CONCLUSIONS

Gray goldenrod (Solidago nemoralis) grows natively in such habitats as open forests and woodlands of such species as jack pine (Pinus banksiana) and black oak (Quercus velutina), in dry prairies in Wisconsin (Curtis, 1959), on shale (Platt, 1951) and serpentine barrens in the eastern United States, and on the Great Plains of the United States and Canada (Fernald, 1950). It also grows in secondary successional communities on the New Jersey piedmont (Bard, 1952) and on roadbanks and other waste places (Gleason and Cronquist, 1963).

Gray goldenrod seeds under experimental field conditions reached their peak germination in April and May but sporadic germinations continued until September when a fall peak occurred. The cotyledons are green and presumably photosynthetic immediately after rupturing the seed coat so the seedling stage is either very short or non-existent. Developing plants produce a basal rosette which produces branch rosettes from leaf axils. Individuals growing under favorable conditions usually flower in the second season and succeeding ones. Adult plants may reproduce both vegetatively by branch rosettes or by seeds from flowering shoots. Individual plants may produce as many as twenty-two fully-developed branch rosettes within two years. Plants growing in ten- to twelve-year-old abandoned fields on the New Jersey piedmont produced an average of about 10,000 flowers per flowering

shoot. Reproduction under other conditions may be greeter or less then that observed in successional fields on the New Jersey piedmont (cf. Hurlbert, 1970).

Gray goldenrod achenes germinate readily in light on the surface of: damp paper toweling, nutrient agar, or moist mineral soil. No cold treatment is required for laboratory germination in the range of 30 to 50%. No after-ripening over winter seems to be required. Apparent field germination rates of 5 to 10% may be expected under favorable conditions. (Apparent germination equals the number germinated divided by the total number of seeds in the germination sample.)

Mature grey goldenrod plants do not produce chemicals inhibitory to their own seedlings; seeds germinate and grow best in sites where adults of the same species occur. Plants became established but did not flower in 0.09 m^2 plots in a forty-year-old abandoned pasture when the juveniles "competed" with annuals and other perennials. This suggests that the conditions in a forty-year-old field are not suitable for grey goldenrod establishment and flowering. In the forty-year-old abandoned pasture, conditions near red cedar trees were more favoreble for grey goldenrod establishment than were conditions in grass sod (the sod was removed from the plots) or conditions distant from red cedar.

In a field that was ten years old in the fall of 1967, plots were established along a moisture gradient from the top of a hill to the bottom and part way up the other side; the plots contained comperative shaded (51% light reduction) and unshaded plots side by side. No other species were allowed to grow on those plots. Fifty per cent

shading increased germination and establishment; germination and establishment was greatest on the moist top and bottom of the gradient. Plants growing in the open were more than two times heavier and covered more area per plant than those under shade even when the density under shade and in the open was the same. Survival for one year tended to be greater on the north- and south-facing slopes and under shade than on the top and bottom of the gradient or in the open. Plants growing in the open had a higher percentage of plants flowering then those in the shade.

In the open, flowering was greatest on the sides and bottom of the gradient. Under shade, flowering was greatest on the upper slope and on the bottom of the gradient; no plants under shade flowered on the steepest slope (30°) facing north. Plants containing less than four branches tended not to flower except under dense conditions. Flowering plants in the open tended to have twice as many branches per plant as flowering plants under shade. In the open, flowering plants tended to possess the most branches on the upper end of the gradient than on the other parts of the gradient. Under shade, flowering plants tended to possess the most branches near the top and at the bottom of the gradient. Apparently dense, tall vegetation usually found growing at the bottom of the moisture gradient excludes gray goldenrod from such habitats and gray goldenrod has become adapted to conditions on the slopes where vegetation may be sparse.

The germination of seeds on nutrient agar containing chopped stem, root, and decaying plant material of Achillea Millefolium, Agropyron repens, and Andropogon scoparius was significently delayed (99% level) as compared to germination on nutrient agar containing

no plant material (the control). Germination was fastest on the control and slowest on agar containing Achillea Millefolium tissue; the delay produced by the other two species was essentially the same when compared using a Duncan multiple-range test at 99% significence. Comparative field plots testing the inhibitory effect of mature plants of Solidago nemoralis, Achillea Millefolium and Andropogon scoparius showed no statistically significant effect at the 95% level, but the trends suggested establishment inhibition by Andropogon scoparius and establishment promotion by Solidago nemoralis and Achillea Millefolium mature plants.