WEED CONTROL USING ALLELOPATHIC CROP PLANTS

GERALD R. LEATHER
Weed Science Research, USA
Frederick, Maryland 21701
(Received September 12, 1982; revised November 15, 1982)

Abstract—The concept that some crop plants may be allelopathic to common weeds of agricultural lands is receiving greater attention as an alternative weed control strategy. Several crops showing promise are: grain and forage species such as barley (*Hordeum*), oat (*Avena*), fescue (*Festuca*), and sorghum (*Sorghum*), and the agronomic species of corn (*Zea*) and sunflower (*Helianthus*). Among the problems that hinder the conclusive demonstration of allelopathic effects of crop plants are the loss of that capacity through selection and the variability among cultivars. Recent studies to evaluate the allelopathic potential of crop plants have shown that several sunflower varieties inhibit the germination and growth of associated weeds and to a greater extent than found in several biotypes of native sunflower. Aqueous extracts of dried sunflower and rape tissue inhibited or stimulated germination and growth of weeds, and the response depended upon the source of extract, the extract concentration, and the weed species tested. The validity of bioassay results was tested in a 5-year field study with sunflower and oat grown in rotation. Weed density increased in all plots but the extent of increase was significantly less in plots of sunflower than in control plots. The use of crop plants with increased allelochemical production could limit the need for conventional herbicides to early season application with late season control provided by the crop.

Key Words—Allelopathy, weed control, sunflower, *Helianthus annuus* L.

INTRODUCTION

The present U.S. crop-yield loss due to weeds is estimated to be 10%. New weed control strategies are needed to supplement current chemical, mechanical, cultural, and biological methods. Allelochemicals that inhibit the germination and growth of weed species and are produced and released by growing crop plants or their residues are receiving increased attention for
weed control. Funke (1941) suggested that the exclusive presence of certain weed species in cultivated fields may be the result of selectively inhibitory substances produced by the crop plant.

Recent studies considering the role of allelopathy in weed control have been reviewed by others (Rice, 1974; 1979; Altieri and Doll, 1978; Putnam and Duke, 1978), and all stress the difficulty of conclusively demonstrating allelopathic potential under normal cropping systems. Several crops showing promise in bioassay to inhibit the growth of certain weeds have recently been reported. Putnam and Duke (1974) evaluated 526 accessions of cucumber (Cucumis sativus L.) and found that some inhibited proso millet (Panicum miliaceum L.) growth by 75%. Lockerman and Putnam (1979, 1981) evaluated the most active cucumber accessions in field trials and found that interference caused by allelopathy and competition reduced weed densities. Massantini et al. (1977) described the effects of 141 soybean (Glycine max. L.) lines on Helminthis echioides and Alopecurus myosuroides and found that two lines inhibited the growth of H. echioides but none affected A. myosuroides growth. They also found that one soybean line promoted the growth of both weeds. Fay and Duke (1977) evaluated 3000 accessions of Avena sp. germ plasm for the production of scopoletin, a chemical identified as an allelopathic agent, and found four accessions which exuded three times the amount of a commercial oat cultivar. Leather (1983) found that several varieties of sunflower (Helianthus annuus L.) were more allelopathic to broadleaf weeds than the native wild sunflower described by Wilson and Rice (1968). Other research (Barnes and Putnam, 1982; Lehle and Putnam, 1982) reported the use of cover crops with high allelochemical production for weed control in orchards and no-till cropping system.

Studies are reported here that identify the allelopathic potential of crop plants and their chemical interaction with weeds and weed seeds.

METHODS AND MATERIALS

Plant Materials. Crop plants were grown under field conditions or in the greenhouse with supplemental, full-spectrum metal halide lamps. The plants were harvested at several stages of growth and broadleaf plants separated into leaf and stem tissue, and grass plants separated into leaf and culm tissue. The tissue was dried at 90°C and ground in a Wiley mill.

Seed Germination. Effects on seed germination were evaluated with extracts of dried tissue prepared by shaking 4 g of ground tissue with 100 ml of water for 24 hr at 25°C. The extracts were filtered and 10- and 100-fold dilutions prepared. Control solutions were prepared with mannitol–water adjusted to the osmotic potentials of the extracts. Germination of wild mustard [Brassica kaber (DC.) L.C. Wheeler var. pinnatifida (Stokes) L.C.