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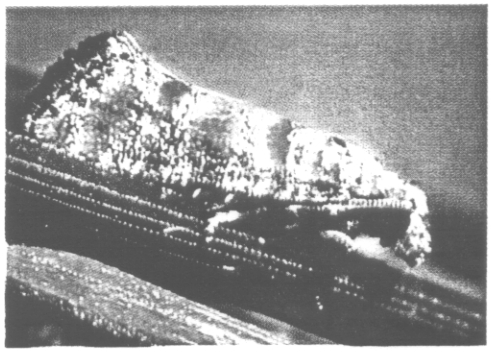

"Occurrence and Seasonal Activity of Pine Tip Moths in Georgia"

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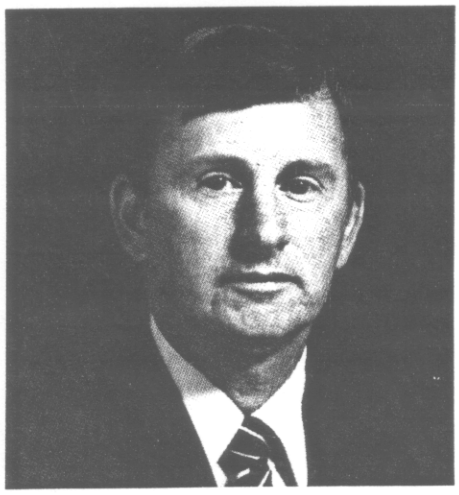

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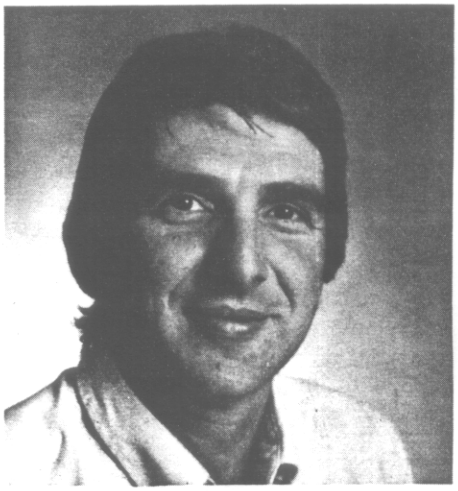

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Occurrence And Seasonal Activity Of Pine Tip Moths In Georgia

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INTRODUCTION

Pine tip moths, *Rhyacionia* spp., are among the most common insects which attack pines in Georgia and throughout the South. Their damage may be negligible or very serious depending on site quality, tree host species, geographic province, tip moth population densities, and tip moth species. Georgia has very different environmental conditions in various parts of the state. Therefore, it is often difficult to anticipate when these pests will be active, when damage assessment should be made and when controls, if any, should be applied. We report here, the results of studies to determine where the three most common species of tip moths occur and how their life cycles compare within the different physiographic provinces of Georgia.

DESCRIPTIONS AND GENERAL BIOLOGIES OF RHYACIONIA SPP. MOTHS

The most abundant and ubiquitous *Rhyacionia* species in Georgia and in the Southeastern United States is the Nantucket pine tip moth, *R. frustrana* (Comstock) (Berisford, 1988). It is the smallest of the three common species in the state with a wingspan of 10-17 mm. The wings are mottled rusty red and buff in color (Fig. 1). As with all species of *Rhyacionia* the wings are folded on the back when the moths are at rest. *Rhyacionia frustrana* attacks all hard pines except longleaf pine, *Pinus palustris,* although slash pine, *P. elliotti, var. elliottii* is less preferred (Hood et al. 1985) and is somewhat resistant to attack (Yates 1960, 1966). The pitch pine tip moth, *R. rigidana (Fernald),* also occurs throughout the state and attacks the same host species as *R. frustrana* but it is much less common (Miller and Wilson 1964, Baer and Berisford 1975). *Rhyacionia rigidana* is larger than *R. frustrana* with a wingspan of 15-20 mm. The wings have reddish brown patches and a distinct gray band in the middle of the wings (Fig. 1). The subtropical pine tip moth, *R. subtropica* Miller, occurs only in the Coastal Plain and primarily attacks slash pine. *Rhyacionia subtropica* is the largest pine tip moth in Georgia. The wingspan is 15-22 mm and the wing color patterns are similar to *R. rigidana,* but the wings are almost white in areas between the brown patches of scales (Fig. 1). Detailed descriptions of these species may be found in Powell and Miller (1978). Other species of tip moths such as *R. aktita* Miller and *R. busckana* Heinrich also occur in Georgia but are rare compared to the three species above (Powell and Miller 1978).

