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BIOLOGY AND CONTROL OF COMMON MILKWEED

The University of Nebraska - Lincoln PH.D. 1980

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BIOLOGY AND CONTROL OF COMMON MILKWEED

by

Gary L. Cramer

A DISSERTATION

Presented to the Faculty of

The Graduate College in the University of Nebraska

In Partial Fulfillment of Requirements

For the Degree of Doctor of Philosophy

Major: Agronomy

Under the Supervision of Dr. Orvin C. Burnside

Lincoln, Nebraska

December, 1980

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TITLE

Biology and Control of Common Milkweed

BY

Gary L. Cramer

APPROVED	DATE
Professor Orvin C. Burnside	12/15/80
Professor M. K. McCarty	12/15/80
Professor J. M. Daly	12/15/80
Professor Herman Knoche	12/15/80
Professor Lloyd Haderlie	12/15/80

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A. Distribution, Interference, and Biology of Common Milkweed (*Asclepias syriaca*) in Nebraska

Abstract. The greatest infestations of common milkweed (*Asclepias syriaca* L.), in descending order, occurred on areas occupied by soybeans [*Glycine max* (L.) Merr.], oats (*Avena sativa* L.), railroad rights-of-way, sorghum [*Sor-* [*Sorghum bicolor* (L.) Moench], fallow land, roadsides, corn (*Zea mays* L.) winter wheat (*Triticum aestivum* L.), pasture, and alfalfa (*Medicago sativa* L.) Average common milkweed populations in row crops of eastern Nebraska ranged from 11,100 to 45,200 plants/ha. Average yield reductions in common milkweed infested areas of the fields ranged from 2 to 10% for corn, 4 to 29% for sorghum, and 12 to 19% for soybeans. Reductions in yields tended to increase with increasing common milkweed populations. Germination percentage of common milkweed and sorghum were not significantly affected by growing medium conductivities below 7 and 13 mmhos/cm^2, respectively. Growth media of pH 2 significantly reduced germination percentage, hypocotyl length, and radicle length of both common milkweed and sorghum as compared with a pH of 4 to 10. Undiluted aqueous extracts of common milkweed shoot and root material significantly reduced germination percentage, hypocotyl length, and radicle length of sorghum. However, decomposition of common milkweed residues in soil for up to 5 months did not adversely effect sorghum growth. No allelopathic response from common milkweed on sorghum was

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shown using a stairstep apparatus which eliminated direct competition between the two plants.

Additional index words. Allelopathy, *Asclepias syriaca*, competition, interference, sorghum, yield reduction.

INTRODUCTION

Common milkweed occurs in many cropland and noncropland areas of northeastern North America (1,4). This perennial broadleaf is a common weed problem in eastern and south central Nebraska. In Nebraska it is estimated that 5 million acres of land is infested with common milkweed (5).

Common milkweed is adapted to a wide range of climatic and edaphic conditions. It will tolerate salt concentrations up to 2500 ppmw and pH ranging from 2 to 12 (2). Infestations may be found on soils of any textural group, but they are most prevalent on soils of loamy texture that are well-drained (6). The major concern with common milkweed infestations is the reduction in crop yields which occur. Nebraska research (3) shows that common milkweed infestations reduced grain sorghum yields as much as 21% and yield loss increased with severity of infestation. Losses of grain sorghum yield shown were attributed entirely to competition. However, others have indicated that noncompetitive (allelopathic) mechanisms may play a role in yield reductions (7,8). It has been shown that aqueous extracts from field collected common milkweed

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leaves will inhibit growth of grain sorghum seedlings (7). Using a stairstep pot experiment, it was shown that leachate from both living and dead common milkweed plants caused a reduction in sorghum growth (8).

Objectives of these experiments were to determine the distribution of common milkweed in eastern and south central Nebraska, study its biology, and evaluate possible allelopathic influence on grain sorghum.

MATERIALS AND METHODS

Roadside survey. Distribution and severity of infestations of common milkweed in eastern Nebraska were based on visual estimates of common milkweed infestations taken in June 1976 through 1979. The survey was subdivided to cover three areas, each beginning and ending in Lincoln, Nebraska. The three oblong routes were northeast to South Sioux City, south central to Alma, and southeast to Nebraska City and Beatrice which totaled about 1200 km. At 1.6 km intervals severity of common milkweed infestations were estimated in the field and roadside ditch on either side of the road by visual observation as the vehicle was slowed to 32 km/h. Severity of infestations were rated as 0, 0 to 10, 10 to 100, and 100 to 1000 plants per 0.4 ha over the entire field.

Competitive experiments. Common milkweed grows in clumps which facilitates the use of a paired plot method for determining the competitive effects of infestations on

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crops. Effect of common milkweed infestations on plant population, grain yield, and protein content of corn, sorghum, and soybeans were determined during 1976 through 1979. Grain samples were harvested from a 7.6 m. length of row within the common milkweed infestation and at least 3 m outside the infestation in the same crop row. Common milkweed plants were counted between rows each 7.6 m long, and crop plants were counted within the 7.6 m row plots. Grain samples were dried at 80 C for 1 week and weighed. A portion of each sample was ground to pass through a 2 mm screen to be analyzed for protein content (Kjeldahl method). Data are expressed as percentage reduction in common milkweed infested areas as compared with noninfested areas.

Conductivity and pH. Experiments were conducted in the laboratory to determine the effect of growing media conductivity and pH on germination percentage, radicle length, and hypocotyl or coleoptile length of common milkweed and sorghum seeds. Conductivity treatments were prepared by adjusting the conductivity of distilled water with potassium chloride. Resulting conductivities were 0.02 (distilled water), 0.5, 1, 2, 3, 7, 13, and 25 mmhos/cm^2. Distilled water was modified with hydrochloric acid or sodium hydroxide to obtain pH values of 2, 4, 6, 8, and 10. Ten common milkweed or sorghum seeds on filter paper in 9 cm petri dishes received 5 ml of the various conductivity or pH solutions as a germination solution.

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Treatments were replicated 5 times. Petri dishes were then placed in a laboratory germinator operated at an alternating 20 C for 16 h of darkness and 30 C for 8 h of light. Germination percentage, radicle length, and hypocotyl or coleoptile length were recorded after 7 days.

Repeated leaching. To establish the effects of repeated leaching on solution conductivity and pH, 8 L of a half-strength modified Hoagland's solution was leached through washed sand or Sharpsburg silty clay loam (Typic Argindoll):washed sand mixture (50:50) for 7 consecutive days. At the end of each leaching, conductivity and pH measurements were recorded. Samples of each days leachate were saved for germination experiments and the leachate was brought back up to the original 8 L volume with fresh half-strength modified Hoagland's solution. Germination experiments with the leachate samples were conducted as previously described.

Aqueous extracts. To determine if common milkweed contains compounds toxic to the growth of other plants, aqueous extracts of field collected common milkweed shoots and 6-week-old greenhouse-grown seedlings were used as the growth media for common milkweed and sorghum seeds. Extracts were made by homogenizing 12.5 g of common milkweed shoots or roots in 125 ml of distilled water for 5 min in a Polytron homogenizer. The mixture was then filtered with a Buchner funnel till dry.

Ten seeds of common milkweed or sorghum placed on a

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