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POPULATION DENSITY AND REPRODUCTIVE OUTPUT OF *ACROPTILON REPENS* L., IN TURKEY

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Abstract

Acroptilon repens of the family Asteraceae L., is a rhizomatous perennial, extends from Turkey throughout Central Asia to China. *A. repens* is a major weed in vineyards, orchards and meadows in Central Turkey. Our aim was to describe the population density of *A. repens* patches in Central of Turkey. The patch experiment was conducted in 15 undisturbed meadows in 2003. Six 1 m^2 plots were placed in each patch, 2 in the centre (C), 2 halfway between the centre and the edge (M), and 2 at the edge of each patch (E). Twenty capitula were randomly selected from each plot to record the number of healthy and undeveloped seeds as well as the number of seeds damaged by herbivores. Population density of *A. repens* was recorded in August when the plant was mature. Mean shoot density of the 15 *A. repens* patches in 2003 was 12.14 m^{-2}. The capitula density per shoot ranged 4.20- 229.60 plant $^{-1}$. The relationship between mean number of capitula per shoot and shoot density in *A. repens* were found negative correlation. The number of seeds per capitula of *A. repens* was on average 52.36 and ranged from 12.06-24.31.

Introduction

Acroptilon repens is a herbaceous perennial that propagates by seeds and vegetative means. It has erect stems and ranges in height from 30 to 80 cm (Welsh *et al.*, 1993). Its natural range extends from Turkey throughout Central Asia to China. *A. repens* is an invasive weed in North America but also causes problems in disturbed habitats in its native range in Asia. In Turkey, for example, *A. repens* is a major weed in vineyards and orchards, where the soil is regularly tilled in order to reduce competition for water between the fruit trees and herbaceous vegetation (Mordovets & Golovin, 1983; Sozeri & Maden, 1994, Uygur *et al.*, 2004). Both in its native and exotic range, initial colonisation of a site by *A. repens* involves establishment of genets from seeds or from small root fragments, but subsequent population development seems to occur almost exclusively by the production of shoots via clonal growth (Harrod & Taylor, 1995; Bottoms *et al.*, 2001). It is characterized by its extensive root system, low seed production, and persistence. *A. repens* can commonly be found along roadsides, riverbanks, irrigation ditches, and in pastures, waste places, clearcuts and croplands. *A. repens* is a strong competitor and can form dense colonies in disturbed areas (Watson, 1980). *A. repens* contains an allelopathic polyacetylene compound which inhibits the growth of competing plants (Watson, 1980; Stevens, 1986). This allelopathic effect, combined with dense vegetative reproduction, allows *A. repens* to quickly colonize and dominate new sites. On agricultural land, *A. repens* has caused serious reductions in yields, crop value and may even significantly devalue the land itself. Shoot densities of 19, 32 and 65 shoots/m² have reduced the fresh weight yield of corn by 64, 73 and 88%, respectively (Watson, 1980). This study was conducted to determine population densities of *A. repens* in central Turkey.

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Table 1. Name, region and code of *A. repens* patches in 2003.

Name	Region	Code
Kemerhisar Icmeler	Kemerhisar	1
Camardi	Camardi	2
Between Göreme Avanos	Göreme	3
Opet Cross	Göreme	4
Urgup 2	Urgup	5
Between Kavşak Avanos	Goreme	6
Goreme 2	Goreme	7
Urgup 4	Urgup	8
Göreme 1	Goreme	9
Urgup 3	Urgup	10
Between Avanos-Kayseri	Avanos	11
Urgup 1	Urgup	12
Between Avanos-Nevşehir 1	Avanos	13
Between Avanos-Nevşehir 2	Avanos	14
Zelve	Goreme	15

Material and Methods

Sites: The experiment was conducted in central Turkey on 15 undisturbed meadows (Among Goreme/Nevsehir 38º 38'N, 34º 43'E, Kemerhisar/Nigde 37º 49'N, 34º 35'E, Camardi/Nigde 37º 43'N, 35º 01'E, Avanos/Nevsehir 38º 43'N, 34º 50'E and Urgup/Nevsehir; 38º 37'N, 34º 54'E) in 2003. The name, region and code of patches are given in Table 1. Central Turkey is characterised by a continental climate with high summer temperatures (maximum temperature for the period 2000-2006 was 35.5ºC) and low winter temperatures (-10ºC) and low precipitation (mean annual precipitation, 25 kg/m^2). The soil has more sandy and volcanic tufa. The sites in the undisturbed meadows or along roadside had not been cultivated for at least 10 years.

