia*) *youngana* (Kearfott), and an unidentified species of fly, possibly a *Hylemya*, found only in the larval stage. Twenty other species were found associated with the cones. In 1975 the flight period of *C. youngana*, determined from light trap catches, peaked around June 28. About 45% of each *C. youngana* generation adults did not emerge until at least the second year after completing their development. An undescribed species of *Elfia*, a tachinid, parasitized *C. youngana*. Because damaged cones cannot be differentiated from sound cones, seed collectors should consider the amount of potential damage when determining their needs.

Keywords: Seed and cone insects, *Cydia youngana*, *Picea engelmannii*.

Management Implications

Because damaged cones cannot be differentiated from sound cones and the average seed loss per cone can be high, seed collection projects should determine the average seed loss per cone for each collection site and adjust their needs accordingly.

Introduction

Abundant seed crops do not occur annually in Engelmann spruce, *Picea engelmannii* Parry, in the central Rocky Mountains (Alexander 1969, Ronco and Noble 1971). Small crops can be attributed to a variety of factors, including insect-caused damage to cone and seed production. In white spruce, *Picea glauca* (Moench) Voss, Tripp, and Hedlin (1956) discovered that little or no sound seed was produced in years of small cone crops because the few cones produced were heavily infested by insects. In white spruce in Alaska, insect damage was also greatest when few cones were produced (Werner 1964). Even during good seed years, the percentage of sound seed may be only 25% to 40% of the total seed collected (Alexander and Noble 1976).

The initial goal of this study was to measure the impact of insects on Engelmann spruce seed production at the Fraser Experimental Forest, 70 km west of Denver, Colo., and to identify the responsible insect species. When it was determined in 1974 that *Cydia* (=*Laspeyresia*) *youngana* (Kearfott) was the principal seed destroyer, added studies were undertaken during the period 1975-1978 to determine

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the peak flight period of *C. youngana* and the number of diapausing larvae.

Methods

One conebearing tree was selected outside of, but adjacent to, each corner of 10 previously-established seed collection plots[2] in the Fraser Experimental Forest. Plots ranged in elevation from 2,780 to 3,517 m, and were on differing aspects. Study trees ranged from 20 to 32 m in height.

To determine cone and seed damage by insects, five cones were to have been removed from each tree at weekly intervals from August to the end of seed drop each year from 1974 to 1977, for a total of 20 cones per plot per week. However, only the 1975 and 1977 cone crops permitted this quantity of sampling. During the other years, five or fewer cones were taken weekly at each plot, depending on cone availability. Conebearing branches were shot off trees with a .22 caliber rifle, labeled, and brought to the laboratory for examination. The total number of sound and damaged seeds within the productive zone of the cone (after Tripp, 1954), insect species, developmental stages, and distribution within the cone, were recorded for each collection. Because the maximum amount of damage was evident in the September samples, they were used to determine the mean number of infested cones, damaged seeds, etc. A 2-way analysis of variance was used to test for differences in seed damage attributable to elevation and aspect.

During 1975, one fluorescent and one blacklight trap were installed in the middle crown of an Engelmann spruce tree, about 20 m above the ground (fig. 1) to discover the peak flight period of *C. youngana*, the most important seed destroyer. Adults were trapped during eight 3-day periods, beginning on June 7 and then intermittently until July 26.

More than 400 cones were collected each February from 1976 through 1979 to determine the numbers of *C. youngana* remaining in diapause within the cones. The cones were brought to the laboratory and isolated individually in vials to determine emergence. After 60 days at room temperature (22° C), emerged insects were counted and the cones dissected. All live *C. youngana* larvae found during dissections were counted as diapausing.

Voucher specimens of insects reported on are kept either at the Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo., or in the U.S. National Museum, Washington, D.C.

Results and Discussion

Impact on Seed Production

Twenty-two different species of insects were found associated with Engelmann spruce cones during the study period (table 1). Two of these were seed eaters; the rest were parasites, predators, or scale, fungus, or foliage feeders.