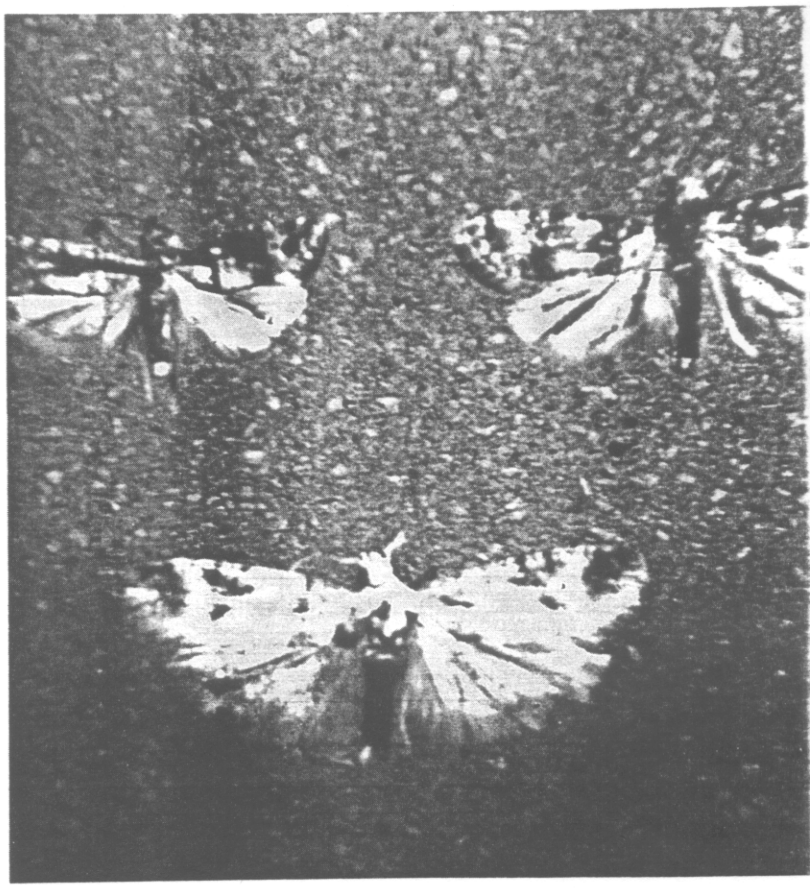

Fig. 1. Adults of the Nantucket pine tip moth, Rhyacionia frustrana (upper left), pitch pine tip moth, R. rigidanca (upper right), and subtropical pine tip moth, R. subtropica (bottom).

The *Rhyacionia* spp. in Georgia have similar life histories although the times of occurrence of the various life stages and numbers of annual generations are different. They overwinter in dead shoots as pupae (Fig. 2). In late winter or early spring the pupa forces its way to the outside of the shoots. Once the anterior part of the pupa is exposed, the pupal skin splits and the adult moth emerges. The pupal skin often remains protruding from the shoot and is an indicator that emergence has occurred. Shortly after emergence, mating occurs and the female begins to lay eggs. Hatching occurs within 10-25 days depending on the temperature and species. Eggs are attached to needles or shoots and may be laid singly or in clusters of 2-10 depending on the species (Fig. 3). When the eggs hatch, the tiny first-instar larvae bore into needle fascicle sheaths and feed on the enclosed needles, often mining the length of the needles (Fig. 4). Second-instar larvae vacate the needle sheath and migrate up the growing shoot where they attack buds and shoots (Yates 1967). The most visible evidence of the initial attacks are droplets of resin on buds and pitch-soaked silk tents or webs on attacked buds in the axil formed by the needle and the shoot (Fig 5). Maturing larvae hollow out buds and bore further into the shoots, killing from 0.5 to 6 inches of the shoots depending on the moth species (Fig. 6), the tree host species, attack density, and host vigor. In severe infestations 10 or more larvae may be feeding within a single shoot. Pupation occurs within the shoots where they remain until adults emerge to initiate a new generation (Fig. 2). The heaviest attacks, and therefore the most damage, normally occur on trees less than 15 ft. high. Heavy damage is more likely to occur on poor sites (Hood et al. 1988), and plantations generally suffer more damage than natural stands (Berisford and Kulman 1967).

