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DENSITY AND DYNAMICS OF *ACROPTILON REPENS* L., PATCHES IN TURKEY

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Abstract

Acroptilon repens is an herbaceous perennial that propagates by seeds and vegetative means. Its natural range extends from Turkey throughout Central Asia to China. *A. repens* is a major weed for grape, orchards and meadow area in Central of Turkey. Our objective was to determine density and expanding of *A. repens* patches in Central of Turkey. The patche experiments were conducted for an 6 undisturbed meadow in 2002-2003. Six of 1x1=1 m^2 plots were randomly selected in each patch (2 central (C), 2 middle (M) and 2 edge (E). Shoot density and height of *A. repens* were recorded at two different times (May and August) and also, fresh-dry weight and patch growth were recorded in August for each of the years from each plots The results of the 6 patches experiments for shoot height of *A. repens* in 2002 and 2003 ranged from 24.94 -31.33 cm and 19.31-25.41 cm plot $^{-1}$, respectively. In addition to this, the shoot density of *A. repens* in 2002 and 2003 ranged from 5.83-26.83 shoot plot^{-1} and 7.50-24.83 shoot plot^{-1}, respectively. The shoot density of *A. repens* was higher in central plot than the edge plot in 2002-2003. The patches of *A. repens* in Goreme1, Urgup 1, Urgup 3 and Urgup 4 in 2002-2003 were extended totaly 5, 16, 9 and 12 shoot plot^{-1}, respectively.

Introduction

Invasion of native plant communities by exotic weeds has become a major ecological concern. Invasive exotic weeds may replace native species and alter ecosystem structure and function (Usher 1988; Vitousek 1990; Mack *et al*. 2000). An effective weed management requires detailed knowledge of the effect of potential control measures on the population dynamics of the weed in the presence of competing vegetation (Briese, 1993; Shea, 1998; Edwards *et al*., 2000). *Acroptilon repens* is an invasive weed in North America but also causes problems in disturbed habitats in its native range in Asia. *A. repens* is an herbaceous perennial that propagates by seeds and vegetative means. Its natural range extends from Turkey throughout Central Asia to China. This plant is also known to display a weedy character in its native range. In Turkey, for example, *A. repens* is a major weed in 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). 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 (Bottoms *et al*., 2001). It is characterized by its extensive root system, low seed production, and persistence. *A. repens* spreads through creeping horizontal roots and seed. *A. repens* 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). *A. repens* can commonly be found along roadsides, riverbanks, irrigation ditches, pastures, waste places, clearcuts, and croplands. *A. repens* is a strong competitor and can form dense colonies in disturbed areas. Dense patches of *A. repens* may have up to 100-300 shoots/m² (Watson 1980). Watson (1980) reported that the plant extends radially in all directions and can cover an area of 12 m² within 2 years. *A. repens* contains an allelopathic polyacetylene compound which inhibits the growth of competing plants (Watson, 1980; Stevens, 1986). Tests conducted with alfalfa (*Medicago sativa*), barnyard grass (*Echinochloa crus-galli*), and red millet (*Panicum miliaceum*) indicated *A. repens* effectively inhibits root length elongation of grasses as well as broad-leaved plants by 30% when the polyacetylene compound is at a soil concentration of 4 parts per million (Stevens & Merrill, 1985; Stevens, 1986). This allelopathic effect, combined with dense vegetative reproduction, allows for *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 11-64 shoots/m² have reduced grain yields by 28-75%. 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). The scope of this experiment was to determine density and dynamics of *A. repens* patches in central Turkey.

Material and Methods

Sites: Permanent patches of *A. repens* experiments were conducted in central of Turkey in 6 undisturbed meadows (Between Goreme/Nevsehir; 38º 38'N, 34º 43'E and Urgup/Nevsehir; 38º 37'N, 34º 54'E) in 2002-2003. Central of Turkey is characterised by a continental climate with high summer temperatures (maximum temperature for the period 2000-2006 was 35.50ºC) and low winter temperatures (temperature, -10ºC) and low precipitation (mean annual precipitation, 25 kg/m^2). The site in the undisturbed meadow, which had not been cultivated for at least 15 years, was monitored for 2 consecutive years (2002–03).

