INTERFERENCE OF BROADLEAF WEEDS IN SUGARBEETS

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Introduction

Several investigators have reported severe yield reduction as a result of interference of various annual weed species with sugarbeet. These weeds have been effective competitors against sugarbeet because of their rapid early growth and large size later in the growing season. Venice mallow, lanceleaf sage, redstem filaree, and wild buckwheat are low stature, trailing, erect to ascending compared to tall species that have been used in previous competition studies with sugarbeet. Because of their growth habit, it is unclear if these species would compete favorably with sugarbeet and result in yield reduction.

Venice mallow reduced soybean yields by 250 kg ha^{-1} (Eaton et al. 1973). Weerakoon and Lovett (1986) demonstrated that the growth and productivity of lanceleaf sage was enhanced by wider spacing of sorghum rows. When sown in equal densities with winter wheat, lanceleaf sage showed no evidence of competitive ability but there were indications of positive, allelopathic activity from lanceleaf sage leachates on the germination and early growth of wheat (Lovett and Lynch 1979). The allelopathic effect of these leachates has been reported to be dependent upon the transfer of these chemicals from the weed to crop foliage by rain (Grümmer and Beyer 1960). Redstem filaree has been recognized as a problem weed capable of causing economic losses in pasture and field crops. Redstem filaree densities of 100 to 200 plants m^{-2} reduced yields of wheat, oilseed rape, dry bean and pea by 36%, 37%, 82%, and 92%, respectively (Blackshaw and Harker 1998). Wild buckwheat reduces yields through competition, especially where it occurs in dense stands. Wheat yields were reduced by 25 to 28% by wild buckwheat densities of 215 plants m^{-2} (Nalewaja 1964). Wild buckwheat densities of 172 plants m^{-2} reduced flax yield by 20% (Nalewaja 1964). These studies illustrate that these weeds could have a potential to compete with the sugarbeet crop and result in yield reductions.

The objectives of this study were to determine: a) the effect of various densities of Venice mallow, lanceleaf sage, redstem filaree, and wild buckwheat on sugarbeet root yield and sucrose content, as well as the lowest densities that would result in economic yield reductions, b) determine the duration of time after sugarbeet emergence that these weeds can compete with sugarbeet before economic yield reductions occur.

Material and Methods

Field studies were conducted in 2005 and 2006 at the Powell Research and Extension Center, Wyoming. Sugarbeet cultivar, Treasure was planted to stand in 56 cm row spacing in a clay loam soil (40% sand, 24% silt, 36% clay, 1.3% organic matter, and pH 7.6). Seeds of Venice mallow, lanceleaf sage, redstem filaree and wild buckwheat were seeded by hand along sugarbeet rows after planting in 2005. In 2006, seeds of Venice mallow, lanceleaf sage and wild buckwheat were planted on bedded rows before planting sugarbeet. Sugarbeet was planted in a redstem filaree infested area in 2006. Individual plots were established immediately after the emergence of each weed species and sugarbeet. There was a weed density and duration of competition study for each weed species. The experimental design was a randomized complete block design with 3 to 4 replications depending on weed species. Plots were furrow irrigated and fertilized during the growing season to optimize growing conditions.

Season long competition of various densities: Densities of 0, 2, 4, 6, 8, 10 plants m^{-1} and 0, 6, 12, 18, 24, 30 plants m^{-1} of Venice mallow, lanceleaf sage, redstem filaree, and wild buckwheat were established over the sugarbeet row in 2005 and 2006, respectively. Densities were lower in 2005 because of poor establishment of the weed species. Plots were kept free from other weeds by hand removal and cultivation through out the growing season. Sugarbeet and weeds were harvested from the center row of each plot at the end of the study. Weeds were cut at the soil surface and weighed for biomass. A sub-sample of sugarbeet was pulled from each plot and sent for quality analysis at the Western Sugar tare laboratory in Billings, Montana.

Duration of competition: Duration of competition studies were established in a similar way as the density studies. Shortly after emergence, the weeds were thinned to a density of 6 plants m^{-1} and 18 plants m^{-1} of Venice mallow, lanceleaf sage, redstem filaree, and wild buckwheat over the sugarbeet row in 2005 and 2006, respectively. Densities of weeds were lower in 2005 because of poor establishment. These weeds were allowed to compete with sugarbeet for 2, 4, 6, 8, 10, and 12 weeks after weed emergence before hand removal. Weed biomass was harvested in the center row of each plot at each removal period. Weed management and sugarbeet harvesting were done in a similar fashion as in the density studies.

Results and discussion

There was very poor establishment of lanceleaf sage and redstem filaree in 2005, and no data was collected from these weed species.

Season long competition: In 2005, sugarbeet root yield decreased as Venice mallow density increased from 0 to 10 plants m^{-1} of row, however, wild buckwheat density did not influence sugarbeet root yield at the same densities.

