INFLUENCE OF SOIL N, P, K SUPPLY ON HERBACEOUS INVASIVE SPECIES FROM GRASSLANDS

INFLUENTA APROVIZIONĂRII CU N, P, K A SOLULUI ASUPRA SPECIILOR INVAZIVE IERBOASE DIN PAJIŞTI

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Abstract: *The purpose of this work is to provide useful pieces of information concerning plant species invasion phenomenon in Romanian grasslands. Researches were realized during 2003-2005 on 26 permanent grasslands situated in places with different environmental conditions from Banat region (western Romania). Grasslands studied in this work show a great soils variety. Here we are interested about nitrogen, phosphorus and potassium supply. Thus is quantified the comportment of herbaceous invasive species under the influence of soil NPK supply. For this purpose here is calculated the correlation considering as dependent variable annual coefficient of grassland surface occupation (spreading coefficient) with herbaceous invasive species.*

Rezumat: *Scopul acestei lucrări este să aducă informații utile privind fenomenul invaziei speciilor de plante în pajiştile din România. Cercetările au fost realizate în perioada 2003-2005 pe 26 de pajişti situate în locuri cu condiții de mediu diferite din Banat (vestul României). Pajiştile studiate în această lucrare prezintă o mare varietate a condițiilor de sol. Aspectul urmărit se referă la aprovizionarea solului cu azot, fosfor şi potasiu. Astfel s-a cuantificat comportamentul speciilor invazive ierboase sub influența aprovizionării solului cu NPK. În acest scop a fost calculate coeficientul de corelație considerând ca variabilă dependentă coeficientul anual de ocupare a suprafeței cu specii invazive ierboase (coeficient de răspândire).*

Key words**:** *herbaceous invasive species, NPK supply, grassland, correlation.*
Cuvinte cheie: *specii invazive ierboase, aprovizionare cu NPK, pajişte, corelație.*

INTRODUCTION

Grasslands are ecosystems with a great variation of the ecologic factors. In case of secondary grasslands characteristic vegetation is maintained by human activity, being strength linked with animal breeding because these surfaces are grazed or cut by centuries or millennia.

In conformity with BOOTH *et al*. (2003) abiotic environment natural fluctuation can influences a species to invade or to persist into a vegetation community. In this work is analysed the influence of some soil chemical features (nitrogen, phosphorus and potassium supply) on the dynamics of invasive species from grasslands.

Many studies realised on the correlations between soil quality and invasion of plant species show the existence of a positive correlation between soil nutrients supply and invasive species (BURKE *et* GRIME, 1996; WEDIN *et* TILMAN, 1996; HARRISON, 1999; HUENNEKE *et al*., 1990; STOHLGREN, 1999; SHERER-LORENZEN *et al*., 2000).

The purpose of this work is to provide useful pieces of information concerning plant species invasion phenomenon in Romanian grasslands. One of the reasons that leaded to this situation is the decrease of the animal number that is using these surfaces after 1989.

MATERIAL AND METHOD

Researches were realized during 2003-2005 on 26 permanent grasslands situated in places with different environmental conditions from Banat region (western Romania). The data

were collected twice a year: at the end of May and at the beginning of September. Research plots were situated at altitudes comprised between 87 and 370 m, on soils with pH between 5.4 and 8.0 pH.

One of the research methods used in this work is mapping the aerial projection of invasive plant species (shrubs and herbs) on 100 m^{-2} (10 m x10 m) plots divided in 25 m^{-2} (5m x 5m) sub plots. The data obtained in this way helped us to analyze spatial distribution, and to calculate the coverage index for studied species, which is the ratio in percent of the surface covered by shrubs, to the surface of the plot.

Also, these data helped us to calculate the spreading coefficient, which represents the increase in surface covered by shrubs starting from a reference surface of $1m^2$ between two years ($year^{-1}$).

Grasslands studied in this work show a great soils variety. Here we are interested about nitrogen, phosphorus and potassium supply. In this way we have collected soil samples from all studied plots and the chemical analyzes were done in the agro-chemistry lab of Banat's University of Agricultural Sciences and Veterinary Medicine from Timişoara.

Statistical methods used are linear regression and Bravais-Pearson correlation.

RESULTS AND DISCUSSIONS

Nitrogen is a very important element for plant nutrition, this being the reason for the numerous experiences realised in this type of studies. In this way SHERER-LORENZEN *et al.* (2000) show that the fertilisation with nitrogen is favouring invasive species because these have a great nitrogen assimilation rate, this fact contributing to the degradation of the competition balance from a balanced vegetation community.

