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Suppressive Effect of Some Forage Plants on the Growth of *Ambrosia artemisiifolia* and *Iva xanthiifolia*

Senka Milanova[1], Vladimir Vladimirov[2] and Svetla Maneva[1]

[1]Plant Protection Institute, 35 Panayot Volov str., 2230 Kostinbrod, Bulgaria (senkamilanova@yahoo.com)
[2]Institute of Botany, Bulgarian Academy of Sciences, Acad. Georgi Bonchev St., bl. 23, 1113 Sofia, Bulgaria

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ABSTRACT

A pot trial in greenhouse conditions has been carried out to investigate the role of some plant species in suppression of *Ambrosia artemisiifolia* and *Iva xanthiifolia* growth. Screening of several plant species (*Medicago sativa* L., *Lolium perenne* L., *Dactylis glomerata* L. and *Elymus repens* (L.) Gould – all from both turf and seeds) was conducted. The results of the experiment showed that some perennial plants, especially *L. perenne*, *D. glomerata and M. sativa*, can be a reliable means of suppression of the growth and seed production of *A. artemisiifolia* and *I. xanthiifolia*. Moreover, simple greenhouse screening turned to be a reliable method for predicting this potential suppressive role under certain conditions.

Keywords: *Ambrosia artemisiifolia*, *Iva xanthiifolia*, invasive alien species, weed control

INTRODUCTION

An alien species, which becomes established in natural or semi-natural ecosystems or habitats, is an agent of change and threatens native biological diversity. Its successful spread depends on the species ability to disperse and on the competitive nature of relationship between the invader and its surrounding native neighbours (Weber, 2005). *Ambrosia artemisiifolia* L. and *Iva xanthiifolia* Nutt. are among the invasive and weedy species that have strong impact on the environment, agriculture and human health. The danger of these species is perceived in their strong competition, huge seed production and immense allergic features (Janjić and Vrbničanin, 2007). In the past decade much attention has been paid to the distribution of *A. artemisiifolia* and *I. xanthiifolia* in the Balkan countries (Marisavljević and Veljković, 2002; Soljan and Muratović, 2004; Vrbničanin et al., 2004, 2006, 2008, 2009; Malidža et al., 2006; Marisavljević et al., 2006).

Recently, both species have been recorded in different localities in Bulgaria (Dimitrov, 2001; Milanova, 2001; Dimitrov and Tzonev, 2002; Milanova and Nakova, 2002; Vladimirov, 2003, 2006, 2007; Valkova and Vladimirov, 2007). Kazinczi et al. (2008a, 2008b) reported several reasons which play a considerable role in *Ambrosia* distribution in Hungary and those are valid for most of the other countries in South-Eastern Europe. Lack of natural enemies in Europe, inadequate human activities (increase in wastelands, and lack of proper stubble treatments or professional advising of farmers), increasing hobby gardening, inexperience of local population, crop seeds infested with *Ambrosia* achenes, expensive weed control technologies and the appearance of herbicide-resistant biotypes are the most important factors in this respect. Surveys reported in literature or conducted in the field have shown that some perennial grass species suppress the density and growth of *A. artemisiifolia* and *I. xanthiifolia*. Also, some crops can suppress the growth and seed production of weeds (Dimitrova and Serafimov, 2007; Kruidhof et al., 2008).

The objective of this study was to investigate the role of some forage plant species in suppression of the growth of the invasive alien and weedy species *A. artemisiifolia* and *I. xanthiifolia*.

