COMMON TOADFLAX (LINARIA VULGARIS) A PERSISTENT WEED IN ALFALFA (MEDICARGO SATIVA) HAY FIELDS.

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ABSTRACT

The spread and persistence of common toadflax (Linaria vulgaris) when growing alone and in competition with alfalfa *(Medicargo sativa)* maintained as a hay crop in central Alberta Canada was monitored over a four year period. Competition from alfalfa reduced the rate of spread of the weed, and multiple harvests of the crop prevented toadflax seed set. The presence of the weed did not significantly affect the yield of alfalfa.

INTRODUCTION

Common toadflax *(Linaria vulgaris)* is a perennial weed that propagates both by seed and vegetatively through shoot production from its spreading root system. It is classed as a noxious weed under the Alberta Weed Control Act (1979) and its seeds are considered primary noxious weed seeds under the Canadian Seed Act.

The weed has become an increasing problem on crop land in Alberta where < 240 000 ha of crop land were found to be infested with the weed in 1987 (Alberta Agriculture Weed Survey). While herbicide application, or frequent tillage, can control or eliminate the weed in annual cropping systems there are no recommended control treatments for the toadflax growing in a permanent pasture or on hay land. Alfalfa (*Medicago sativa)* is a forage crop of high economic value in Alberta, where it is grown in pure stands, or in binary mixtures with a range of grasses, for hay or pasture production. Some of the largest infestations of toadflax have been found in older stands of alfalfa managed for hay production. Whether the presence of the weed has a serious impact on forage production has not previously been documented. This work looked at the competitive effect and spread of common toadflax growing with alfalfa harvested as a hay crop.

METHODS

The three treatments were alfalfa and toadflax growing alone or in a binary mixture. Plots were established in the spring of 1989 in Edmonton, Alberta. Each treatment plot was 3 m x 3 m and separated from neighbouring plots by a 1 m pathway of cultivated soil. Each treatment was replicated four times in a randomized complete block design. In plots containing alfalfa the seed was broadcast by hand on to the soil surface, at a seeding rate of 6 kg/ha, after which the plots were lightly raked to incorporate the seed. In plots containing toadflax a single shoot, 10 cm in height and with a 10 cm root, was transplanted into the centre of each plot. Toadflax shoots were obtained from a nearby natural infestation.

The plots were harvested once at the end of the establishment year, three times in the first production year 1990, and twice in the second and third production years 1991 and 1992. Harvests were taken when the alfalfa reached 10% bloom.

Since toadflax patches tend to be circular in shape (Nadeau *et al.*, 1991), maximum patch diameter was measured at each harvest to determine the spread of the infestation. Toadflax shoot density was measured either by counting all of the shoots in a small patch, or, when the patches grew larger, based on the shoot number in a 1m x 0.25m quadrat placed across the centre of the patch. Toadflax biomass was measured by hand harvesting all of the toadflax shoots within a plot at a height of 3 cm. Once the toadflax had been harvested from the plot, alfalfa yield was measured from a 3m x 0.6m swath, cut with a flail type forage plot harvester. All biomass samples were dried in a forced air oven to constant weight.

RESULTS AND DISCUSSION

The toadflax plants were able to grow and spread in the presence of alfalfa, but the presence of the weed did not significantly effect alfalfa yield in any year, or at any harvest (Table 1). Occasionally the mean alfalfa yield was numerically greater in the presence of the weed.

Competition from alfalfa, however, severely reduced toadflax shoot density and shoot biomass over three harvest years and slowed the lateral spread of the weed. The spread of the weed patch, in the presence of the competitor crop, reached a maximum diameter of 1.1 m during the first production year and then declined to 0.93 m by the end of the third production year (Table 2). By contrast, in the absence of competition, toadflax had spread beyond the edge of the plot (diameter of 3.44 m) early in the second production year. Toadflax shoot density was also significantly reduced by alfalfa competition and declined over the three years of the test. Toadflax biomass in the presence of the alfalfa crop was less than one tenth of the biomass produced in the absence of competition and also declined during the course of the experiment.

In the spring of each year the toadflax was able to maintain a height similar to the alfalfa, but, following cutting, the alfalfa had a more rapid rate of regrowth and soon began to shade the weed. Greenhouse studies have indicated that common toadflax is quite sensitive to low light levels (data not presented). When growing in competition with barley, significant spread of the toadflax patch occured after the removal of the crop canopy (Nadeau *et al*. 1991). The size of the toadflax patch at the end of the first alfalfa production year was similar to that achieved when growing in a single season with barley as the competitor (Nadeau et al, 1991), in the following two years alfalfa competition and the twice yearly harvests prevented any further significant development of the patch. More frequent alfalfa harvests might lead to further reductions of toadflax growth and the depletion of its root reserves. Over the three year period of this study the alfalfa remained vigorous and was able to contain the spread of the weed, however, alfalfa stands typically decline in density as they age and thus a toadflax infestation might have a more significant effect on alfalfa yield if stand is maintained into the fourth or fifth production year.

Toadflax did produce flowers when growing in competition with alfalfa, but harvesting the crop two or three times during the growing season prevented any seed production. Propagation by seed was thus eliminated. However, since the weed continued to persist and maintain its patch size within the alfalfa stand, any subsequent soil cultivation, at the end of the alfalfa stands' productive life, would result in the spread and re-inoculation of the land with toadflax root pieces. Nadeau et al. (1992) showed that root pieces as small as 1mm in diameter and 1cm in length are capable of shoot production.

Results from this study suggest that infestations of common toadflax in alfalfa may only have a significant effect on alfalfa yield in old or thin stands, but that the continued persistence of the weed in an alfalfa stand could act as a significant source for reinfestation and spread, from root pieces, in subsequent crops.

REFERENCES

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Table 1

Alfalfa yield (kg/ha) when growing alone or in competition with common toadflax.

Year	Alfalfa	Alfalfa + Toadflax
1990	8035	9002
1991	6475	7372
1992	5602	6471

Table 2

Biomass (g/plot), stand diameter (cm), and shoot density #/m2, of common toadflax when growing alone or in competition with alfalfa 1990- 1992.

Harvest	Stand diameter		Shoot density		Biomass	
	Tf	Tf + A	Tf	Tf + A	Tf	Tf + A
June 90	113	65	504	164	359	12.4
Aug. 90	268	110	708	100	340	7.2
Oct. 90		-		-	128	1.4
July 91	344	69	-	40	538	5.0
Oct. 91		93	-	40	232	4.7
July 92		75	-	5	-	7.2
Oct. 92		85	-	5	-	1.8

Tf - Toadflax growing alone.
Tf + A Toadflax growing in competition with alfalfa.