MATERIALS AND METHODS

Seventeen collection sites were selected to monitor the seasonal activity of *R. frustrana, R. rigidana,* and *R. subtropica*. Collection sites were located at about 50 mile intervals along two transects through the state (Fig. 7).

Fifty to 70 infested shoots were collected every two weeks from each site. Infested shoots were examined in the laboratory and numbers of tip moth eggs, larvae, and pupae were recorded and identified to species where possible. The instars of the larvae collected were determined by head capsule measurements and compared to published values for each species (Fox et al. 1971, McGraw and Wilkinson 1974, Gargiullo and Berisford 1982).

Nine Conrel[R] delta-type pheromone traps were placed at each site and 3 each were baited with rubber septa containing 2 mg. of synthetic pheromone for each *Rhyacionia* spp. (Hill et al. 1976, 1981, Roelofs et al. 1979). Traps were monitored biweekly when shoots were collected to determine if adults had been active during each preceding 2-wk period. Traps at one location (Effingham County) were checked at 1-3 day intervals to positively establish adult activity patterns in the Coastal Plain. Activity patterns for *R. frustrana* and *R. rigidana* had already been established for the Piedmont (Berisford 1974, Canalos and Berisford 1981).

Catches and development data were graphed to allow comparisons of development rates and activity periods in the Mountain, Piedmont, and Coastal Plain Provinces. Data from all sites within each physiographic province were lumped to provide average values for the region.

Fig. 2. Tip moth pupa in a shoot killed by larval feeding.

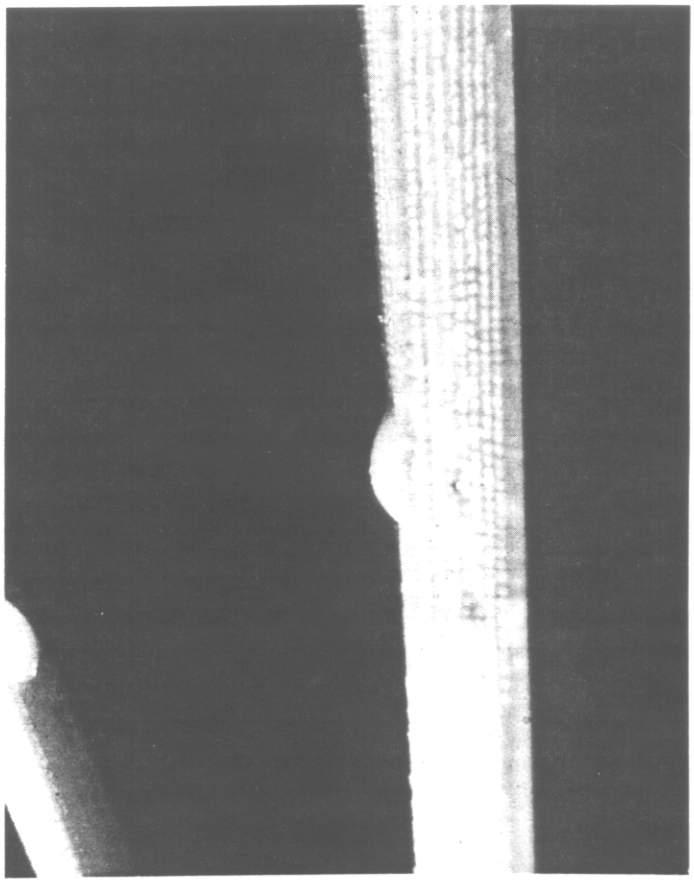

Fig. 3. Egg of Rhyacionia frustrana on a pine needle.