In 2006, sugarbeet root yield decreased and weed biomass increased as weed densities increased from 0 to 30 plants m^{-1} over the sugarbeet row. Venice mallow reduced the average sugarbeet root yield by 21, 29, 35, 40, and 49% at densities of 6, 12, 18, 24, and 30 plants m^{-1} of row, respectively. Sugarbeet root yield regressed against Venice mallow density fit a linear regression equation, $Y = 69.94 - 1.10x$ with an $R^2 = 0.79$. The regression equation was used to calculate the minimum number of plants to economically reduce sugarbeet root yield based on the cost of weed control. The minimum number of Venice mallow was determined to be 14 plants m^{-1} of row. Lanceleaf sage reduced the average sugarbeet root yield by 18, 28, 41, 51, and 51% at densities of 6, 12, 18, 24, and 30 plants m^{-1} of row, respectively. Sugarbeet root yield regressed against lanceleaf sage density fit a linear regression equation, $Y = 66.93 - 1.25x$ with an $R^2 = 0.78$. The minimum number of lanceleaf sage to economically reduce sugarbeet root yield was determined to be 12 plants m^{-1} of row. Redstem filaree reduced the average sugarbeet root yield by 18, 38, 39, 60, and 63% at densities of 6, 12, 18, 24, and 30 plants m^{-1} of row, respectively. Sugarbeet root yield regressed against redstem filaree density fit a linear regression equation, Y = 79.87 – 1.76x with an R^2 = 0.87. The minimum number of redstem filaree to economically reduce sugarbeet root yield was determined to be 7 plants m^{-1} of row. Wild buckwheat reduced the average sugarbeet root yield by 19, 41, 49, 58, and 68% at densities of 6, 12, 18, 24, and 30 plants m^{-1} of row, respectively. Sugarbeet root yield regressed against wild buckwheat density fit a linear regression equation, Y = 65.86 – 1.59x with an R^2 = 0.80. The minimum number of wild buckwheat to economically reduce sugarbeet root yield was determined to be 9 plants m^{-1} of row. During this study, water and nutrients were adequate for plant growth. Light and space could have been the limiting factors for which competition occurred. Sucrose content was not influenced by weed densities in either year.

Duration of competition: Sugarbeet root yield was not influenced by Venice mallow and wild buckwheat duration of competition in 2005. In 2006, sugarbeet root yield decreased and weed biomass increased as duration of Venice mallow competition increased. Root yields were reduced by 4, 15, 15, 19, 21, and 27% at 2, 4, 6, 8, 10, and 12 weeks of Venice mallow competition, respectively. The data was described by a linear regression equation of Y = 73.75 – 1.60x with an R^2 = 0.63. The regression equation was used to calculate the minimum time Venice mallow must compete before causing economical sugarbeet root yield reduction based on the cost of weed control. The minimum time Venice mallow must compete with sugarbeet was determined to be 10 weeks. Lanceleaf sage biomass increased with increasing duration of competition. Lanceleaf sage duration of competition reduced sugarbeet root yield by 6, 8, 15, 18, 19, and 22% at 2, 4, 6, 8, 10, and 12 weeks of lanceleaf sage competition, respectively. The data was described by a weak linear regression equation of Y = 67.62 – 1.26x with an R^2 = 0.50. The minimum time lanceleaf sage must compete with sugarbeet before root yields are reduced economically was determined to be 12 weeks. Redstem filaree weed biomass increased with increasing duration of competition. Redstem filaree duration of competition on sugarbeet root yield was not additive. It reduced sugarbeet root yield by 14, 36, 43, 33, 42, and 39% at 2, 4, 6, 8, 10, and 12 weeks of redstem filaree competition, respectively. The data best fit a linear regression equation of Y = 75.68 – 1.53x with an R^2 = 0.50. The minimum time redstem filaree must compete with sugarbeet before root yields are reduced economically was determined to be 10 weeks. Wild buckwheat weed biomass increased with increasing duration of competition. Wild buckwheat duration of competition reduced sugarbeet root yield by 2, 2, 12, 13, 22, and 23% at 2, 4, 6, 8, 10, and 12 weeks of wild buckwheat competition, respectively. The data was described by a weak linear regression equation of Y = 71.57 – 1.51x with an R^2 = 0.42. The minimum time wild buckwheat must compete with sugarbeet before root yields are reduced economically was determined to be 10 weeks. The duration of competition of these weed species was very long, compared to species that have been used in previous competition studies with sugarbeet. This probably was related to the low stature of these weeds that does not allow them to grow tall and shade the sugarbeet canopy. Sucrose content was not influenced by duration of competition in either year which was similar to the density studies.

Literature cited

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