MATERIAL AND METHODS

A pot trial in greenhouse conditions was carried out in the Plant Protection Institute – Kostinbrod in Bulgaria during the vegetation season of 2009. Screening of several plant species was conducted in 4 replications. One hundred seeds of each species were sown per pot with 452 cm^2 soil surface. The pot trial was carried out with a sandy loam soil (48% sand, 42.8% clay, pH 5.8, organic matter content of 2.26%). The sowing was conducted with the lucerne (*Medicago sativa* L.) variety Pleven 6, rye-grass (*Lolium perenne* L.) variety Leia, and cock's-foot (*Dactylis glomerata* L.) variety Dubrava. The seeds of common couch (*Elymus repens* (L.) Gould), marsh-elder (*Iva xanthiifolia*) and common ragweed (*Ambrosia artemisiifolia*) were collected in the region of Kostinbrod. Turf variants of the investigated species were included (10.5 cm diameter for each pot). The following trial plan was applied:

a) 1. *Iva xanthiifolia* (control); 2. turf of *Elymus repens* + *Iva xanthiifolia*; 3. *Elymus repens* seeds + *Iva xanthiifolia*; 4. turf of *Lolium perenne* + *Iva xanthiifolia*; 5. *Lolium perenne* seeds + *Iva xanthiifolia*; 6. *Medicago sativa* seeds + *Iva xanthiifolia*; 7. turf of *Dactylis glomerata* + *Iva xanthiifolia;* 8. *Dactylis glomerata* seeds + *Iva xanthiifolia*,

b) The same variants with *Ambrosia artemisiifolia*.

Fresh weight of biomass per pot, and the number of plants of each alien weed species were recorded twice. The first recording was conducted at the early flowering stage of lucerne and the beginning of earring of perennial grass species (*ca*. 60 days after sowing). The second one was done at the same growth stage of the perennial plants. At the end of the vegetation season (September 30th) the seeds of *A. artemisiifolia* were collected and counted from each pot. The data was processed by the analysis of variance using F-test for testing significance and LSD for significance of differences between control and variants at levels of $P<0.05$, $P<0.01$ or $P<0.001$, depending on variance within the variants. Variants were separated in groups of similar behavior using $LSD_{0.05}$ values by Duncan's method (Sokal and Rohle, 1981).

RESULTS AND DISCUSSION

The results showed that inhibitory effect on the growth of *I. xanthiifolia* was achieved by all test species except *Elymus repens* from seeds (Table 1). Turfs of both *Lolium perenne* and *Dactylis glomerata* strongly reduced its fresh biomass per pot by 99.53% and 94.62%, respectively. The ranking among plants based on their suppressive role for growth of *I. xanthiifolia* was: turf of *Lolium perenne* > turf of *Dactylis glomerata* > turf of *Elymus repens* > *Lolium perenne* from seeds > *Medicago sativa* from seeds > *Dactylis glomerata* from seeds. The suppressive capacity of perennial crops was stronger as their fresh biomass increased. This fact is attributed to a heightened competition over the limited resources.

Table 1. Influence of some perennial plants on the formation of aboveground fresh biomass of *Iva xanthiifolia*

Variants*	Perennial plants – fresh weight/g per 1 pot	*Iva xanthiifolia*			
		Fresh weight/g per 1 pot	Percent of control	Fresh weight/g per 1 plant	Percent of control
V1		73.75 a	100.00	6.540 a	100.00
V2	102.50	14.18 c	19.23	1.195 bc	18.27
V3	7.73	80.00 a	108.47	6.405 a	97.94
V4	120.00	0.35 d	0.47	0.029 d	0.44
V5	115.00	18.00 bc	24.41	1.062 cd	16.24
V6	43.68	20.56 bc	27.88	1.802 bc	27.55
V7	65.00	3.97 d	5.38	0.408 d	6.24
V8	20.10	25.75 b	34.92	2.33 b	35.63
Sd:	6.06	3.86		0.186	
F:	115.31	124.9		379.64	
$LSD_{0.05:}$	12.69	7.018		0.186	

*Variants: V1 – IVAXA pure stand (Control); V2 – turf of AGRRE + IVAXA; V3 – AGRRE seeds + IVAXA; V4 – turf of LOLPE + IVAXA; V5 – LOLPE seeds + IVAXA; V6 – MEDSA seeds + IVAXA; V7 – turf of DACGL + IVAXA; V8 – DACGL seeds + IVAXA. According to Duncan's method variants with the same letter ('a' to 'e') belong to one group.

