

ABSTRACT OF THE THESIS

Inhibition of Perennials by Yellow Foxtail
on First-year old Fields

by HARVEY FLEET, Ph.D.

Thesis director: Professor James A. Quinn

If arable land in the temperate latitudes of the eastern United States is plowed in the spring of the year and then abandoned, a dense stand of annual plants will usually develop during that growing season. Seed-derived perennials (including biennials) are very few, both in number and species, and very reduced in size, compared to those on older fields, where the status of annuals is very different.

Yellow foxtail grass (Setaria glauca [L.] Beauv.) is commonly a major component of this annual flora. The questions investigated in this study were: (1) Does yellow foxtail inhibit the growth of the perennials on first-year old fields? and (2) If it does inhibit growth of perennials, what is the mechanism?

Artificial shade was shown in another study to be a potent inhibitor of perennials. This shade is shown in this research to be very similar in intensity and distribution to that found under an annual canopy. Growth of six common old field species of herbaceous perennials grown from seed with clipped yellow foxtail plants, which give no

shade, was strongly inhibited. Two species of perennials were grown surrounded by, but not in contact with, yellow foxtail plants. These were not inhibited. Neither foxtail leaf-leachate nor root-leachate had an inhibitory effect on the seven species of perennials tested. In addition, the root-leachate had no effect on germination of the perennial seeds tested. Carbon-14 introduced as glucose into foxtail plants, in two experiments, was not transferred into either the soil or hawkweed plants (Hieracium pratense) grown in pots with the foxtail. The lack of both transfer of metabolite from foxtail roots and an inhibitory effect of root-leachate is evidence against the presence of allelopathy in the root zone. Inhibition of growth of perennials grown with foxtail at the same time as uninhibited perennials receiving root-leachate is evidence for competition for soil resources as a source of the inhibition. In two experiments, growth of hawkweed when grown with foxtail at increasing levels of moisture stress was shifted to a level closely corresponding to that of hawkweed alone grown under high water stress. Tops of inhibited hawkweed plants grown in pots with foxtail had less phosphorous and potassium than hawkweed grown alone. Growth of both absorptive surface and length of foxtail roots was observed to be far more rapid than that of tested perennials.

Events in early old field succession are interpreted

as follows: (1) Where the annuals, and in particular, yellow foxtail grass, form a complete cover before or just as the seed-derived perennials are getting started, the perennials, cut off from their source of energy by shading, are unable to elaborate vegetative tissue and enter into competition for soil resources. (2) In other circumstances where the foxtail canopy is incomplete, competition for soil resources - in particular, water, phosphorus, and potassium - and not shade limits the perennials' growth. Of these three soil factors, competition for water is probably indirectly the most severely limiting because of the water-removing capabilities of the yellow foxtail root system, and the consequent lowering of the availability of phosphorus and potassium. (3) Upon the death of the annuals in the fall, the perennials are immediately released from their competitive influence. They grow unimpeded by the annuals throughout the fall, winter, and following spring, becoming established before the annuals germinate at the start of the next growing season.