Figure 1.—Light trap position in Engelmann spruce.

A seed moth, *Cydia youngana* (Kearfott), was responsible for most of the insect-caused seed loss, accounting for an average annual loss of 28% of the total seed production (table 2). The annual loss was 32% or 33% during the first 3 years but decreased to 14% the last year. Within infested cones, an average of 39% of the seeds was damaged during the 4 years.

Seed loss to *C. youngana* accounts for a large portion of unsound seed at the Fraser Experimental Forest. During the years of this study (1974-1977) seed caught in traps at Fraser averaged 56% unsound (Alexander and Noble 1976, Alexander, personal communication). Thus the 28% seed loss caused by *C. youngana* in this study may account for 50% of all the unsound seed.

The seed moth infested an average of 68% of the cones during the 4 years. The percentage of infested cones was highest in 1976 when cone production was lowest (table 2). Simultaneously, the mean percent of cones infested with two or more larvae was also highest. This indicates the moth may oviposit more eggs on fewer cones in poor cone years and thus cause a higher percentage to have multiple infestations.

There were no significant differences in damage attributable to elevation or aspect.

Flight, Oviposition, and Feeding Habits of *Cydia youngana*

The life history and habits of *C. youngana* were similar to those reported from British Columbia by Tripp (1954).

[2]*Alexander, Robert R. 1968. Seed production of Engelmann spruce in uncut stands in relation to seed source. Study Plan 1201.24, on file at the Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo., 33 p.*

Table 1.—Insects associated with Engelmann spruce cones

Insect	Habits	Years found	Percent of cones colonized
Lepidoptera			
Tortricidae			
Cydia youngana (Kearfott)	Seed eater	1974-77	70
Diptera			
Tipulidae			
Tipula sp.	Plant feeder	1974	<1
Sciaridae			
Bradysia sp.	Fungus feeder	1974-77	<2
Cecidomyiidae			
Dasineura sp.	Scale feeder	1974-76	48
Tachinidae			
Elfia n. sp.	Parasite	1974-77	5
Unidentified larva[1]	Seed eater	1976	15
Hymenoptera			
Ichneumonidae			
Dolichomitus sp.	Parasite	1976	([2])
Porizon moderator (L.)	Parasite	1976	([2])
Exeristes comstockii Cr.	Parasite	1976	([2])
Scambus longicorpus Wly.	Parasite	1976	([2])
Scambus protentus Wly.	Parasite	1976	([2])
Scambus hispae Harris	Parasite	1976	([2])
Braconidae			
Bracon sp.	Parasite	1974-77	3
Torymidae			
Torymus sp.	Parasite	1974-77	3
Pteromalidae			
Mesopolobus sp.	Parasite	1976	9
Unidentified species A	Parasite	1976	5
Unidentified species B	Parasite	1976	2
Platygastridae			
Platygaster sp.	Parasite	1974-77	14
Coleoptera			
Lathridiidae			
Melanophthalma sp.	Fungus-mold feeder	1976	<1
Corticaria sp.	Fungus-mold feeder	1976	<1
Hemiptera			
Anthocoridae			
Tetrapheps canadensis Prov.		1976	<1
Thysanoptera			
Thripidae			
Oxthrips sp.	Plant feeder	1974-77	30

[1] *Possibly Hylemya sp.*
[2] *Ichneumonidae as a group colonized 2.5% of the cones in 1976.*

In 1975, adult moths flew from early June to late July with peak flight in the latter part of June (fig. 2). Of the two light sources used, blacklight attracted the most moths. Eggs were deposited from early June until early July in all 4 years of the study. Most eggs were deposited on the apical half of the cone.

After hatching, *C. youngana* larvae moved to the center or productive zone of the cone (fig. 3) where most feeding took place. Feeding within the cone (fig. 4) continued until September when the larvae hibernated. In 1976, when most cones were infested, two or more *Cydia* larvae often became established within the rachis of a single cone. In such cases the larvae separated themselves with plugs of frass (fig. 5). Although cannibalism was not directly observed, it was occasionally evident during cone dissections.