V1 – V8: Bayer code

Table 2. Influence of some perennial plants on the formation of aboveground fresh biomass of *Ambrosia artemisiifolia*

Variants*	Perennial plants - fresh weight/g per 1 pot	*Ambrosia artemisiifolia*				
		Number plants per 1 pot	Fresh weight/g per 1 pot	Percent of control	Fresh weight/g per 1 plant	Percent of control
			I cut			
V1		56.75 bc	58.75 b	100	1.071 a	100
V2	85.00	71.00 a	10.72 d	18.26	0.147 d	13.67
V3	7.76	62.00 b	66.50 a	113.20	1.078 a	100.72
V4	165.00	34.00 d	1.18 e	2.00	0.035 e	3.24
V5	82.50	41.00 c	8.93 d	15.19	0.218 cd	20.35
V6	39.78	56.25 bc	13.90 d	23.66	0.248 cd	23.09
V7	56.25	36.75 d	11.60 d	19.74	0.317 c	29.58
V8	18.48	56.00 bc	42.55 c	72.43	0.765 b	71.45
Sd:	5.50	2.95	2.69		0.073	
F:	185.54	39.17	176.25		66.50	
$LSD_{0.05}$	11. 55	6.139	5.61		0.152	
			II cut			
V1		65.00 a	85.00 b	100	1.323 b	100
V2	82.50	27.00 d	16.36 d	19.25	0.604 d	45.62
V3	11.35	51.25 c	111.20 a	130.88	2.172 a	164.00
V4	92.50	12.75 e	3.33 e	3.91	0.253 e	19.11
V5	150.00	8.00 e	2.33 e	2.74	0.281 e	21.22
V6	80.00	23.50 d	8.00 de	9.41	0.353 e	26.62
V7	39.00	56.50 b	57.50 c	67.65	1.018 c	76.89
V8	19.60	49.50 c	58.75 c	69.12	1.198 bc	90.52
Sd:	8.38	2.927	5.21		0.112	
F:	67.39	107.84	126.82		70.28	
$LSD_{0.05}$	17.56	6.088	10.83		0.233	

*Variants: V1 – AMAR pure stand (control); V2 – turf of AGRE + AMAR; V3 – AGRE seeds + AMAR; V4 – turf of LOLPE + AMAR; V5 – LOLPE seeds + AMAR; V6 – MEDSA seeds + AMAR; V7 – turf of DACGL + AMAR; V8 – DACGL seeds + AMAR. According to Duncan's method variants with the same letter ('a' to 'e') belong to one group

V1 – V8: Bayer code

The same trend was found for *A. artemisiifolia* suppression. The data on the first cutting showed that under conditions of turf of both *L. perenne* and *D. glomerata* the number of common ragweed emerged plants decreased by 40.1% and 35.5% respectively, compared to control (Table 2). The turf of *L. perenne* was found to have a strong inhibition effect, reducing the fresh biomass of the invader by 98%. The best suppressive effect on the emergence and growth of *A. artemisiifolia* at the time of the second cutting had turf and seeds of *L. perenne*. The reduction of fresh biomass per pot was 96.1% and 97.3%, respectively, as compared to control. Lucerne also showed inhibitory effect on the growth of *A. artemisiifolia* with a 90.6% reduction in fresh weight per pot. This fact was due to increasing lucerne competitiveness after the first cutting. This crop is characterized by a slow rate of development after sowing. This is congruent with a statement of Dimitrova (2008), who reported that, after sawing lucerne, it participated in the sward only with 14% and the weeds with 86%, which was a result of the negative weed effect before the first cut. In field conditions in 2008 a strong negative effect of lucerne it was observed during the second mowing on the emergence of *A. artemisiifolia* plants, number of branches, fresh and dry weight (Valkova et al., 2009). Our results were confirmed by Duncan's method. It was shown that variants 5 (*L. perenne* seeds + *A. artemisiifolia*) and 6 (*M. sativa* seeds + *A. artemisiifolia*), which had mixed characteristics of fresh weight/g per 1 plant at the time of first cutting, increased their depressiveness during the regrowth period and became similar to variant 4 (turf of *L. perenne* + *A. artemisiifolia*) at the second cutting. It is worth noting that after the first cutting plants of *I. xanthiifolia* did not regrow. On the other hand, *A. artemisiifolia* plants again regrew and formed seeds after the second cutting. The different behaviour of the two invaders after cutting is apparently related to the different abilities of these species to produce basal branches. The average number of *Ambrosia* seeds/1 pot in the variants was counted:

