

## SUGAR BEET - WEED INTERACTIONS

*Abdelouhab Mesbah, Stephen D. Miller,  
K. James Fornstrom, and David E. Legg*

### INTRODUCTION

A weed is commonly defined as a plant growing where it is not wanted. This definition implies a cost associated with the misplaced plant. In sugar beet production, the primary cost is a reduction in yield due to competition. Competition occurs when two or more plants seek a limited resource essential for growth. The resources that most often limit yields are water, light, and nutrients. Under certain situations, crops and weeds might compete for space. The interactions between these factors make competition a complex and dynamic process.

### NATURE OF COMPETITION

**Light.** The relative competitiveness of plants is determined largely by their growth habits. Weeds that have a height advantage over sugar beets often gain a strong competitive edge for light (Table 1). Other factors that influence competitiveness for light include leaf area, leaf

angle, and leaf arrangement on the stem. Any reduction in the availability of light to sugar beets can have a dramatic impact on growth and yield potential because sugar beets convert solar energy into chemical energy for growth and root development. Under irrigated conditions, the most severe competition between sugar beets and weeds appears to center around light.

**Water.** The availability of water fluctuates substantially throughout the growing season. The amount of water available to a plant is determined by rainfall and irrigation, water-holding capacity of the soil, and the plant's root development and structure. A plant's ability to compete for moisture is determined largely by the volume of soil that its roots occupy. Weeds with large root systems are likely to be more detrimental to sugar beets during periods of water stress. Therefore, under dry land or limited irrigation conditions, the most severe competition between sugar beets and weeds may center around available soil moisture.

**Nutrients.** Plant species growing close together often compete for available nutrients. Several factors may provide certain plants a competitive advantage for obtaining nutrients, including early root penetration in the soil, high root-to-shoot ratio, and high uptake potential. It may seem that competition for nutrients could be resolved by additional fertilizer application, but several studies indicate otherwise. Weeds often absorb nutrients faster and in relatively large amounts compared to sugar beets. Thus, yield losses due to competition frequently increase with increased fertility because weed growth is stimulated.

**Table 1.** Effects of different weed species on the amount of light received at the top of sugar beet canopy.

Weed species	Plant height (inches)	Light (Q* x 100)	Reduction (%)
Sugar beets	22	23.5	--
Green foxtail	37	18.6	20
Wild oat	41	18.3	22
Wild mustard	26	12.7	46
Kochia	58	8.2	65

\* Q = quantum

## FACTORS AFFECTING COMPETITION

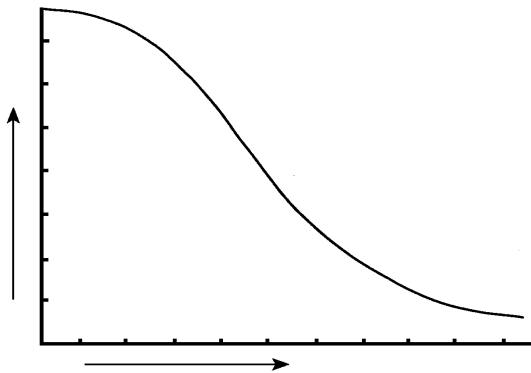
**Species.** Weed species vary widely in their competitive abilities with sugar beets (Table 2). A successful competitor must be efficient at capturing or using limited resources. Plant characteristics that impart these traits vary depending upon the resource being sought. Weed species

**Table 2.** Sugar beet root yield as influenced by season-long competition of different weed species and densities

Weed species	Density plants/33ft of row	Root yield reduction (%)
Green foxtail	10	9
	30	19
Wild oat	10	14
	30	22
Wild mustard	4	19
	8	26
Kochia	5	33
	15	61

that develop an extensive root system early in the growing season would be expected to compete effectively for nutrients and moisture. Leaf and plant height characteristics determine the competitiveness of a species for light.

