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TABLE 1
Correlation matrix (86 degrees of freedom) for seedlings 35 days after sowing*

	Seed weight	Germination rate	Seedling weight
Seed weight	1.00	0.17 NS	0.36**
Germination rate	—	1.00	0.81**
Seedling weight	—	—	1.00

* Seedlings in this sample ranged in age from 10 to 31 days from germination.
**Significant at p = 0.01.

TABLE 2
Correlation matrix (86 degree of freedom) for 23-day-old seedlings*

	Seed weight	Germination rate	Seedling weight
Seed weight	1.00	-0.16 NS	0.43**
Germination rate	—	1.00	-0.43**
Seedling weight	—	—	1.00

* Seedlings in this sample germinated from 6 to 16 days after sowing.
**Significant at p = 0.01.

was selected at random from each seedlot 35 days after sowing; another sample consisted of one seedling from each seedlot lifted at random 23 days after it had germinated, thus forming a sample population of uniform age. Seedlings in these two samples were oven-dried (95°C) and weighed individually. The remaining seedlings were planted in a nursery for later study (see last paragraph).

Seed weights among the two samples ranged from 3.7 to 10.9 mg with a population mean of 5.7 mg. Despite this wide range, the correlation coefficient between seed weight and dry weight of seedlings 35 days after sowing was only moderate (r = 0.36, significant at p = 0.01, Table 1).This relationship includes some variation resulting from different ages of seedlings; however, when the influence of age was removed, as in the correlation of seed weight with weight of 23-day-old seedlings (Table 2), the correlation coefficient was only slightly improved (from r = 0.36 to r = 0.43).

A much stronger correlation (r = 0.81) was found between germination rate and dry weight of seedlings 35 days after sowing. The multiple correlation coefficient between seedling weight and germination rate and seed weight combined was 0.84.

The results agree with those of Ackerman and Gorman (Pulp Pap. Mag. Can. 70:167-169, 1969), who found that only a small part of the initial variation in seedling size of white spruce, *Picea glauca* (Moench) Voss var. *albertiana* (S. Brown) Sarg., and lodgepole pine, *Pinus contorta* Dougl. var. *latifolia* Engelm., could be accounted for by seed size. They also suggested that rate of germination and genetic factors were possible sources of variation.

The experiment also provided information about germination vigor. The weight of 23-day-old seedlings was negatively correlated with the date of germination (r = -0.43, Table 2). In other words, seeds germinating early produced larger 23-day-old seedlings than those germinating later. Since the rate of germination is indicative of germination-vigor classes, it is suggested that in Japanese larch the vigor of initial seedling growth is related to germination vigor.

Lack of uniformity in the size of stock creates problems in nursery management, whether seedlings are grown in nursery beds or in containers. The results reported here show that, although seed weight has some effect on initial size of Japanese larch seedlings, most of the variation can be accounted for by differences in the rate of germination. Since a principal goal of nursery operations is to produce a uniform crop of seedlings in a short period, treatments favoring early germination will be advantageous in Japanese larch. Whether the influences of seed weight and germination rate extend beyond the first growing season will be the subject of further study with the 880 seedlings remaining from this experiment.—K.T. Logan, Petawawa National Forestry Institute, Chalk River, Ont., and D.F.W. Pollard, Pacific Forest Research Centre, Victoria, B.C.

ENTOMOLOGY

Possible Use of Canopy Light Traps in Predicting Spruce Budworm Egg-mass Counts.—Light traps, illuminated with naptha-

TABLE 1
Counts of spruce budworm pupae, egg masses, and females per canopy light trap and calculated ratios.

Year	Area	Counts/10 m² foliage: Female pupae (1)	Counts/10 m² foliage: Egg masses (2)	Total females in light trap (3)	Ratios: Light-trap females (3) / Female pupae (1)	Ratios: Egg masses (2) / Light-trap females (3)
1974	C	86	668	7,339	85	0.09
1975	C	100	804	10,315	103	0.08
1975	J	27	338	8,500	315	0.04
1976	A	91	380	2,158	24	0.18
1978	ANS	87	245	1,197	14	0.20
1978	Q	27	160	1,158	43	0.14

TABLE 2
Comparison of observed and expected egg-mass densities in 10 plots based on Fig. 1

Plot	Female pupae/10 m² (1)	Total light-trap females (2)	Ratio (2)/(1)	Expected egg masses/light-trap female (Fig. 1)	Egg masses/10 m²: Expected	Egg masses/10 m²: Actual
1	27	297	11	0.23	68	93
2	71	177	2	0.40*	71	65
3	33	339	10	0.25	85	114
4	9	329	37	0.13	43	53
5	4	1,083	271	0.04	43	25
6	1.3	878	675	0.025	22	23
7	1.3	1,357	1,043	0.020	27	20
8	0	592	(592)	(0.025)	(15)	4
9	0	818	(818)	(0.021)	(17)	7
10	0	No data				9

*Extrapolation of Fig. 1.
( ) A female density of 1.0/10m² being assumed, although no pupae were found on plots 8, 9, and 10,in a sample of 36 midcrown branches per plot.