In this work is quantified the comportment of invasive species under the influence of soil nitrogen supply. For this purpose here is calculated the correlation coefficient considering as dependent variable annual coefficient of grassland surface occupation (spreading coefficient) with herbaceous invasive species (figure 1).

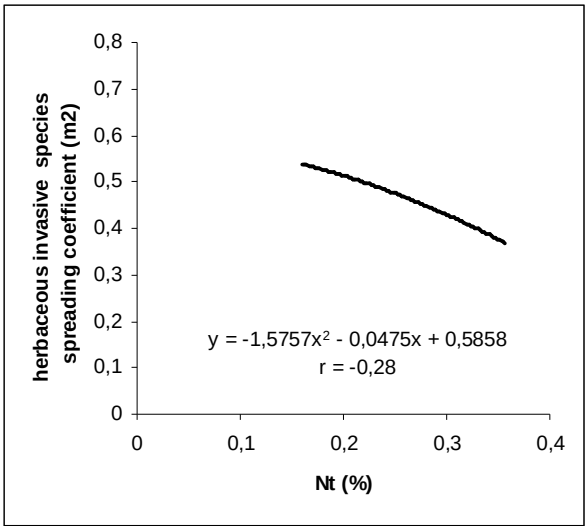

Figure 1 Correlation between soil nitrogen supply and herbaceous invasive species spreading coefficient

Correlation coefficient obtained here is $r = -0.28$ and is showing the absence of correlation among these values. The same conclusion can be mentioned analyzing the trend of regression curve represented in figure 1.

Most of the analyzed species are indifferent for soil nitrogen supply, this fact being compensated through their great competition capacity for resources.

Another argument supporting this result is given by the nitrogen ecologic indexes of ELLEMBERG (1974) cited by KOVACS (1979) and the indexes mentioned by CIOCÂRLAN (2000) for the plant species studied in this work (table 1).

Thus, in conformity with CIOCÂRLAN (2000), most of these species are indifferent for the nitrogen from soil.

Table 1

Soil mineral nitrogen indexes of studied invasive species

Species	KOVACS J.A. (1979)*	CIOCÂRLAN V. (2000)**
Euphorbia cyparissias L.	3	indifferent
Juncus effusus L.	4	indifferent
Carduus acanthoides L.	8	N_{3-4}
Eryngium campestre L.	4	indifferent
Dipsacus laciniatus L.	5	indifferent
Carlina vulgaris L.	2	indifferent
Xanthium spinosum L.	7	N_{3-4}
Carthamus lanatus L.	-	N_{3-4}
Pteridium aquilinum (L.) Kuhn	3	indifferent

* x – indifferent; 1 – only on soils poor in mineral nitrogen; 3 – especially on soils poor in mineral nitrogen; 5 – soils moderate supplied with nitrogen; 7 – especially on soils rich in nitrogen; 8 – indicator species for mineral nitrogen in soil; 9 – only on soils excessively rich in nitrogen, indicating stocking, pollution.

** N_{1-2} – indicator species for soils very low to low supplied with nitrogen; N_{3-4} – indicator species for soils average to well supplied with nitrogen.

VON HOLLE B. *et al.* (2004) cited by SARAH HICKS (2004) says that during the increase of soil mineral nitrogen is decreasing the susceptibility to invasion of plants community.

Other researchers have obtained positive correlations (SHERER-LORENZEN *et al.*, 2000; WEDIN *et* TILMAN, 1996; BROOKS, 2003) and pollution have determined the nitrogen level increase. In conformity with their researches this fact was leading to the increase of annual invasive species participation in vegetation carpet.

Similar results have obtained MONACO *et al*. (2003) showing that soil nitrogen could intervene in the competition between annual invasive species and perennial grasses.

Phosphorus is another element important in plants' mineral nutrition being many times associated with the nitrogen in the experiences framework of some researchers (HUENNEKE *et al.*, 1990). They have treated the plots with NP fertilizers and have noticed that invasive species increased significantly as coverage in vegetation community in the second year from the fertilisation. These were replacing even the most prolific species from vegetation carpet.

Following this idea we are representing the influence of the soil phosphorus supply on the dynamics of herbaceous invasive species.

Thus, here is calculated the correlation coefficient and polynomial regression considering as dependent variable herbaceous invasive species spreading coefficient and soil phosphorus supply representing independent variable (figure 2).

