Effect of N and P Fertilization on Weed Flora of Maize (*Zea Mays* L.) Crop

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Abstract

From May to September 2016, a corn hybrid was sown in a field in central Greece. The experiment was laid out in a randomized complete block design with six replications and five fertilization treatments, namely NutriSphere-N Nitrogen Fertilizer (75%), NutriSphere-N Nitrogen Fertilizer (100%), AVAIL Phosphorus Fertilizer (75%), AVAIL Phosphorus Fertilizer (100%) and unfertilized (control). Data analysis confirmed that the different type of fertilization has a significant effect on the composition of weed flora. In particular, the results of the present study indicated significant differences between the fertilization treatments concerning density and diversity of weeds. Furthermore, weed diversity in the control treatment was highest, while it was lower in plots receiving application of N and P. However, total weed dry mass was lower in plots receiving no fertilizer and P fertilization, and highest in plots receiving N. Differences in terms of weed growth between the two types of fertilization could be attributed to differences revealed in the composition of the weed flora.

Keywords: *diversity indices, fertilization, maize, weed flora.*

INTRODUCTION

As it is generally known, maize is a cereal crop which is widely grown throughout the world in a range of agroecological environments. Weeds muscle out crops and other desirable plants by competing for water, nutrients, sunlight and space. Besides other production constraints, weed infestation is considered of premier importance, as grain yield losses due to weeds in maize have been estimated to range from 35 to 83% (Usman *et al.*, 2001). Competition for nutrients is primarily for nitrogen because, in general, all nutrients in the soil except N and water are immobile and rely on root contact and diffusion over a very small distance for uptake (Sprague and Dudley, 1988).

Fertilization alters soil fertility, which affects not only crop growth, but also diversity and growth of weeds (Banks *et al.*, 1976; Pysek and Leps, 1991; Jørnsgård *et al.*, 1996). The diversity of weed communities will determine the nature

of weed management strategies required and changes in diversity may be indicative of potential weed management problems (Derksen *et al.*, 1995). The aim of weed management should be to reduce the impact of weeds on crop yield by maintaining a diverse community of relatively controllable weed species in a way that any weed species that is difficult to control does not become dominant (Clements *et al.*, 1994).

The objective of the present study was to evaluate various types of fertilization in terms of their effect on weed growth and diversity in maize crop. In particular, attention was paid on nitrogen and phosphate fertilization.

MATERIALS AND METHODS

From May to September 2016, a corn hybrid (P1114) was shown in the experimental field in Aliartos (Latitude: 38°24', Longitude: 23°07'),

Tab.1. Influence of fertilization (AVAIL Phosphorus Fertilizer (75%): A1, AVAIL Phosphorus Fertilizer (100%): A2, NutriSphere-N Nitrogen Fertilizer (75%): N1, NutriSphere-N Nitrogen Fertilizer (100%): N2) and control (C)) on weed density, dry weight and total biomass (means with different letters indicate differences at a 5% level of significance according to LSD test).

Weed species	Weed Density (plants/m ²)					Dry weight (g/ m ²)				
	A1	A2	N1	N2	C	A 1	A2	N1	N2	C
<i>Abutilon theophrasti</i>	0	0	3.7	5.6	3.1	0	0	7.8	12.1	6.8
<i>Amaranthus retroflexus</i>	3.5	2.5	4.2	4.5	0	8.3	6.1	8.8	8.7	0
<i>Chenopodium album</i>	0	3.4	0	4.2	2.2	0	6.9	0	7.4	5.1
<i>Convolvulus arvensis</i>	0	0	2.9	0	0	0	0	4.9	0	0
<i>Datura stramonium</i>	0	2.1	0	0	0	0	6.2	0	0	0
<i>Digitaria sanguinalis</i>	3.8	4.2	5.6	8.1	3.3	10.3	13.4	15.7	24.3	9.8
<i>Echinochloa crus-galli</i>	0	3.3	4.2	0	3.2	0	6.4	8.2	0	7.8
<i>Polygonum aviculare</i>	0	0	0	0	2.8	0	0	0	0	4.7
<i>Portulaca oleracea</i>	4.2	2.1	0	3.8	2.9	7.8	5.6	0	5.2	4.4
<i>Setaria viridis</i>	3.7	0	0	0	0	6.3	0	0	0	0
<i>Sorghum halepense</i>	0	0	0	0	0	0	4.7	0	0	0
Total biomass						32,7c	49,3b	45,4b	57,7 a	38,6bc