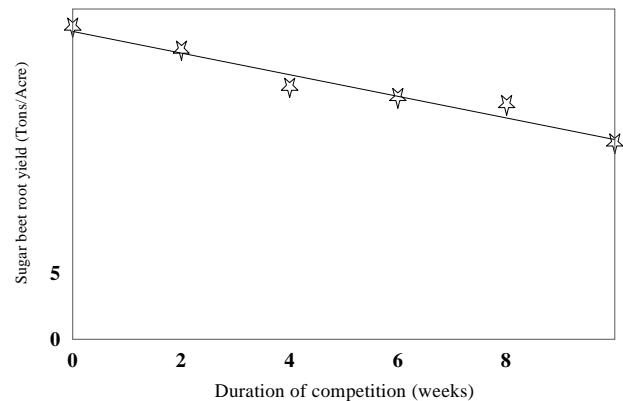
**Density.** The size of sugar beet root yield loss is directly related to weed populations (Figure 1). The relationship is not linear on either end of the density



**Figure 1.** Relationship between crop yield and weed density. (Normally, a low weed density has little impact on yield. Large densities of weeds can have a severe impact.)

spectrum. A low weed population usually does not affect yield. In the central portion of the curve, yields decrease rapidly as weed populations increase. At high weed populations, each additional weed has a diminished impact on yield until a maximum yield loss is reached. The lack of yield response at higher weed populations is due to competition among adjacent weeds that reduce the competitiveness of weeds with the crops.

**Duration.** The amount of time that weeds coexist with sugar beets dramatically impacts the yield loss (Figure 2). The critical period of competition for weeds emerging simultaneously with sugar beets varies with the weed species, population, and environmental conditions.



**Figure 2.** Sugar beet root yield versus duration of competition from 16 wild mustard plants/33ft. or row.

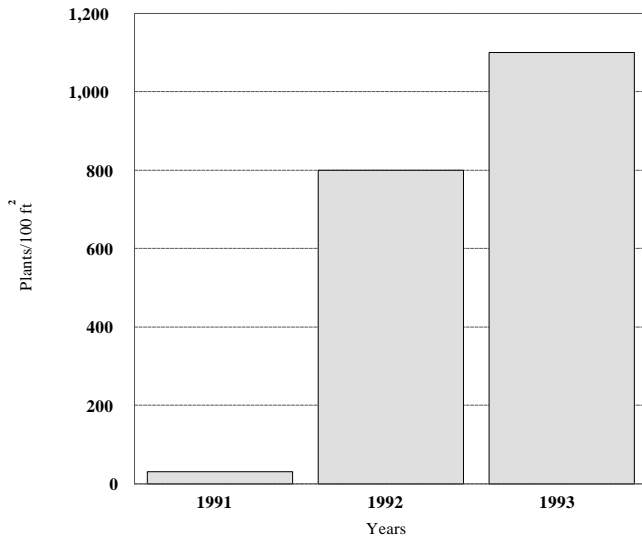
Under many situations, sugar beet yields will not be influenced by early season competition when weeds are controlled within four to six weeks of planting. This “window of opportunity” for controlling weeds may be shortened when weed densities are high, or when soil nutrients and moisture are limited.

**Environment.** Environmental conditions throughout the growing season may significantly impact the interaction between sugar beets and weeds. Moisture and light are probably the most important factors, but temperature also influences relations between sugar beets and weeds. Sugar beets generally are more sensitive to weeds under conditions that favor high yields.

## NONCOMPETITIVE EFFECTS OF WEEDS

The primary reason for controlling weeds is to prevent yield losses caused by competition; however, weeds also impact sugar beet production in other ways. These additional factors should be considered when developing weed management goals to fully account for the cost of weeds.

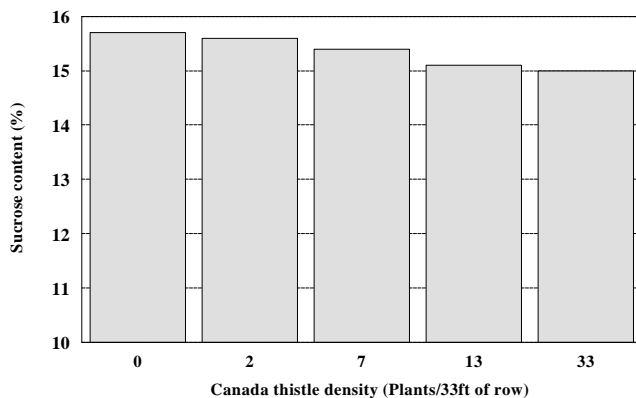
**Weed Seed Production.** Most weed species are prolific seed producers. A relatively low weed population can add large amounts of seed to the soil seed reservoir (Figure 3). A second characteristic of weedy plants is seed dormancy. Dormancy ensures that weed seed will survive for many years in the soil, maintaining the soil seed reservoir. Weeds left uncontrolled in sugar beets not only compete with the crop, but also produce seed that will be a source of infestations in future years.