Control (V1) – 1044 seeds; V2 – 30 seeds; V3 – 240 seeds; V4 – 0 seeds; V5 – 0 seeds; V6 – 9.5 seeds; V7 – 135 seeds and V8 – 225 seeds. It is evident that the plants in variants with turf and seeds *of L. perenne* did not have any seeds. This fact was attributed to the formation of a dense stand of *Lolium*, which covered entirely the whole area and suppressed the growth and development of *A. artemisiifolia* plants. According to Mitchley et al. (2009) *L. perenne* is a suitable nurse species for grassland creation on infertile substrates as it provides rapid initial cover and stability. The ranking of the perennial plants based on their suppressive role in the formation of seeds of *A. artemisiifolia* was: turf and seeds of *L. perenne* > *M. sativa* seeds > turf of *E. repens* > turf of *D. glomerata* > *D. glomerata* seeds > *E. repens* seeds. Field experiments showed that *M. sativa* and a mixture of *M. sativa* and *D. glomerata* reduced the density and formation of aboveground biomass and seeds of *A. artemisiifolia* (Valkova et al., 2009). Our results are in accordance with Kazinczi et al. (2008a, 2008b). These authors reported that *A. artemisiifolia* was dominant in the first two years after soil cultivation of wastelands. After three years its abundance decreases, and it can entirely disappear. This confirms that understanding of the role of competition in plant invasions requires studies of both the ability of the invader to grow and increase in population size in the recipient community and the recipient community's tolerance of the invading species (Vila and Weiner, 2004).

CONCLUSION

The results of the experiment have shown that some perennial plants, especially *L. perenne*, *D. glomerata* and *M. sativa*, can be a reliable means of suppressing the growth and seed production of *A. artemisiifolia* and *I. xanthiifolia*. Moreover, simple greenhouse screening turned out to be a reliable method for predicting this potential suppressive role under certain conditions.

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Potiskujuće delovanje nekih vrsta krmnog bilja na rast *Ambrosia artemisiifolia* i *Iva xanthiifolia*

REZIME

Uloga nekih biljnih vrsta u potiskivanju rasta *Ambrosia artemisiifolia* i *Iva xanthiifolia* ispitivana je u ogledu u posudama pod uslovima staklenika. Ispitivano je nekoliko biljnih vrsta (*Medicago sativa* L., *Lolium perenne* L., *Dactylis glomerata* L. i *Elymus repens* (L.) Gould – svaka kao busen i seme). Rezultati eksperimenta su pokazali da neke višegodišnje biljke, naročito *L. perenne*, *D. glomerata* i *M. sativa*, mogu predstavljati pouzdan način potiskivanja rasta i produkcije semena vrsta *A. artemisiifolia* i *I. xanthiifolia*. Pored toga, jednostavan postupak skrininga u stakleniku pokazao se kao pouzdan metod za predikciju ove potencijalno potiskujuće uloge pod određenim uslovima.

Ključne reči: *Ambrosia artemisiifolia*; *Iva xanthiifolia*; invazivne tuđinske vrste; suzbijanje korova