BIOLOGICALLY ACTIVE SECONDARY METABOLITES
OF BARLEY. I. DEVELOPING TECHNIQUES AND
ASSESSING ALLELOPATHY IN BARLEY

D.L. LIU\(^1\) and J.V. LOVETT* \\

Department of Agronomy and Soil Science \\
University of New England \\
Armidale, N.S.W., 2351, Australia \\

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Abstract—Allelopathic effects of barley (Hordeum vulgare L.) on white mustard (Sinapis alba L.) were assessed using modified bioassays that reduced other environmental influences. In a Petri dish bioassay, germination of white mustard was delayed and the radicle lengths were significantly inhibited at a density of 0.5 barley seed/cm\(^2\). In a ‘siphoning’ bioassay apparatus, when the two species were sown together, radicle elongation of white mustard was not inhibited one day after sowing but became increasingly inhibited as bioassay time increased. Barley allelochemicals were released from the roots in a hydroponic system for at least 70 days after commencement of barley germination. Solutions removed from the hydroponic system of growing barley delayed germination and inhibited growth of white mustard. The allelopathic activity of barley was further confirmed at a density of 0.3 barley seed/cm\(^2\) in a modified stairstep apparatus.

Key Words—Allelopathy, germination, bioassay, siphoning apparatus, hydroponics, stairstep assay, barley, Hordeum vulgare, Sinapis alba.

INTRODUCTION

Separation of allelopathy from other aspects of plant interference remains one of the most challenging tasks in studies of plant interference (Harper, 1977). Methods used in studying allelopathy have received more criticism than those

*To whom correspondence should be addressed.
\(^1\)Present address: Bureau of Sugar Experiment Stations, P.O. Box 651, Bundaberg, Queensland 4670, Australia.
for studying competition. This has resulted in some ecologists holding deep reservations concerning the significance of allelopathy.

Techniques applied to studies of allelopathy have frequently been crude, contributing to uncertainties about the significance of allelopathic phenomena. Leather and Einhellig (1986, 1988) reviewed the literature pertaining to the use of bioassays and discussed the general suitability of different assays for studying allelopathy, demonstrating that many reports of allelopathy are questionable because the bioassays were not suitable indicators. Soaking of plant parts in either water or organic solvents, for example, may lead to the release of chemicals that are not normally released into the environment (Lovett, 1982). Interpretation of "allelopathic" effects on plants or other organisms may be confounded in these circumstances. Allelopathy occurs only if the chemicals are not only produced by a plant but released into the vicinity of other plants and, ultimately, received under the influence of natural environmental conditions. Therefore, reliable investigations of allelopathy include tests of compounds released by intact living donor plants into the vicinity of receiver plants. This is a fundamental principle in investigations of allelopathy.

Barley (*Hordeum vulgare* L.) has been reported to be a smother crop, which can suppress the growth of weeds through competition for environmental resources (Overland, 1966). However, in the absence of competition, barley still inhibited germination of *Amaranthus hybridus* L. (slim amaranth) and *Chenopodium album* (Went et al., 1952), suggesting that phytotoxins might be involved (Overland, 1966). Overland (1966) further found that the inhibitory activity of barley was selective among broad-leaved plants, chickweed (*Stellaria media* L.) being more severely inhibited than shepherd’s purse [*Capsella bursa-pastoris* (L.) Medic.].

The objectives of this research were to develop techniques for separating competitive influences from allelopathy and, through these techniques, to assess allelopathic activity of barley on white mustard (*Sinapis alba* L.).

**METHODS AND MATERIALS**

*Petri Dish Bioassay.* Allelopathic activity of germinating barley was bioassayed on filter paper in 9-cm Petri dishes in an incubator at 25°C in the dark using surface-sterilized seeds of white mustard (*S. alba*), used to simulate a broad-leaved weed of the same family as *C. bursa-pastoris*, but having synchronous germination. Barley (*H. vulgare*, cv. Triumph) seeds were evenly distributed on two Whatman No. 1 filter papers at rates of 0 (control), 0.13, 0.25, 0.5, 1.0, and 2.0 seeds/cm² with 10 white mustard seeds in each Petri dish for bioassay. The bioassay was designed with five replications.

Because germinating barley absorbs large amounts of water (Alabushev,