Despite the feeding of *Cydia* larvae within a cone, the cone shows no outward sign of damage, and cone collectors cannot readily distinguish between heavily damaged cones and relatively sound cones. However, damage is easily seen when cones are dissected, and persons obtaining cones for seed collection purposes should dissect a sample of cones to determine the quality of the seed.

The average number of larvae in each cone, and the number of multiple larvae per cone varied over the study period. Larvae were found in the greatest numbers in 1975, when 19 larvae were observed in one cone, and 5 to 7 per

cone was common. The maximum number of larvae completing development in a single cone was three. Between 35% and 55% of the *C. youngana* larvae diapaused each year (table 3), indicating a substantial portion of the population has at least a 2-year life cycle.

Unidentified Dipterous Seed Eater

Unidentified fly larvae infested 15% of the cone samples in 1976 (table 1), accounting for 41% of the destroyed seed. They were not present in 1974, 1975, or 1977. The larvae were observed eating seeds within the cone from early June until late July, when they presumably left the cones. These habits suggest the larvae were a species of *Hylemya* (Muscidae). Hedlin (1973) reported *Hylemya anthracina* (Cz.), a spiral spruce cone borer with similar characteristics and capabilities, in Engelmann spruce cones in British Columbia.

Other Insects

Of the other insects listed in table 1, *Platygaster* sp. (Hymenoptera: Platygastridae) was rare in 1974 and 1975, but infested 14.2% of the cones in 1976 (514 cones, 73 insects). Species of *Platygaster* are reportedly parasitic on *Cecidomyiidae* (Borror and White 1970); the increased population of platygastrids in 1976 may have been responsible for a decrease in midge populations we observed that year.

Table 2.—Cone infestation statistics for *Cydia youngana* for 10 plots, Fraser Experimental Forest

	Year cones were infested				
	1974	1975	1976	1977	Mean
Number of cones examined	60	620	45	400	
Mean percent of infested cones	72	67	92	41	68
Mean percent of total seeds damaged	32	32	33	14	28
Mean percent of damaged seeds in only infested cones	37	46	35	38	39
Mean percent of cones with 2 or more larvae	25	27	62	6	30

Table 3.—Numbers of dead, matured, and diapausing *Cydia youngana* larvae

	Year cones were infested			
	1975	1976	1977	1978
Cones collected	434	414	442	490
Larvae dead	49	45	9	163
Matured larvae (Emerged as adult)	180	122	31	82
Live larvae (Diapausing)	111	103	18	98
Larvae in diapause (percent)	38	46	37	54

Elfia n. sp. (Diptera:Tachinidae) was common all years (e.g., 1976 rearings of 514 cones produced 28 insects, or an infestation rate of 5.4%). The larvae are parasitic on *C. youngana* (fig. 6). The parasite was noted only after the host larva had moved to the cone rachis.

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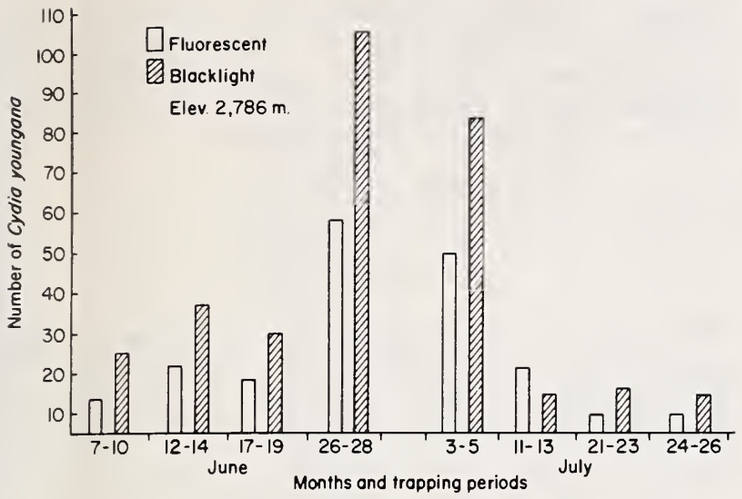

Figure 2.—Flight period of *Cydia youngana* determined by light trapping, Fraser Experimental Forest, Colorado, 1975.