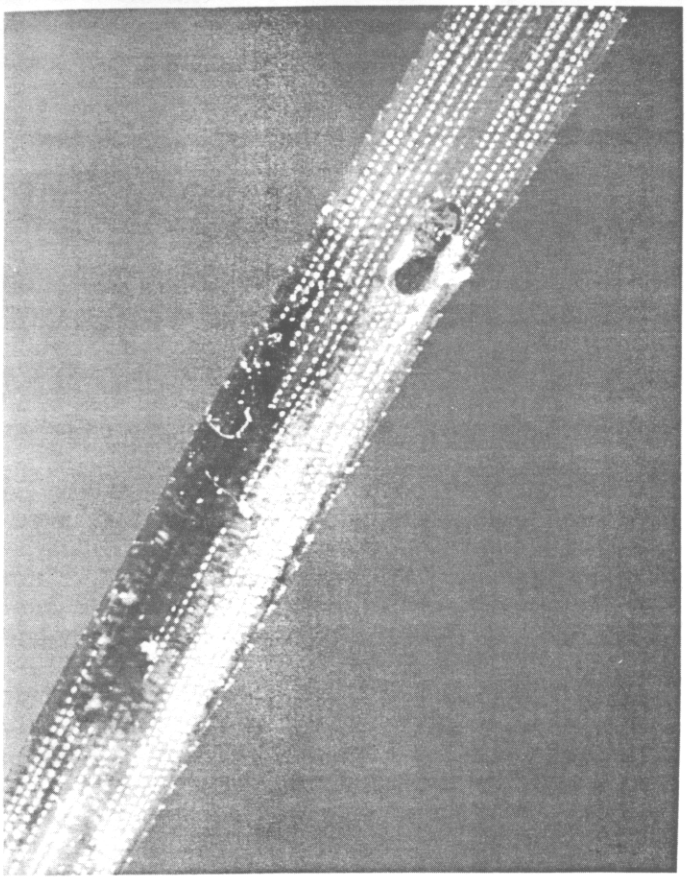

Fig. 4. Larval mine inside a pine needle.

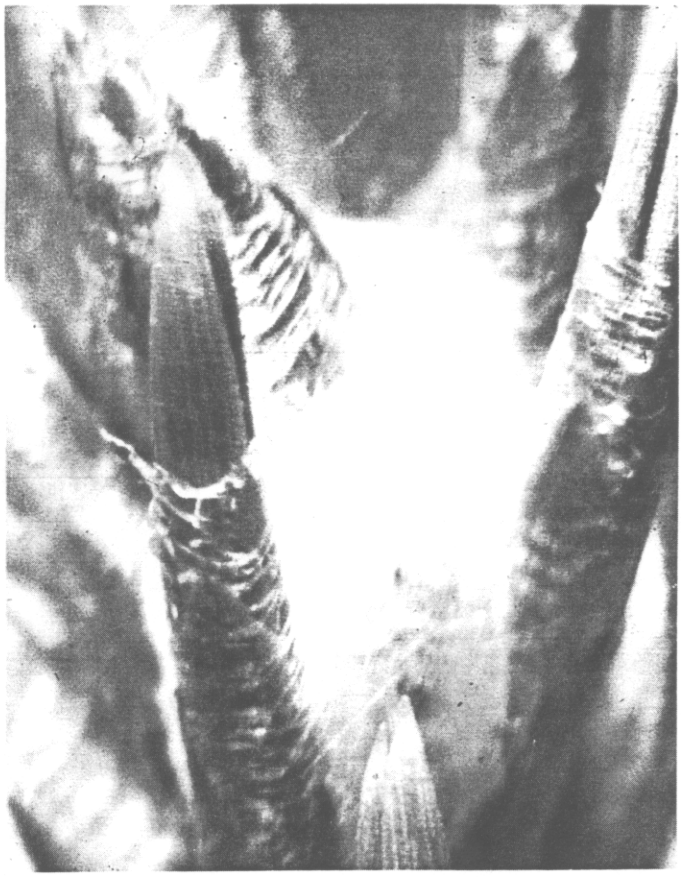

Fig. 5. Resin covered web formed by a larva attacking a bud.

Fig. 6. Shoot killed by heavy attacks of Rhyacionia frustrana.