Experimental design: On the each of patch, size of selected patches were measured from central to edge in a four direction. Six of 1x1=1 m^2 plots were randomly selected in each patch (2 central (C), 2 middle (M) and 2 edge (E)) (Fig. 1). Shoot density and height of *A. repens* were recorded in two different times (May and August) in each years from each plots and patch growth were recorded in August. In May and in August, stage of *A. repens* was capitula and maturity, respectively. In each year, in August, above-ground biomass harvested, separated into *A.repens* and ‘other vegetation (weeds)’ and fresh-dry weight was determined for each plots. In addition to this plant materials were oven dried at 105ºC , for 2 days in order to obtain dry weight. When patch size of *A. repens* were extended, the number of plant counted with length from all edge directions for dynamics of plant patche growth. The expand of *A. repens* patch were determined with the number of plants how far it from edge of patch.

Statistics: All datas (shoot density and shoot height, fresh-dry weight of *A.repens* and ‘other vegetation (weeds)) were evaluated by analysis of variance. The means were separated by the Duncan’s Multiple Range Test at the 0.05 level of probability.

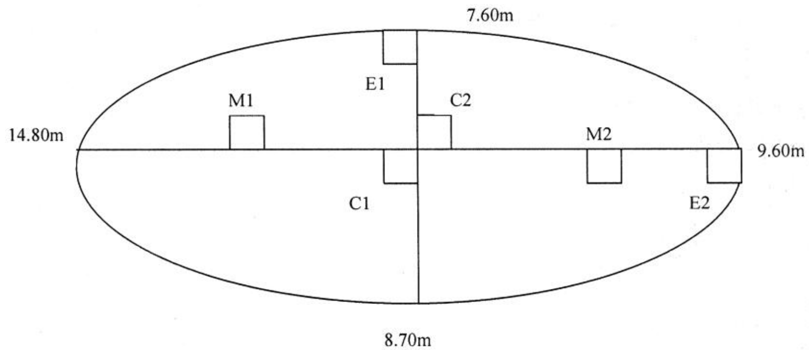

Fig. 1. View of one patch of *A. repens* from Urgup 4.

Results and Discussion

Density of *A. repens*: The results from the patches experiments for mean shoot height of *A. repens* in 2002 and 2003 were changed 24.94 -31.33 cm and 19.31-25.41 cm plot $^{-1}$, respectively, and did not differ significantly ($p<0.05$) (Fig. 2). According to Koloren *et al*., (2005), mean shoot height at the meadow (22.3 cm) was greater than at the two fallowland sites (18.2 cm). Welsh *et al*., (1993) reported that *A. repens* had erect stems and ranges 30 to 80 cm. Mean shoot density of *A. repens* in May 2002 and 2003 were similar result in all plots and their range were between 7.60-25.67 and 7.83-24.83 plot $^{-1}$ and did not differ significantly among C1, C2 and M1; M2, E1 and E2, respectively (Fig. 3). As seen Fig. 3, in August 2002, shoot density of *A. repens* at C1, C2, M1, M2, E1 and E2 were 8.83, 6.17, 7.33, 6.80, 6.20 and 5.83 plot $^{-1}$, respectively, and did not differ significantly ($p<0.05$). Dence pathches 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* at the meadow was 77.00 plot $^{-1}$. Furthermore same researchers found that shoot density of *A. repens* was 100.70 at the fallowland.

The results showed that mean fresh and dry biomass of *A. repens* were higher in central (C1 and C2) plots in 2002-2003, but did not differ significantly ($p<0.05$) in 2002 (Fig. 4). The same results were found for the other plots (M1, M2, E1 and E2) in 2002. On the contrary of this results, fresh and dry biomass of 'other vegetation (weeds)' were higher in Edge (E1) in 2002 and Middle (M1) in 2003, respectively (Fig. 5). Koloren *et al*., (2005) found that above-ground biomass of *A. repens* did not differ between the treatments (soil tillage, removal of one thirds of all shoots, removal of two thirds of all shoots and undisturbed control). They also reported that biomass of 'other vegetation (weeds)' was significantly reduced by soil disturbance, compared to the two simulated herbivory treatments and the control. In the soil disturbance plots, 'other vegetation (weeds)' made up 15% of the total above-ground biomass compared to approximately 50% in the control plots (Koloren *et al*., 2005). Soil disturbance on the *A. repens* can survive and grow in tilled soils. *A. repens*, even when dead, can leave allelopathic residues in the soil and prevent the growth of other plants for two growing seasons (Watson, 1980; Whitson, 1997; Renkin, 1997). Kelsey & Bedunah (1989) reported also steady increases in the spread of *A. repens* patch appear to be caused by allelopathy, or plant chemical defense. Environmental conditions, such as soil texture and precipitation levels, can affect the ability of individual species to dominate vegetative communities (Fraleigh *et al*., 2001).