**Figure 3.** Effects of uncontrolled wild proso millet population (1991) on the number of plants found in subsequent years.

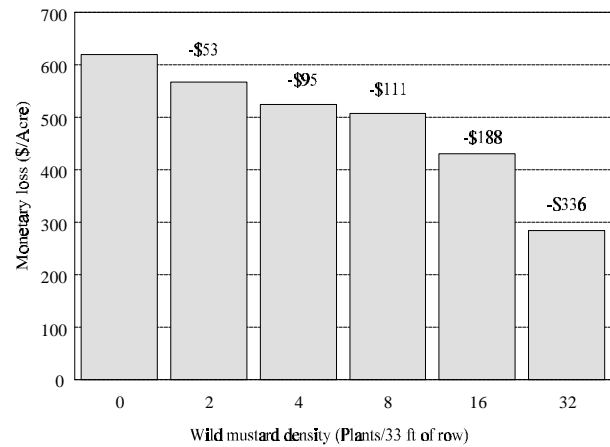
**Harvesting Efficiency.** Certain weeds can interfere with harvesting sugar beets through increased harvest losses of small beets. Heavy infestations of wild mustard doubled the number of small beets in research trials.

**Reduced Crop Value.** Weeds can lower the quality of sugar beets by reducing sucrose percentage (Figure 4). For example, five Canada thistle plants per 100 feet of row reduced sucrose percentage by 0.03 percent.



**Figure 4.** Sucrose content as influenced by season-long competition of various Canada thistle densities.

**Economic Loss.** Dollar loss due to wild mustard interference in sugar beets increased with increasing wild mustard densities (Figure 5). Based on \$35 per ton of sugar beets, two wild mustard plants per 33 feet of row caused a monetary loss of \$53 per acre.



**Figure 5.** Predicted monetary loss in sugar beet yield from various wild mustard densities, (average sugar beet price \$35/T).

**Aesthetics.** The least important impact of weeds on sugar beet production is on the appearance of the crop. Unfortunately, aesthetics play an important role in many weed management decisions, especially in sugar beets where weeds are readily visible late in the season. Attitudes toward weeds need to change so that weed management goals are developed on the basis of economics, rather than a measure of pride.

## SUMMARY

Effective weed control is a critical component of profitable sugar beet production. Left uncontrolled, weeds may reduce yield, interfere with harvest, reduce the value of the crop, and increase future weed problems.

Developing realistic goals for weed management programs is an important step for a producer. The objective of a weed management program should be to obtain a level of control that protect sugar beets from economic yield losses and other costs associated with weeds. Although several factors need to be considered in weed management decisions, the economic consequences of weeds on crop yield should be the primary concern.

## REFERENCES

Mesbah A. 1993. *Interference of Broadleaf and Grassy Weeds in Sugar Beets*. Ph. D. Dissertation. University of Wyoming. 117 pages.

Miller, S. D., K. J. Fornstrom and A. Mesbah. 1993. *Canada thistle: Can We Afford Not to Control It. Reflections* - University of Wyoming 3:15.

Miller, S. D., K. J. Fornstrom, T. Neider, P. Renner, A. Mesbah, P. Koetz, W. York, J. Lauer, and J. Krall. 1993. *Progress Report Weed Control, Agronomic Crops*. Ag. Expt. Stn. 148 pages.

*Trade or brand names used in this publication are used only for the purpose of educational information. The information given herein is supplied with the understanding that no discrimination is intended, and no endorsement information of products by the Agricultural Research Service, Federal Extension Service, or State Cooperative Extension Service is implied. Nor does it imply approval of products to the exclusion of others which may also be suitable.*

*Persons seeking admission, employment, or access to programs of the University of Wyoming shall be considered without regard to race, color, national origin, sex, age, religion, political belief, disability, veteran status and marital or familial status. Persons with disabilities who require alternative means for communication or program information (braille, large print, audiotape, etc.) should contact their local UW Extension Office. To file a complaint, write the UW Employment Practices/Affirmative Action Office, University of Wyoming, P.O. Box 3354, Laramie Wyoming 82071-3354*

*Steven F. Horn, Director Agricultural Experiment Station, University of Wyoming, Box 3354, Laramie, WY 82071.*