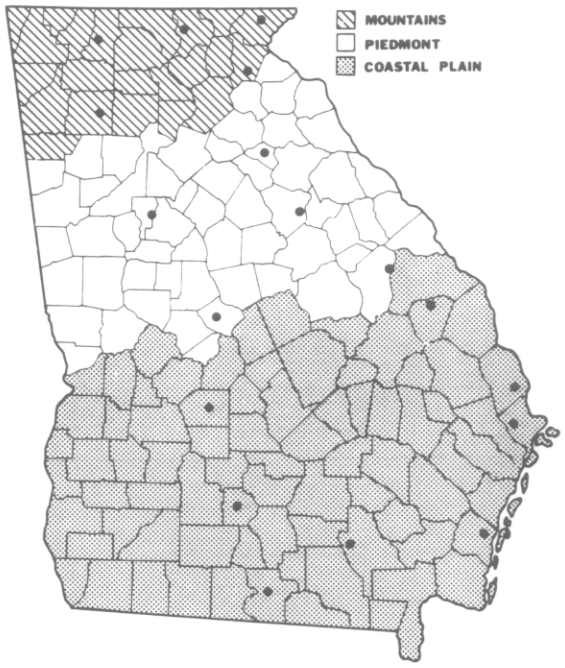

Fig. 7. Locations of trapping and sample sites in each physiographic province.

RESULTS AND DISCUSSION

Pheromone trap catches and data from shoot collections showed that *R. frustrana* and *R. rigidana* were present at all sites in the state, and that *R. subtropica* occurred only in the Coastal Plain. Infestation levels varied widely depending on the tip moth species and tree species attacked.

Figure 8 shows adult activity patterns as determined by seasonal trap catches for each tip moth species in the Mountain, Piedmont, and Coastal Plain Provinces.

Rhyacionia frustrana has three generations in much of the Mountain Province and in the Piedmont Plateau fourth generation of Georgia (Fig. 8a). There is no evidence of a partial fourth generation sufficient to cause damage in the Piedmont as speculated by some growers (Kudon et al. 1988). It appears that some high elevations in Northeast Georgia may have only two generations (Ross et al. 1988). However, our data from this study are insufficient to determine if that occurs. We have confirmed that four generations occur in the Coastal Plain. Pheromone trap catches from Effingham County show four distinct generations with some overlap in adult emergences between generations three and four (Fig. 9). However, Gargiullo et al. (1985) found no overlap between these generations in the same part of the state. Figure 10 shows when the various developmental stages occurred within each physiographic province.

Rhyacionia rigidana apparently has two generations in all parts of the state (Fig. 8b). The second generation is asynchronous with *R. frustrana* (Fig. 11) (Berisford 1974, Canalos and Berisford 1981) even though they may infest the same trees. These data may help explain the considerable difficulty in controlling pine tip moths in some areas where high populations of both species occur. The occurrence of the various life stages of *R. rigidana* are shown in Fig. 12.

The subtropical pine tip moth, *R. subtropica*, was found only in the Coastal Plain where it was trapped at every collection site. The moth has one distinct adult emergence in late winter or early spring, but two subsequent emergences overlap slightly (Fig. 8c). There appears to be three generations (Fig. 13), but the last two show considerable overlap in the different life stages present. McGraw (1975) reported two generations and a partial third generation in Florida. *Rhyacionia subtropica* has not been intensively studied in Georgia, so its impact on pines is therefore unknown. However, it apparently does not become very abundant. Prior to this survey, *R. subtropica* had been reported to occur only in Lanier and Ware counties (McGraw 1975).

Tip moth damage may be serious on high value trees such as Christmas trees, even if growth loss does not occur. Attacks on small trees may ruin the form plus the market value may be reduced by the presence of large numbers of dead shoot tips. Also, attacks on shoots and/

