# BI-MONTHLY RESEARCH NOTES

*A selection of notes on current research conducted by the Forestry Branch, Department of Forestry and Rural Development*



## BOTANY

**Cone Production Induced by Drought in Potted Douglas-Fir**—Flower bud formation in forest trees has been frequently linked with hot, dry spring and summer weather, and seed crop periodicity to climatic variation (J. D. Matthews, Forestry Abstracts 24. 1963). Holmsgaard and Olsen (Forstlige Forsøgsvaesen i Denmark, 30. 1966), have recently demonstrated induction of flowering in beech by drought treatment. Optimum response was on plants dessicated between June 17 and August 12. With this exception, relative importance of the effect of temperature versus the effect of moisture stress has not been separated nor the critical time and duration of flower-inducing weather closely defined. Three of six Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) clones grafted in 1959, to provide research material for such studies, produced cones each year since 1962 when held outdoors. In 1964, the heaviest cone year, 10% of the planted, and 42% of the potted, open-bed grafts of these clones produced cones. Individuals held in the greenhouse were always devoid of reproductive tissues.

If above-average temperature is a direct requirement for floral initiation in Douglas-fir, the greenhouse environment should have favored cone production. Alternatively, the possibility of a cold requirement for pre-conditioning prior to the period of bud differentiation did not seem consistent with the erratic flowering response of the species to its natural environment. It was suspected that routine watering of the grennhouse-held plants was more conducive to vegetative growth than floral initiation. The outside plants, which were dependent upon natural precipitation with occasional supplementary watering, were periodically subjected to periods of moisture stress which could have temporarily arrested growth and favored flower bud initiation.

To test the role of moisture stress on cone production a reciprocal transfer of greenhouse and outside grafts was made on April 28, 1964. Shoot growth on greenhouse plants was already well advanced while vegetative buds were just beginning to swell on the outside plants. The material at each location was equally divided for a 60-day wet or dry treatment extending to June 28, after which routine watering was resumed. Each of the four groups contained 20 plants equally composed of six original greenhouse plants and 14 original outside plants. The outside location was changed from open beds to a lath shadehouse at the beginning of the experiment. Rain was excluded from the outside plants during the treatment period by plastic sheeting over the shadehouse roof.

The wet series were watered to runoff at 1-to-3-day intervals, and the dry series were restricted to between 50 and 150 ml of water per pot at intervals of 2 to 5 days. The water added to the dry series averaged 30 ml a day spread over the surface of the 7-inch pots. All material was brought into the greenhouse on May 1, 1965, for cone counts and to provide a uniform environment for the second season's growth. Data from the two clones represented in the experiment were combined since both clones responded similarly to treatment.

Reproductive tissues were not found on any of the plants in the wet series, whereas 11 out of 40 produced cones in 1965 in response to the previous year's drought treatment (Table 1). Cone and seed development appeared normal. Among the original outside plants, cone production response was much stronger when drought treatment was applied in the greenhouse than when applied to plants retained outside. This may be attributed to more favorable temperature and light conditions for continued bud development in the greenhouse or to the much more severe growth reduction of the outside plants due to drought.

TABLE 1

Effect of Location and Moisture Stress on Cone Production and Height Growth

| Movement April 28, 1964 | No. of plants | No. Reproductive | Total Cone Count 1965 | | Mean Height Growth (cm.) | |
|---|---|---|---|---|---|---|
| | | | Female | Male | 1964 | 1965 (Greenhouse) |
| Dry Series | | | | | | |
| Greenhouse to Outside | 6 | 1 | 0 | 1 | 15 | 5 |
| Retained Greenhouse | 6 | 0 | 0 | 0 | 17 | 17 |
| Retained Outside | 14 | 2 | 3 | 140 | 4 | 4 |
| Outside to Greenhouse | 14 | 8 | 10 | 463 | 6 | 11 |
| Wet Series | | | | | | |
| Greenhouse to Outside | 6 | 0 | 0 | 0 | 20 | 11 |
| Retained Greenhouse | 6 | 0 | 0 | 0 | 23 | 21 |
| Retained Outside | 14 | 0 | 0 | 0 | 8 | 7 |
| Outside to Greenhouse | 14 | 0 | 0 | 0 | 8 | 13 |

Plants which had been continuously held in the greenhouse before treatment contributed only one male cone in response to drought. Shoot growth had started at the time treatment commenced and bud initials on the new shoots may have been developed to the stage where differentiation into reproductive buds could no longer be altered by treatment. Owens and Smith (Can. J. Botany 42:1031-1047. 1964) reported that reproductive primordia of Douglas-fir are histologically distinguishable from vegetative primordia when elongation commences on the new shoots on which they develop. Since growth was advanced, drought reduced height growth of the original greenhouse plants to a lesser degree than that of the later-flushing, original outside plants. Height growth reduction continued into the second year in all four dry-series groups. The cone induction response of individual plants within groups showed no correlation with the severity of height growth reduction in the year of treatment.