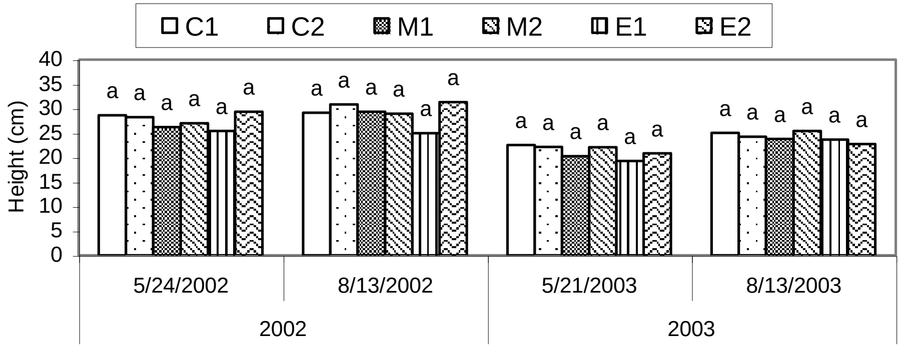

Fig. 2. Height of *A. repens* patch within 2002-2003. (Different letters show significant differences at p<0.05 significance level according to Duncan's multiple range test)

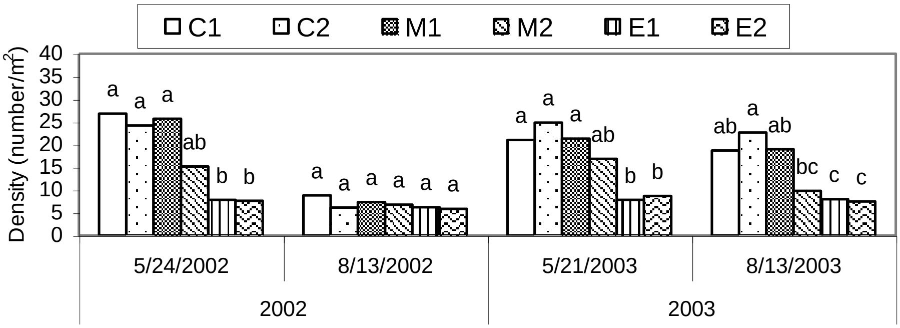

Fig. 3. Shoot density of *A. repens* patch within 2002-2003 (Different letters show significant differences at p<0.05 significance level according to Duncan's multiple range test)

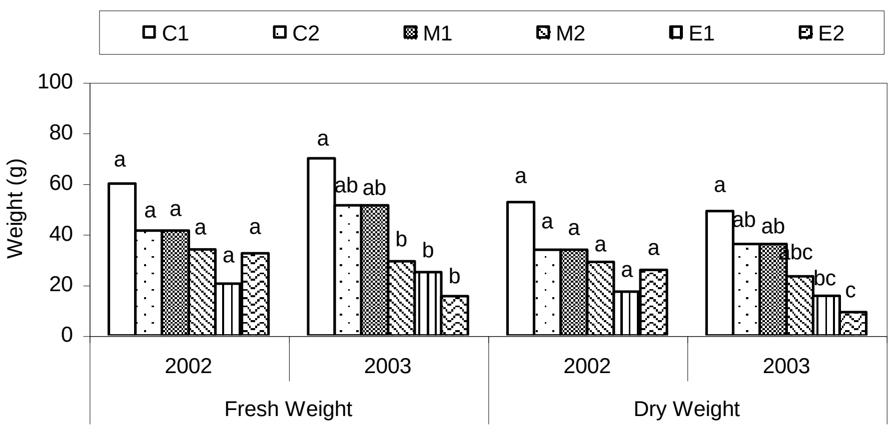

Fig. 4. Fresh and dry weight of *A .repens* patch within 2002-2003 (Different letters show significant differences at p<0.05 significance level according to Duncan's multiple range test)