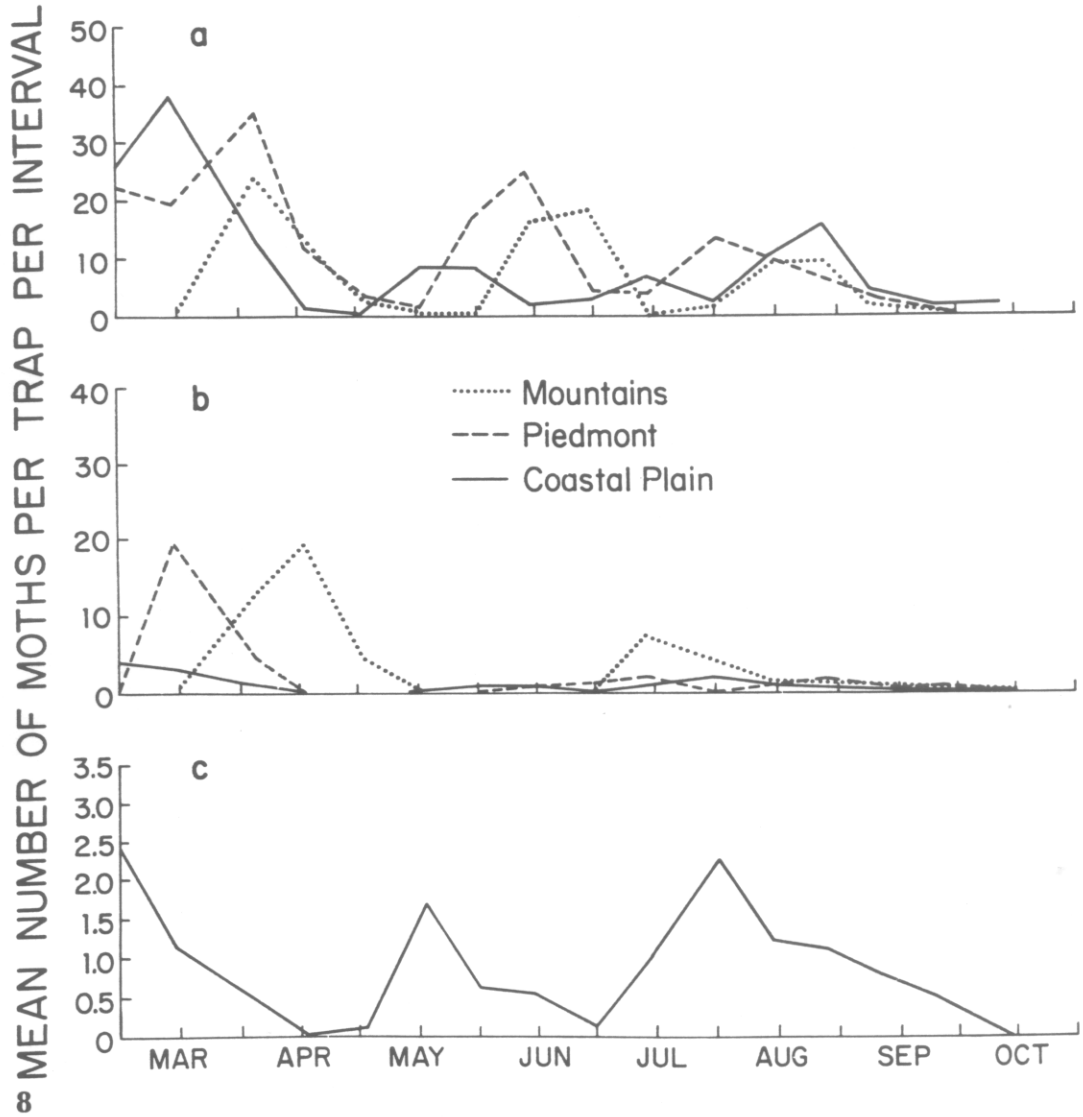

Fig. 8. Pheromone trap catches of Rhyacionia frustrana, R. rigidana and R. subtropica adults in the Mountain, Piedmont and Coastal Plain Provinces. a = R. frustana; b = R. rigidana; c = R. subtropica.