Post-experiment observations further support the hypothesis of a regulatory role of moisture stress in floral initiation of Douglas-fir. Thirty-four of 102 grafts of two clones continuously held in the greenhouse and subjected to a much reduced routine watering regime in 1965, bore flowers of either or both sexes in 1966. Again in 1965, 100 Douglas-fir, 2+2 transplants, were lifted about 1 week before vegetative bud break, potted and held in the shadehouse. In addition to transplant shock at a susceptible growth stage, the stock was inadvertently allowed to dry out after potting. This resulted in a severe height growth reduction and 16% mortality. Two seedlings bore one female cone each and three seedlings bore 3–5 male cones in 1966, suggesting the possibility of stimulating cone production in very young juvenile material by controlled drought treatment.

These cone production responses from moisture stress suggest that floral initiation, in long-lived species with pronounced seed crop periodicity, may require critically timed conditions that are temporarily unfavourable to vegetative growth. Current experiments are seeking the optimum timing, duration and level of moisture stress for control of floral initiation.—L. F. Ebell, Forest Research Laboratory, Victoria, B.C.

## ENTOMOLOGY

**Erratum:** Vol. 23—No. 2, page 11

In TABLE I, the heading "Beetles in flight traps" applies to the last six columns; "Kerry" applies to the last three columns, and "Naver" applies to columns 4-6.

**A Record of *Tetropium cinnamopterum* Kirby in White Spruce Logs in Central British Columbia**—*Tetropium cinnamopterum* Kirby, has been considered of minor importance when compared with *Monochamus* sp. in the deterioration of timber (Gardiner L.M., Can. Entomologist 89(6): 241-263. 1957; and Richmond H.A. and Lejeune R.R., Forestry Chron. 21(3): 168-192. 1945). During a pathological study in 1965-66 in central B.C., however, the author observed a heavy attack by *T. cinnamopterum* in white spruce (*Picea glauca* (Moench) Voss) stored in two different areas. *Monochamus* was confined to lodgepole pine (*Pinus contorta* Dougl. var. *latifolia* Engelm.). Insects were identified by Dr. D. A. Ross, Forest Research Laboratory, Vernon, B.C.

Galleries of *T. cinnamopterum* up to 8 cm total length and 5 cm in depth occurred commonly (> 15 holes per sq ft) in 135 spruce veneer logs at Williams Lake, B.C. Material was originally winter-felled and stored in piles from April to October, 1965. Twenty adults emerged in December from an 18-inch log section, 12-inches in diameter, stored inside for three weeks.

In 150 winter-felled spruce logs at Upper Fraser, B.C., piled from April to October, 1966, larvae were first noted in the inner bark during June. They continued to feed in this region during August and penetration into sapwood was apparently completed in a period of not more than seven weeks. Adults emerged from 2×4-inch lumber cut from these logs and kept at 68-70°F in Vancouver in November and again in March, following four months of outside storage and another four weeks in the laboratory.

Holes were oval, ranging from 4×2 mm to 5×3 mm. The L-shaped galleries penetrated the sapwood approximately radially, then turned sharply to follow the boundary of heartwood and terminated in a pupal chamber slightly larger than the tunnel. (Fig. 1).