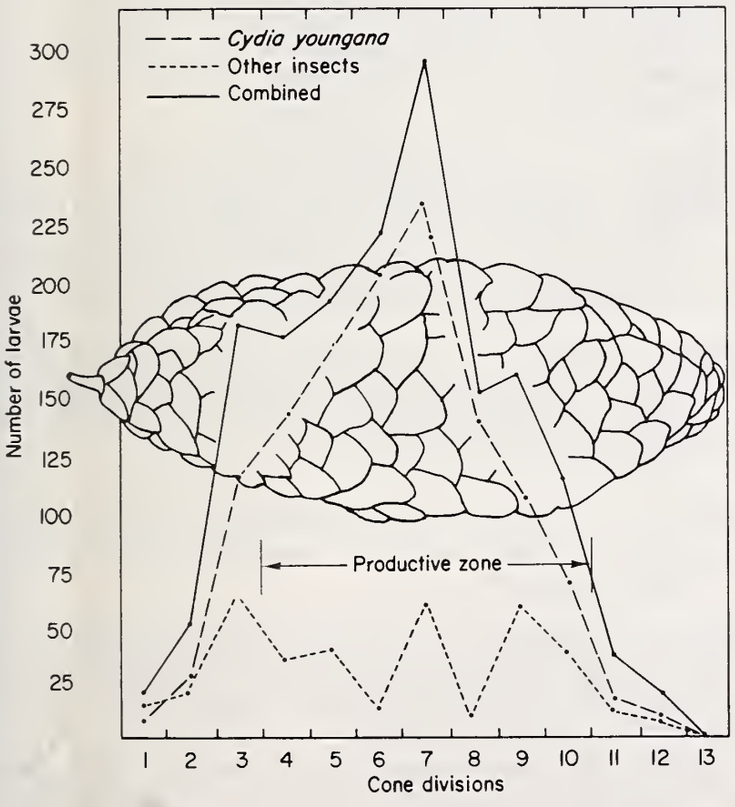

Figure 3.—Distribution of larvae within Engelmann spruce *Picea engelmannii* Parry cones on the Fraser Experimental Forest, 1974.

Figure 4.—Seed destruction by *Cydia youngana* larva.

Figure 5.—*Cydia youngana* larvae in rachis of Engelmann spruce cone. Larvae are separated by a plug of frass.

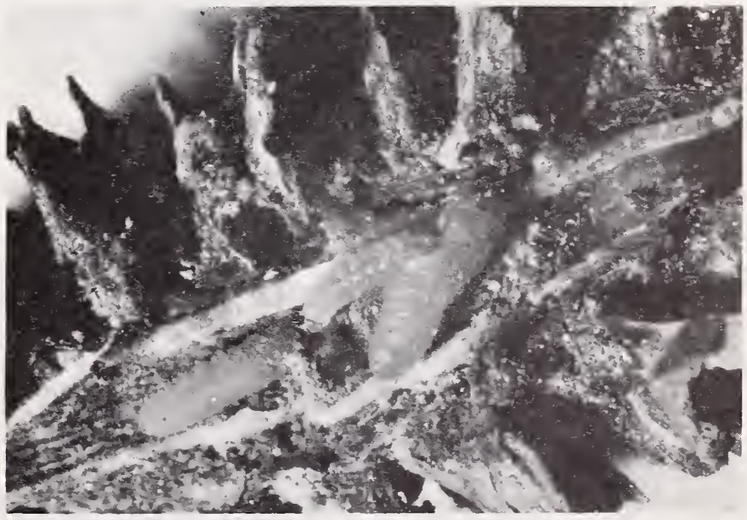

Figure 6.—Parasitism of *Cydia youngana* larva by *Elfia* n. sp.

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