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Some Growth Aspects of Seymeria cassioicies

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SUMMARY

The root parasite, Seymeria cassioides, will not initiate height growth without attachment to a host root when grown under normal fertility conditions, although the seedling may remain alive for 40 days or more without a host. During this time the roots elongate markedly. Fresh pine root segments do not influence the direction of root growth. Although S. cassioides is always root parasitic in nature, it apparently produces most of its own food, as plants that are vigorously parasitizing pines die when placed in the dark even though the host plant is exposed to light.

Additional keywords: root parasite, hemiparasite, Scrophulariaceae.

INTRODUCTION

The discovery in the late 1960's that Seymeria *cassioides* [J. F. Gmel. (Blake)], or senna seymeria, could cause serious growth reduction and mortality of slash pine *(Pinus elliottii* Engelm.*)* led to a number of studies on various aspects of the biology of this and related root parasites (Musselman and Mann 1976). In the course of these studies, we observed the extent and nature of early root growth and evaluated the necessity of light for survival.

MATERIALS AND METHODS

In order to determine plant development without the influence of a host, waxed cartons, measuring 7 x 7 x 23 cm, were fiilled with a 50:50 mixture (by volume) of sandy loam topsoil and vermiculite. This mixture permitted easy recovery of delicate roots. Thirty-six containers were sown with about 10 senna seymeria seeds each in the center of the container; after germination only one plant was allowed to remain in each carton. Cartons were watered regularly.

To determine if pine root segments affected root orientation, 18 additional cartons were sown with senna seymeria seeds placed in one corner. In nine, fresh segments of lateral pine roots were inserted into the growing media from the bottom; in the other nine, the pieces were inserted from the top. All pine roots were placed in the opposite corner from the seeds and were replaced weekly with fresh pieces. They were taken from lateral roots of 2- and 3-year-old loblolly *(P. taeda* L*)* pine and measured about 0.64 cm in diameter and 10 cm long.

All cartons were placed in a greenhouse with temperatures maintained at 26° to 30° C. Seeds failed to germinate in some containers; so the number of replicates was not uniform among treatments. Ten, 20, 30, and 40 days after an individual seed germinated, stem development was evaluated and cartons were carefully emptied for observation of root orientation and measurement of length.

For the light studies, seeds were sown in plastic pots with a horticultural mix of one part peat to two parts vermiculite and containing a l-month-old slash pine seedling. After the senna seymeria plants reached about 2 cm, they were thinned to one per pot. A water-soluble fertilizer (Peters'@ 20-19-18 NPK) was applied at a low level every 2 weeks because no nutrients were available in the media. The study was begun when the parasites were 4 months old and had a mean height of 15.5 cm. The plants were actively parasitizing the pine seedlings at this time. Ten pots with both pine hosts and parasitic plants were placed in a growth chamber a 12-hour light photoperiod. Another 10 were placed in a growth chamber with complete darkness. The temperature of the growth chambers was maintained at a constant 22° C. The pots