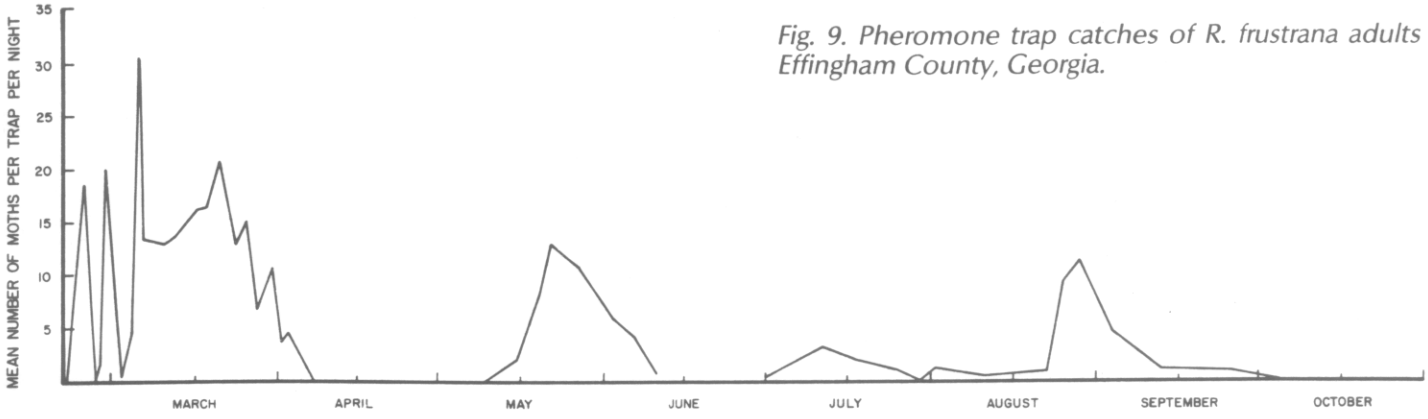

Fig. 9. Pheromone trap catches of R. frustrana adults in Effingham County, Georgia.

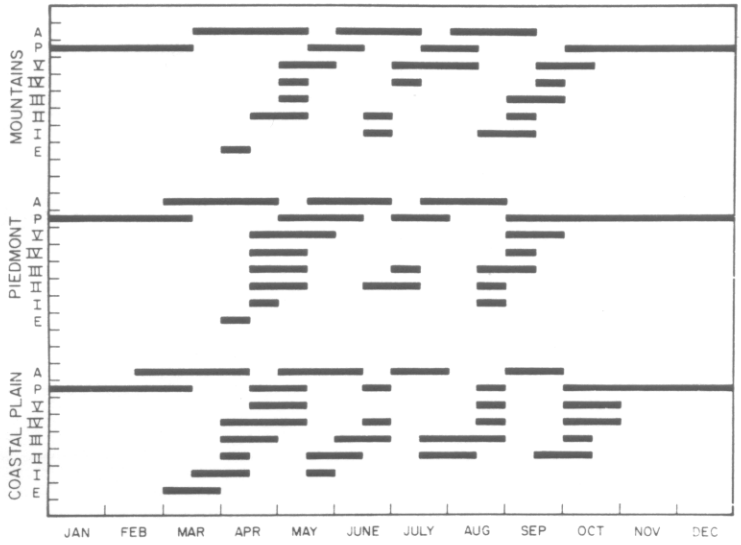

Fig. 10 - Time of occurrence of different life stages of R. frustrana in Mountain, Piedmont and Coastal Plain Provinces. E = eggs; I-V to 5th instars; P = pupae; A = adults.

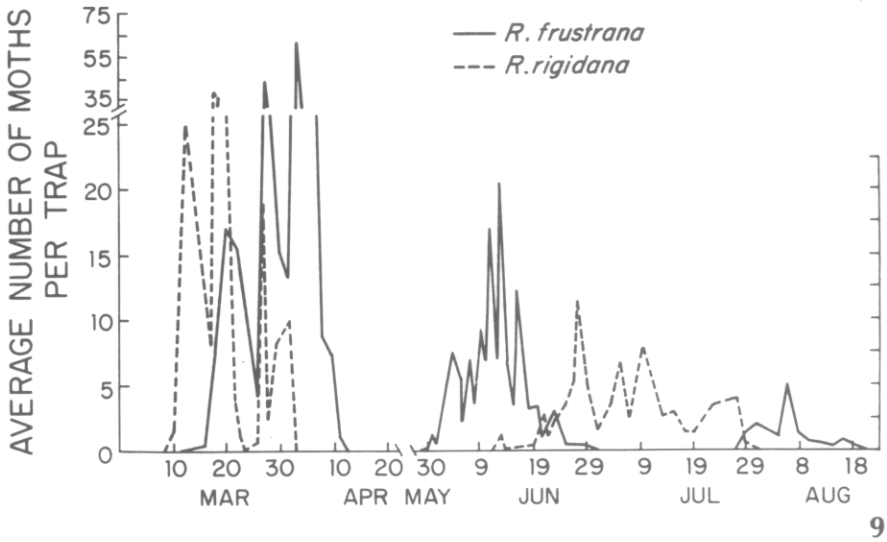

Fig. 11 - Comparison of pheromone trap catches of R. frustrana and R. rigidana adults at the same site.

or conelets in pine seed orchards may significantly reduce seed production of shortleaf pine, *P. echinata* Mill. (Yates and Ebel 1972). In forest stands, even though tip moth populations and numbers of infested shoots may be high, damage is usually insufficient to warrant control. However, in certain stands damage may be so severe that chemical control is required to prevent high tree mortality, severe growth loss and/or loss of tree form. Trees which receive tip moth control are significantly taller and have better form than untreated trees (Berisford et al. 1989). Most severe infestations are dominated by *R. frustrana* (Baer and Berisford 1975).