which is located in central Greece. The soil type was clay loam with a pH of 7.23, 24% w/w soil moisture, 4600 $\mu\text{mhos/cm}$ soil salinity, 11.26 ppm N-NO_3^- , 5.78 ppm N-NH_4^+ and 21.46 ppm P. The experiment was laid out in a randomized complete block design with six replications and five fertilization treatments namely, NutriSphere-N Nitrogen Fertilizer (75%), NutriSphere-N Nitrogen Fertilizer (100%), AVAIL Phosphorus Fertilizer (75%), AVAIL Phosphorus Fertilizer (100%) and unfertilized (control). Plot size was 52m². The field was processed with moldboard plowing in a depth of 20-25 cm, which was followed by one rotary hoeing at 5-10 cm, including the incorporation of the fertilizers.

Weed evaluation was conducted 68 days after sowing (DAS) during corn growing season.

At each sampling date, a 0.5 X 0.5 m quadrat was systematically positioned to avoid edge effects and re-sampling of the previously sampled areas in each plot (two replications).

All weeds present in the quadrat were clipped, collected, sorted by species, counted, and oven dried at 60°C for 48 h before weighing. Then, weed species were measured.

Weed density was calculated as the total plant number of a particular weed species per square meter.

Total weed density was calculated as the total number of all weed species per square meter.

Diversity of weed species was assessed by means of several indices (Simpson, Shannon – Weiner, Brillouin, Margalef). Diversity indices estimation was done using BPMSG Diversity Calculator (2012).

Fig.1. Evaluation of weed diversity by using different diversity indices. Error bars represent standard errors.

Tab.2. Influence of fertilization (AVAIL Phosphorus Fertilizer (75%): A1, AVAIL Phosphorus Fertilizer (100%): A2, NutriSphere-N Nitrogen Fertilizer (75%): N1, NutriSphere-N Nitrogen Fertilizer (100%): N2) and control (C)) on density and dry weight of broad-leaf (B) and grass (G) weed species.

Total weed density (species/m ²)	A1	A2	N1	N2	C
B	7.7	10.1	10.8	18.1	8.2
G	7.5	7.5	9.8	8.1	9.3
Dry weight (g/m ²)	A1	A2	N1	N2	C
B	16.1	24.8	21.5	33.4	16.3
G	16.6	24.5	23.9	24.3	22.3

RESULTS AND DISCUSSION

Results indicated significant differences between the fertilization treatments concerning density and diversity of weeds.

First of all, *Digitaria sanguinalis* was observed as the dominant species in all treatments (Tab. 1.).

Furthermore, weed diversity was highest and lowest in the control treatment and in plots receiving N and P, respectively (Fig. 1.)

However, total weed biomass was lower in plots receiving no fertilizer and P fertilization, and highest in plots receiving N (Tab. 1.). Dry weight of *Abutilon theophrasti* was highest in the plots with N fertilizer application (Tab. 1.). Our results are in full agreement with the findings of a similar study from University of Nebraska which refers that maize response to N addition was significantly lower than that of velvetleaf, indicating that

velvetleaf may be most competitive at high levels of nitrogen and least competitive when nitrogen levels are low (Barker *et al.*, 2006).