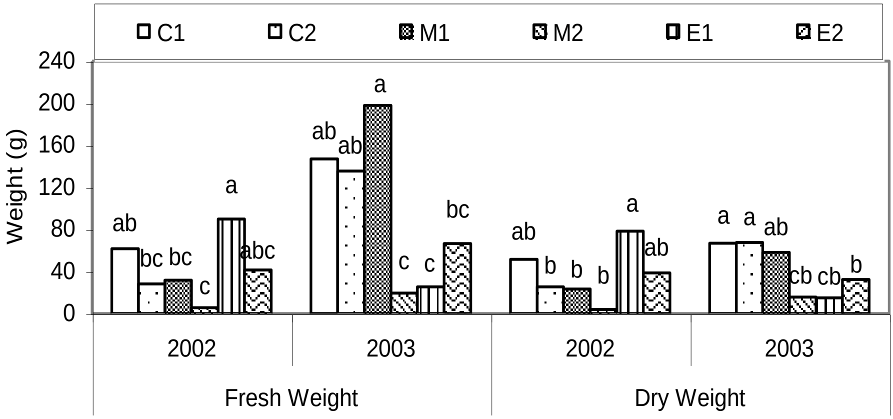

Fig. 5. Fresh and dry weight of 'other vegetation (weeds)' within 2002-2003 (Different letters show significant differences at p<0.05 significance level according to Duncan's multiple range test)

Table 1. Dynamics of *A. repens* patches.

Patche area	**Patch margin (m)**	**2002**		**2003**	
		Number of added plants			
		May	**August**	**May**	**August**
Goreme 1	9.20	-	1 pl* (in 32 cm)	-	1 pl (in 35 cm)
	23.07	-	-	-	-
	30.00	-	-	-	-
	39.60	2 pls (in 30 cm) 1 pl (in 80 cm)	-	-	-
Goreme 2	29.35	-	-	-	-
Urgup 1	6.30	1 pl (in 90 cm) 1 pl (in 105cm)	-	-	1 pl (in 70 cm) 1 pl (in 102 cm) 1 pl (in 115 cm) 1 pl (in 140 cm) 1 pl (in 150 cm) 1 pl (in 170 cm)
	7.45	1 pl (in 30 cm)	1 pl (in 25 cm)	1 pl (in 25 cm) 1 pl (in 50 cm)	1 pl (in 5 cm) 1 pl (in 30 cm) 1 pl (in 55 cm)
	5.80	1 pl (in 20 cm)	-	-	-
	11.40	-	-	-	-
Urgup 2	8.60	-	-	-	-
Urgup 3	8.50	-	-	-	
	11.80	3 pls (in 70 cm) 1 pl (in 114 cm)	-	-	1 pl (in 15 cm) 1 pl (in 40 cm) 1 pl (in 50 cm) 1 pl (in 60 cm) 1 pl (110 cm)
	12.80	-	-	-	-
	14.80	-	-	-	-
Urgup 4	7.60	-	-	-	-
	8.70	1 pl (in 60 cm)	-	-	-
	9.60	2 pls (in 50 cm)	-	4 pls (in 50 cm)	1 pl (in 50 cm) 1 pl (in60 cm) 2 pls (in 70 cm) 1 pl (in 130 cm)
	14.80	-	-	-	-

(* pl: Plant)

Dynamics of *A. repens*: The patches growth were determined in a each year at 2 different times. The results on dynamics of *A. repens* pathes are given in Table 1. Shows that shape of patch in Goreme 2 and in Urgup 2 were different from the other patches because they were lengthwise. All patches were set up in 2001 and firstly, they were observed in May 2002 for dynamics and density of *A. repens*. In addition to this, the numbers of *A. repens* shoot were determined from margin (m) in 2002-2003. Although there were no extended in patche of Goreme 2 and Urgup 2, the patche of Urgup 1, and Urgup 4 had high number of *A repens* shoot (Table 1). Watson (1980) reported that the *A. repens* extends radially in all directions and can cover an area of 12 m² within 2 years. Schultz (2005) reported that *A. repens* spread was largely from the lateral expansion of an extensive creeping root system. Individual plants reproduce vegetatively (i.e., are clonal) and become patches with many interconnected stems. These patches slowly have an increase in stem density and over time expand laterally. Finally, in this experiment, the patches of *A. repens* in Goreme1, Urgup 1, Urgup 3 and Urgup 4 in 2002-2003 were extended totaly 5, 16, 9 and 12 plant plot^{-1}, respectively. Further patch experiments are also needed to investigate the density and dynamics of *A. repens* to identify growth of *A. repens* patch.

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