TABLE 3
The number of light-trap females that will likely result in severe defoliation relative to female pupal density

	Female pupal density/10 m² foliage: 10	20	40	60	80	150
Maximum acceptable count of females in light trap	10,000	6,000	2,500	1,500	1,100	750

fuel lamps and located in forest clearings, have been used for many years in the Maritime Provinces to monitor changes in the abundance of spruce budworm moths at selected locations. In recent years, this monitoring program has been expanded by the use of light traps suspended within the crown canopy to obtain an index of budworm-moth abundance in infested stands. The data were used to compare moth counts in adulticide-treated stands with counts in untreated areas, and to find the relationship between moth abundance (females) and egg-mass counts. The latter project is the topic of this note.

Observations were made in five study areas over 4 yr. Populations were estimated from three different samples taken in each area — pupae plus pupal cases, egg masses, and budworm moths captured during a season (20±3 days) in one light trap suspended within the crown canopy (Table 1). Pupae and egg masses were counted on one midcrown branch per tree on a maximum of 10 trees per location. This small sample size resulted in high intraplot variation.

No relationship was found between the number of female moths taken in a light trap and pupal counts (converted to number of females)

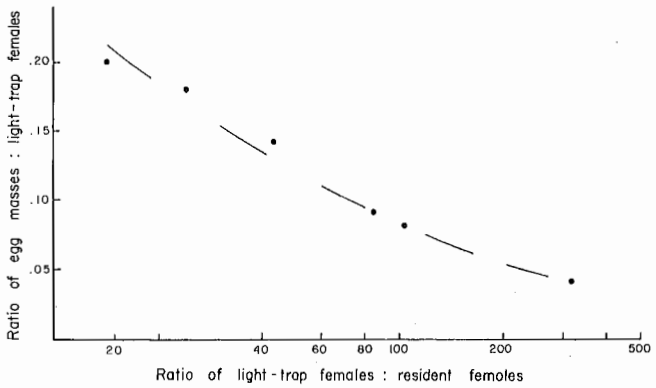

Figure 1. Graphic relationship of apparent oviposition per trapped female to the ratio light-trap females:resident females.

because moth invasion and emigration can profoundly affect local population densities. Similarly, in a graphic analysis of egg-mass counts, a scattered relationship was found between the number of egg masses and the number of female pupae, again because dispersing females can add to, or subtract from, the expected oviposition by a local population. However, an improved relationship was noted when egg-mass counts were plotted over the number of females captured in a light trap. Further improvement was obtained when the ratio of egg masses:light-trap females was plotted over the ratio of light-trap females:resident females (Fig. 1). Although Fig. 1 provides little biological information and ratios must be treated with caution, it suggests that apparent oviposition per trapped female is at a maximum when females are mainly of "local origin" and decreases when the local population is diluted by invaders. This may be because dispersing females, on the average, carry 50% or less of their egg complement.

The sensitivity of Fig. 1 is open to question and we had only one set of independent data (collected by another research group in 1977 in northwestern New Brunswick) for validation (Table 2). Although budworm densities were low in these plots (Table 1), the expected egg-mass counts based on Fig. 1 were within broad limits of the observed counts (Table 2). In view of this, we suggest one possible use of this survey technique: Assuming that larvae from 240 egg masses per $10m^2$ of foliage will cause severe defoliation of balsam fir (greater than 66% loss of current needles), it is possible to calculate (from Fig. 1) the number of light-trap females that would produce 240 masses, given a range of female pupal densities (Table 3). Thus the risk of severe defoliation in a stand may be predictable from the observed catch of females in a canopy light trap. The merit in the system is that, while egg-mass sampling is labor-intensive, counting pupae and tending a light trap require fewer resources.

Light traps capture female moths that have laid most of their eggs (A.W. Thomas, Maritimes Forest Research Centre, pers. commun.) and many other factors (trap location, quality of light, temperature, humidity, level of natural light) can affect the size of a nightly catch. Furthermore, we speculate that a relationship would not exist between the number of light-trap females and the number of egg masses in heavily attacked stands (some dead trees and more than 50% total needle loss among surviving trees), where moth emigration would probably be at a maximum and the site would be unfavorable for invaders. However, Fig. 1 suggests that two population counts — total females in a canopy light trap and resident pupal density — could be used to broadly predict the number of egg masses in moderately infested stands. Additional testing will be conducted in 1979.—C.A. Miller, D.O. Greenbank, and E.G. Kettela, Maritimes Forest Research Centre, Fredericton, N.B.

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