

INTERACTIVE EFFECTS OF DEFOLIATION AND LOW RESOURCE LEVELS ON PHOTOSYNTHESIS, GROWTH, AND GYPSY MOTH LARVAL RESPONSE TO RED OAK SEEDLINGS

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ABSTRACT

The potential for defoliation of oak seedlings by gypsy moth is quite high. We were interested in examining the interactions between various natural stresses and resulting gypsy moth feeding preferences and the results of defoliation stress on the growth and photosynthetic responses of the oak seedlings. A factorial greenhouse experiment was carried out with northern red oak (*Quercus rubra* L.) seedlings. The seedlings were grown under one of eight conditions: high or low light, high or low nutrients, and high or low water in a split-block design with shade cloth over half of the blocks. After two months of growth under these conditions, one-half of the seedlings were completely defoliated manually. This foliage was fed to fourth instar gypsy moth larvae in a preference test with leaf discs from each of the eight treatments in a petri dish. At the end of three months, photosynthetic parameters were measured on a subsample of the seedlings. After four months, trees were harvested, separated into stems, roots, and leaves, leaf area measured, and dry weights obtained. Seedling mortality was also compared for the defoliation treatments.

Photosynthetic quantum yields were similar for plants in all treatments. Light compensation point was significantly higher and dark respiration rate significantly greater for plants grown in high light than for plants grown in low light, an expected acclimation pattern. There were no significant interactions with defoliation. However, there was a significant defoliation x water interaction for maximum net photosynthesis, such that defoliation increased photosynthetic rate when drought stress was present (compensatory photosynthesis), but not when water was plentiful.

Defoliated plants had a 32.6 percent mortality rate; significantly higher than that of undefoliated plants (1.3 percent). Dry weights and leaf areas were significantly reduced by most of the factors. Two-way interactions of stresses with defoliation were significant and in most cases positive, in the sense that defoliation had a lesser effect in depressing growth in the presence of stress than when resources were abundant. There were no significant effects on root:shoot ratio. There were differences in gypsy moth larval leaf consumption/preference due to stress factors. Foliage grown under high light was preferred over foliage produced under shade stress.

The number and magnitude of interactions among stresses imposed in this study were unexpectedly high. Stresses interacted to affect photosynthetic properties, leaf characteristics, and growth. Defoliation x stress interactions on tree responses to defoliation were pronounced.