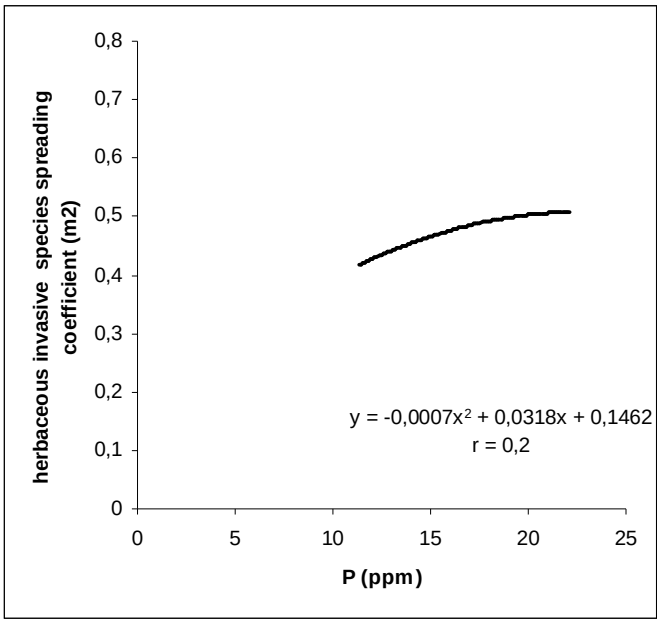

Figure 2 Correlation between soil phosphorus supply and herbaceous invasive species spreading coefficient

Obtained correlation coefficient is low (*r = 0.2*) and shows the absence of interrelation between these two variable.

REBECCA OSTERTAG and JULIA H. VERVILLE (2002) have obtained similar results for annual invasive species (herbaceous) where phosphorus has a decreased influence.

Other researchers have found positive interrelations between soil phosphorus supply and invasive plants abundance (LEISHMAN *et al.*, 2004).

The last nutritive soil element analyzed in this work is ***potassium***. In this way we are evaluating the invasive species comportment under the influence of soil supply with this mineral. In this purpose we calculate correlation coefficient and polynomial regression between these two variables considering herbaceous invasive species spreading coefficient the dependent variable and soil potassium supply the independent one.

The result obtained show the absence of correlation between these variables (*r = -0.1*) (figure 3).

Researches in this field are referring to potassium only in the framework of the experiences with NPK complex fertilizers. In this context invasive species become much more aggressive in comparison with the plots poor in nutrients where also are present invasive species (BURKE *et* GRIMME, 1996).

In the case of *Pteridium aquilinum* literature shows the existence of a powerful influence of potassium, this nutritive element being stocked in offshoots by this species (www.pfaf.org/database/ plants.php ?Pteridium+aqilinum, 20/03/2006).

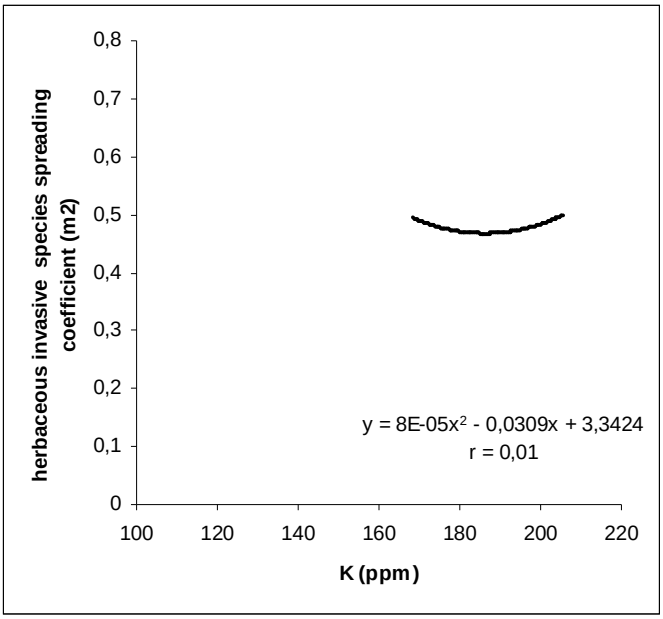

Figure 3 Correlation between soil potassium supply and herbaceous invasive species spreading coefficient

CONCLUSIONS

On the background of obtained results concerning the influence of NPK soil supply we can formulate the next conclusions:

- correlation coefficient between soil nitrogen supply and herbaceous invasive species spreading coefficient is $r = -0.28$ and shows the absence of correlation among these values;
- most of the invasive species are indifferent for soil nitrogen supply, but they have a great competition capacity for resources;
- coefficient correlation between soil phosphorus supply and herbaceous invasive species spreading coefficient is low ($r = 0.2$) and shows the absence of interrelation;
- correlation coefficient between soil potassium supply and herbaceous invasive species spreading coefficient ($r = -0.1$) shows the absence of correlation.

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