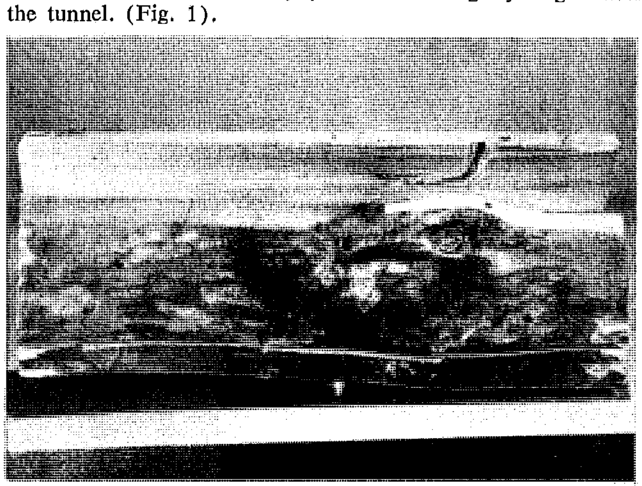

FIGURE 1. Oval holes and L-shaped gallery of *T. cinnamopterum* in white spruce log section.

*Monochamus* sp. was reported commonly by Gardiner in fire-killed Ontario pine, and by Richmond and Lejeune in fire-killed Saskatchewan white spruce. In Finland, Juutinen (Rev. Appl. Ent. 45: p. 451. 1957) noted that *Tetropium* sp. practically confined its attack to felled spruce.

This association with spruce was also suggested in the B.C. sample and the role of wood species, fire damage, and climate, in attack by *T. cinnamopterum* requires clarification. In addition, the absence of *Monochamus* sp. from stored white spruce logs should also be confirmed.—J. W. Roff, Forest Products Laboratory, Vancouver, B.C.

**First Record of *Pleolophus basizona* Parasitizing *Neodiprion swainei***—*Pleolophus basizona* (Grav.), a European parasite liberated in the late nineteen thirties in an attempt to control the European spruce sawfly (*Diprion hercyniae* (Htg.)), has been found parasitising the Swaine jack-pine sawfly (*Neodiprion swainei* Midd.) during population studies on the latter in various localities in Quebec in 1964 and 1965 (Table 1). In addition to the localities shown in Table 1, *P. basizona* was also recovered from *N. swainei* during 1965 at Lake Oriskany, Laviolette County, and Lake Potherie, St. Maurice County.

Studies during 1966 have revealed that *P. basizona* is bivoltine on *N. swainei*. The estimates presented in Table 1 were obtained from collections made in the fall and thus are representative of populations of *P. basizona* overwintering on *N. swainei*. The adult parasites emerged from host cocoons in late May and early June, and immediately attacked current generation sawfly cocoons. Both pupae and adult sawflies were attacked in the cocoon. Second generation populations of *P. basizona* were considerably higher than first generation populations, undoubtedly because the second generation emerged in midsummer, before *N. swainei* spun its cocoon. Thus the parasite must restrict its attacks to as yet unemerged current generation host cocoons, or survive as adults until cocoon formation by the following generation of the host in September. Because *P. basizona* is bivoltine, its impact on host populations is potentially much greater than indicated in Table 1. Studies are now in progress to evaluate the importance of this parasite on *N. swainei*.

This is the first record of *P. basizona* parasitising *N. swainei*. It was previously recovered from *D. hercyniae* in a number of localities in Quebec and in Ontario (Finlayson, Thelma. Can. Entomologist. 92:20-37, 1960). In Ontario *P. basizona* has been known to occur in abundance on *N. sertifer* (Geoff.) (L A. Lyons, Proc. Ent. Soc. Ont. 94: 5-37, 1964). Also, a collection of cocoons of *N. lecontei* (Fitch) from Namur, Papineau County, Quebec, made in October 1966, yielded two female specimens of *P. basizona*.

TABLE 1

Occurrence of *Pleolophus basizona* Grav. in *Neodiprion swainei* cocoon samples in Quebec in October 1964 and 1965

| Year and Plot No. | Number of *P. basizona* ♂ | Number of *P. basizona* ♀ | Number of cocoons reared | % Parasitism |
|---|---|---|---|---|
| 1964 | | | | |
| Plot III | 4 | 7 | 763 | 1.4 |
| Plot IV | 8 | 11 | 179 | 10.6 |
| Plot V | 14 | 33 | 593 | 7.9 |
| 1965 (by dissection—*sex unclassifiable*) | | | | |
| Plot III | — | 0 | 25 | 0 |
| Plot IV | — | 4 | 260 | 1.5 |
| Plot V | — | 3 | 61 | 4.9 |

Plot III—Lac des Iroquois, Roberval County
Plot IV—Rivière à Mars, Chicoutimi County
Plot V —Lac Caouasacouta, Laviolette County