If chemical control becomes necessary, spray timing models have been developed which can maximize control with low frequency of pesticide applications (Berisford et al. 1984, Gargiullo et al. 1983, 1985, Kudon et al. 1988). Spray timing can also be determined for specific sites via computerized models (Pickering et al. 1989).

The occurrences of the immature stages for each species (larvae and pupae) relative to adult activity is shown in Figs. 10, 12-13. Since chemical control of tip moths is usually directed toward small larvae (1st and 2nd instars) before they bore into shoots, these data may be useful to help to plan for control efforts.

SUMMARY

This publication is intended to be a guide to the identification and biologies of the three common pine tip moths found in Georgia. Data presented here are average values for each physiographic province. Local conditions and annual weather fluctuations will cause the timing of these events to vary somewhat from these averages. Intensive monitoring at a given site is necessary to determine precise timing of adult emergence and occurrence of the various developmental stages.

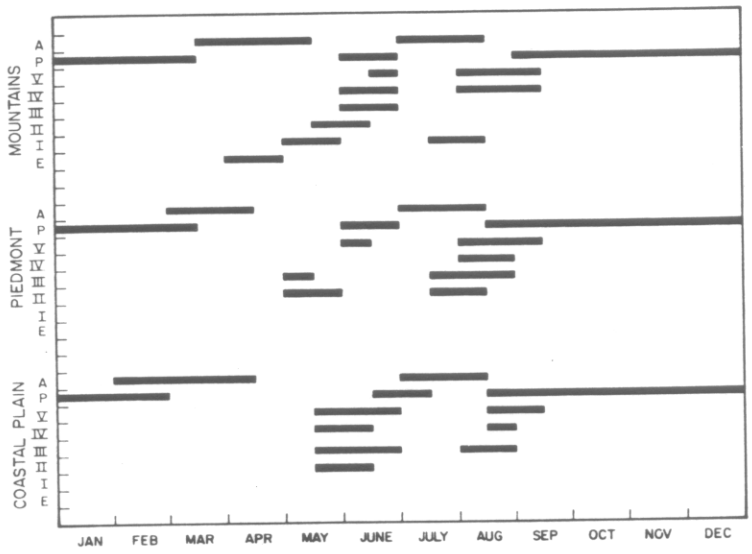

Fig. 12. Time of occurrence of different life stages of R. rigidana in the Mountain, Piedmont and Coastal Plain Provinces. E = eggs; I-V = 1st to 5th instars; P = pupae; A = adults.

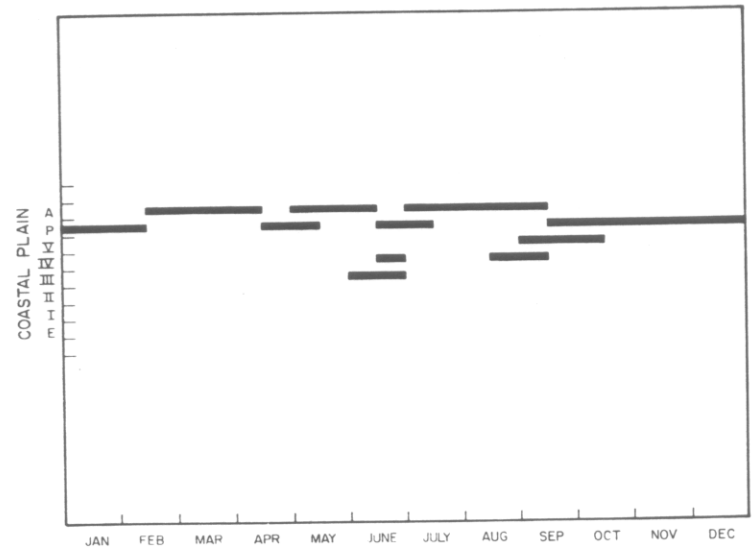

Fig. 13. Time of occurrence of different life stages of R. subtropica in the Coastal Plain Province. E = eggs; I-V = 1st to 5th instars; P = pupae; A = adults.

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