Experimental design: At the each of patch, six 1 m^2 plots were placed inside the patch; (2 central (C), 2 middle (M) and 2 edge (E) for determining shoot, capitula and seed number of *A. repens*. Density of mature plant and capitula were recorded in August 13, 2003. Twenty numbers of capitula were randomly selected from each plot^{-1} for recording seed number and seed situation (undeveloped, insect damaged and healthy) of *A. repens* when stage of *A. repens* was at maturity in August.

Statistics: All data on density of shoots, capitula, seed and situation of seed of *A. repens* were evaluated by analysis of variance. Means are given with standard error.

Results and Discussion

Shoot density: The mean shoot density of *A. repens* patches in 2003 was 12.14 m^{-2} and ranged from 4.83-32.17 shoots plot $^{-1}$ (Fig. 1). Density of plants were generally lower if we compare to previous research results. *A. repens* spreads through creeping horizontal roots and seed and it has a well-developed root system, which functions as the major means of propagation and spreading. The roots of *A. repens* can extend more than 7 meters below the soil surface with 2-2.5 meters of growth occurring the first year and 5-7 meters in the second year (Zimmerman, 1996). Dence patches may exceed 100-300 shoots/m^2 and in this way *A. repens* is able to outcompete and exclude desirable vegetation (Watson, 1980; Maddox *et al*., 1985; James *et al*., 1991; Morrison *et al*.,

1995). Koloren *et al*., (2005) reported that shoot density of *A. repens* in a meadow in Central Turkey was 77.00 per m^2, and in a fallow land and 100.70. Koloren *et al*., (2007) found that mean shoot densities of *A. repens* in May 2002-2003 in Goreme were between 7.60-25.67 and 7.83-24.83 plot $^{-1}$, respectively.

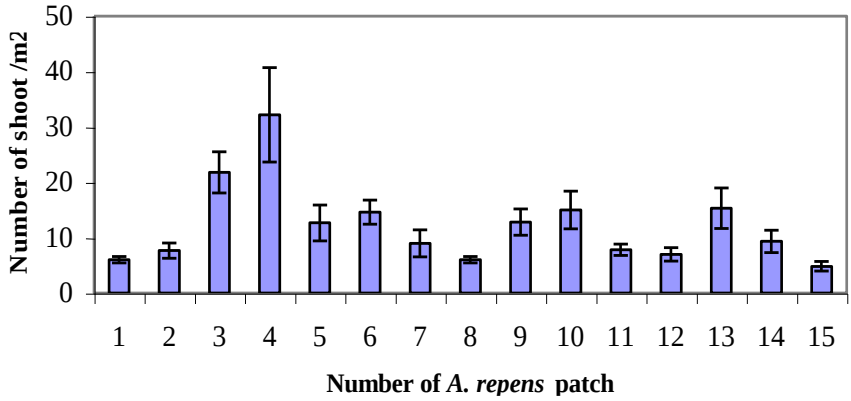

Fig. 1. Shoot density of *A. repens* patch in 2003.

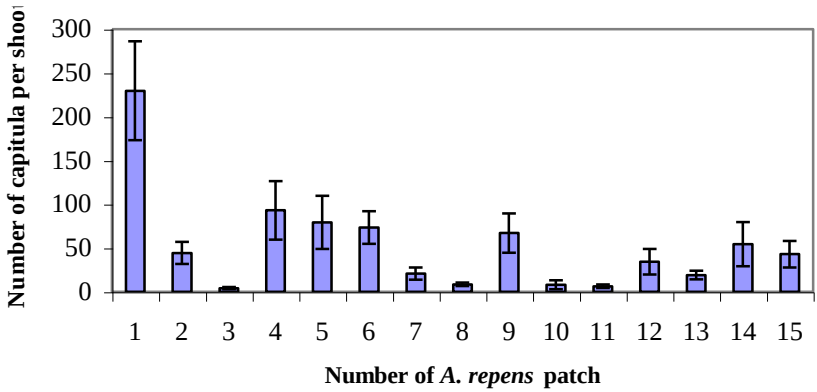

Fig. 2. Number of capitula per shoot of *A. repens* patch in 2003.