In addition to that, the higher dry weight of *Digitaria sanguinalis* was noticed in Nutrisphere 100% treatment (Tab. 1.). The specific weed is a nitrophilous plant and, therefore, responds to nitrogen fertilization very well (Nelson, 2015). Finally, Nutrisphere 100% treatment resulted in the higher total biomass, a finding rather anticipated, as it is generally known that biomass of all weed species tend to increase under nitrogen fertilization (Blackshaw *et al.*, 2003).

Moreover, it was observed that in Nutrisphere 100% treatment both number and dry weight of broad-leaf weed species were higher due to the superiority of nitrophilous species, such as *Amaranthus retroflexus* (Tab. 2.).

Regarding diversity indices, all of them were higher in the untreated plots, as a result of a more balanced diversity of weeds. The results also indicated higher values of Simpson, Shannon – Weiner and Margalef indices of weed community at phosphorus compared with nitrogen fertilizer treatment. A possible explanation is that the application of nitrogen fertilizers could have reduced weed diversity due to rapid crop growth and enhancement of maize development. At the same time, light limitation for the weed communities, growing underneath the crops and due to the rapid and vigorous growth of maize, affects weed species diversity (Yin *et al.*, 2006; Nie *et al.*, 2009).

CONCLUSION

Weeds differ substantially in their response to fertilization. Fertilization alters soil fertility, which affects not only crop growth, but also diversity and growth of weeds.

Competition between crops and weeds for nutrients, and for other factors at different nutrient levels, are complex interactions that depend on many factors. As a result, actions that alter nutrient availability will affect the weed community and the crop's competitive ability.

Weed interference in the field may lead to great reductions of grain yield and nutrient accumulation by maize crop. Further research on nutrient limitation and on the biology of individual weed species is needed in order to control the negative effects of farmland weeds on crop yield while maintaining a diverse weed community.

REFERENCES

1. Banks PA, Santelman PW, Tucker BB (1976). Influence of long-term soil fertility treatments on weed species in winter wheat. *Agronomy Journal*, 68(5), 825-827.
2. Barker DC, Knezevic SZ, Martin AR, Walters DT, Lindquist JL (2006). Effect of nitrogen addition on the comparative productivity of corn and velvetleaf (*Abutilon theophrasti*). *Weed science*, 54(2), 354-363.
3. Blackshaw RE, Brandt RN, Janzen HH, Entz T, Grant CA, Derksen DA (2003). Differential response of weed species to added nitrogen. *Weed Science*, 51(4), 532-539.
4. Cléments DR, Weise SF, Swanton CJ (1994). Integrated weed management and weed species diversity. *Phytoprotection*, 75(1), 1-18.
5. Derksen DA, Thomas AG, Lafond GP, Loeppky HA, Swanton CJ (1995). Impact of post-emergence herbicides on weed community diversity within conservation tillage systems. *Weed Research*, 35(4), 311-320.
6. Jørnsgård B, Rasmussen K, Hill J, Christiansen JL (1996). Influence of nitrogen on competition between cereals and their natural weed populations. *Weed Research*, 36(6), 461-470.
7. Nelson KA (2015). Winter annual weed response to nitrogen sources and application timings prior to a burndown corn herbicide. *International Journal of Agronomy*, 2015.
8. Nie J, Yin LC, Liao YL, Zheng SX, Xie J (2009). Weed community composition after 26 years of fertilization of late rice. *Weed science*, 57(3), 256-260.
9. Pyšek P, Lepš J (1991). Response of a weed community to nitrogen fertilization: a multivariate analysis. *Journal of Vegetation Science*, 2(2), 237-244.
10. Sprague GF, Dudley JW (1988). Corn and corn improvement. 3rd Edition. Agronomy Monograph 18. USA.
11. Usman A, Elemo KA, Bala A, & Umar A (2001). Effect of weed interference and nitrogen on yields of a maize/rice intercrop. *International journal of pest management*, 47(4), 241-246.
12. Yin L, Cai Z, Zhong W (2006). Changes in weed community diversity of maize crops due to long-term fertilization. *Crop Protection*, 25(9), 910-914.