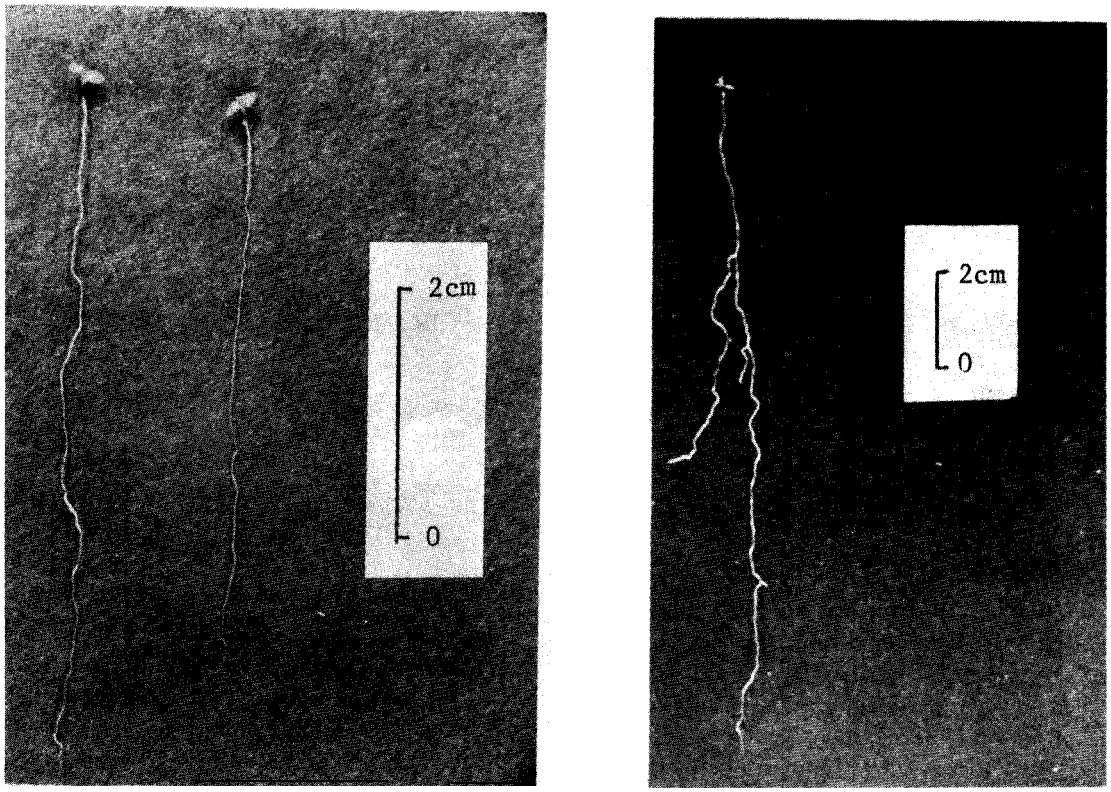

Figure 1—*Seymeria roots 10 days after germination (left). At 40 days (right), the long tap had two distinct laterals and another just developing.*

were watered on the third and seventh days using a green safelight and the tests were ended after 12 days.

In a variation of the preceding test, a greenhouse test was conducted where five pots had both pine and parasite receiving light and five pots had only the pine host receiving light. Black plastic tubes were used to cover the parasites. Tubes were about 6.4 cm in diameter and 46 cm long and were covered with aluminum foil to prevent the black plastic from absorbing heat. The bottom of the tube fit snugly against the soil. Plants were watered regularly.

RESULTS

All senna seymeria plants without host material remained in the cotyledon stage with only two small green leaves appearing in the entire 40 days. Senna seymeria root growth was rapid, considering the size of the seed, which number about 22,000 per gram. Roots averaged 5.4, 7.9, 10.5, and 15.5 cm long at 10, 20, 30, and 40 days after germination, respectively (fig. 1). There were no lateral roots at 10 days, but in most cases laterals were found at 20 days and thereafter. No haustoria were observed on any of the roots, but root hairs and root caps were present.

Regardless of the presence of a segment of pine root, senna seymeria roots grew straight down. There was no indication that the direction of root growth was influenced by pine root segments. More sophisticated methods could have been used to evaluate orientation of root growth, but this method was chosen since it has been observed numerous times that moist segments of pine roots will serve for haustorial attachment, even several months after they are severed'.

In both the growth chamber and greenhouse tests, senna seymeria plants quickly died when they were placed in darkness. After 4-7 days in the dark, mortality of the parasites had started and those still living wilted. Mortality was complete after 12 days. The rate of mortality was about the same if host plants were in light or dark environments. All senna seymeria plants given 12 hours of light in the growth chamber appeared healthy and made normal height growth. Pine hosts showed no obvious effect of continuous darkness over this 12-day period.

'Mann, W. F., Jr. [n.d.] Data on file Southern For. Exp. Stn., Pineville, La.

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DISCUSSION

Previous observations on root growth in hemiparasites of Scrophulariaceae are apparently limited to Oesau (1973, 1975) on *Melampyrum,* Fitzgerald et al. (1975) on Seymeria, and Musselman (1969) on *Aureolaria.* Our results indicate that the primary root of senna seymeria is well adapted for rapid growth into the root zones where pine roots would be available for parasitism. Musselman (1969) reported a seedling of *Aureolaria grandiflora* [Benth. (Penn.)] surviving for 9 months without attachment to a host. Oesau (1973) grew *Melampyrum arvense* [L. (Beitr.)] for about 4 months without a host and recorded a length of 47 cm when the plant died. Although the data in these two cases are limited, it does indicate that rapid and extended development of the primary root may be an important adaptation for root parasites at the seedling stage, allowing them to come in contact with host roots.

In this study, severed segments of pine roots did not affect the direction of growth of the parasite root. This indicates that contact with host roots is random, similar to the findings recorded by Oesau (1975) in a careful study of root development in *Melampyrum.*

The biology of hemiparasites remains unclear. Our limited data indicate that senna seymeria plants will not survive without light, evidence that the plants are not completely dependent on their hosts for food. They usually must form haustoria on roots in order to begin stem development, however, other studies have shown that plants without hosts will develop to maturity if high levels of fertility are provided (Mann and Musselman 1981).

Striga asiatica (witchweed) is in the same family as *Seymeria* and is a well-known pathogen of several grain crops. Rogers and Nelson (1962) report growing a witchweed plant to maturity in total darkness while the host' was maintained in light. Our work, involving vigorous, growing plants, indicates that light is necessary for survival of senna seymeria. Witchweed and *Seymeria* are quite different in their biology, however. Senna seymeria is always green while witchweed germinates beneath the soil and lives without light, being totally dependent on its host for seedling development.

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