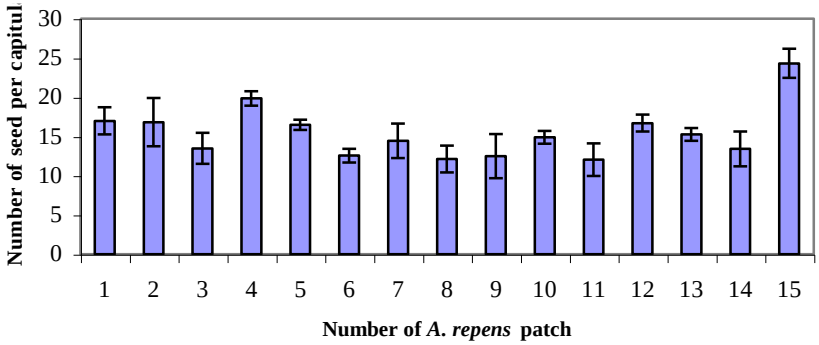

Fig. 3. Density of seed per capitula of *A. repens* patch in 2003.

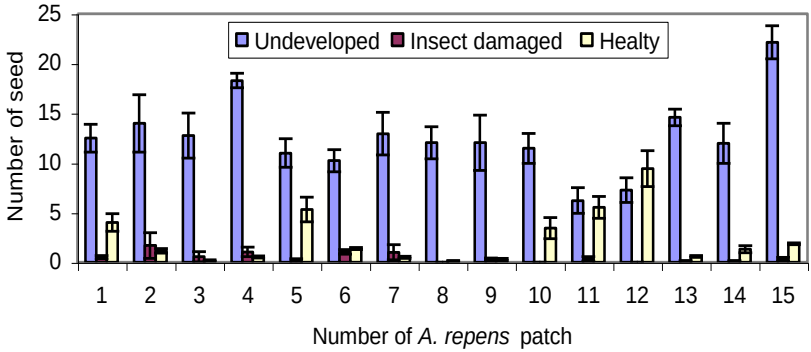

Fig. 4. Seed condition of *A. repens* patch in 2003.

Density of capitula: Mean density of capitula was 52.36 and ranged 4.20-229.60 in *A. repens* patches (Fig. 2). According to Koloren *et al.*, (2005), the total number of seed heads of *A. repens* increased at least up to 200 shoots m^{-2}. There were negative correlation between shoot density and number of capitula. The relationship between mean number of seed heads per shoot and shoot density in *A. repens* contrasts with the commonly found negatively density-dependent linear relationship between shoot density and reproductive output (Bishop & Davy, 1985; Silvertown & Lovett Doust, 1993).

Density and viability of seed: The mean density of seed per capitula (15.46±1.65) similar in all patches and ranged between 12.06-24.31 (Fig. 3). A single *A. repens* shoot can produce about 1.200 seeds per year (Watson, 1980; Whitson, 1999). Watson (1980) reported *A. repens* seed production of about 100 seeds per plant per year along roadsides and about 292 seeds per plant on rangeland in British Columbia, with a high ovule abortion rate. Beck (2001) reports seed production of about 50 to 500 per shoot in Colorado. In Fig. 4, undeveloped seed numbers were higher than the other seed conditions in all patches. It may be the result because of *A. repens* reproduce vegetatively. croptilon repens does not self-pollinate, nor is it a high seed producer (Watson, 1980, Maddox *et al*., 1985) It reproduces primarily vegetatively. The results showed that percentages of undeveloped seeds was 81.59% (range: 43.54-99.13%), of insect damaged seeds 3.10% (range: 0.05-10.03%) and of healthy seeds 15.40% (range: 0.87-56.41%). In the *A. repens* patch (12), healthy seed number was higher than the others. The number and percentage (%) of insect damaged of seed were lowest in all *A. repens* patches (Fig. 4). *A. repens* reproduces by seed and by adventitious buds on horizontally spreading roots. Since *A. repens* produces relatively few seeds and lacks effective mechanisms for seed dispersal, local infestations increase primarily by adventitious roots (Rogers, 1928; Watson, 1980; Whitson, 1999).

In this experiment, the number of density and capitula of *A. repens* were found maximum 32.17 $plot^{-1}$ and 229.60 $plant^{-1}$, respectively. We observed that when density was increased, the number of capitula decreased. In Central Turkey, *A. repens* appears to reproduce primarily by vegetative means, as also depicted by its extensive root systems. The density of seeds was found to be low and most of the seeds were undeveloped and/or damaged.

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