5th CASEE Conference "Healthy Food Production and Environmental Preservation – The Role of Agriculture, Forestry and Applied Biology"

IMPACT OF AMMONIA-LOADED ZEOLITE ON ITALIAN RYEGRASS GROWTH AND YIELD*

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- Application of zeolite in agriculture as nitrogen retaining medium
- Experiment methodology
- Number of seedlings, plant height, yield
- Italian ryegrass response to treatments, increase of yield

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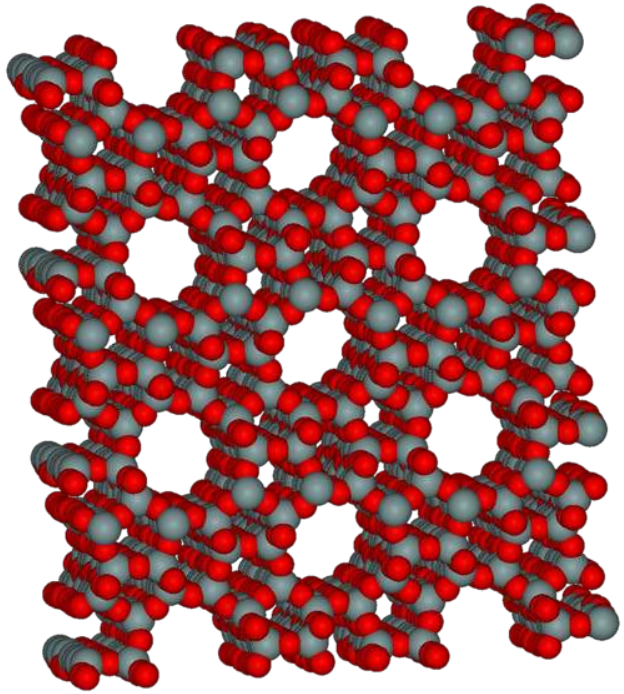
- Zeolites are aluminosilicate minerals widely used as an ion exchange beds
- There are over 40 naturally occurring types and over 200 types in all
- Our experiment was conducted with a natural zeolitic tuff (from “Zlatokop” mine in South Serbia, containing ~70wt. % of clinoptilolite)
- Ammonia-loaded zeolite was formed by binding of ammonia ions from aqueous solution



Clinoptilolite

- natural, inert and non-toxic material
- can be used as a slowly releasing carrier of fertilizer
- it can improve physical properties of soils
- it can be used for treatment of contaminated soils

The name is derived from the Greek words klino (κλίνω;"oblique"), ptylon (φτερών;"feather"), and lithos (λίθος;"stone").

- Clinoptilolite can also influence bioavailability of other plant nutrients
- It can take up ammonium cation from either farmyard manure, composts, or ammonium-bearing fertilizers, thereby reducing losses of nitrogen to the environment
- Clinoptilolite can be recommended for agricultural purposes in terms of sustainable fertilizing and improving system cattle farm - manure - organic fertilizer for forage crops

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Italian ryegrass (*Lolium italicum* L. syn *L. multiflorum* L.)

- Italian ryegrass is an important short duration forage crop in Serbia
- It is highly valued for forage/livestock systems
- Well-adapted to different environmental conditions
- Characterized by fast growth that secures quick tillering, high yield potential and fitness for reduced cultivation

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The experiments carried out in greenhouse included four different treatments:

a) soil (control)

b) soil+zeolite CLI (10 g kg^{-1})

c) soil+ammonia-loaded zeolite NH_4^+-CLI (10 g kg^{-1} equivalent to nitrogen application of 100 kg ha^{-1} N)

d) nitrogen application by mineral fertilizer Calcium ammonium nitrate CAN (100 kg ha^{-1} N, CAN contains 27% nitrogen)

all in 4 replications

The soils used for the experiment were:

- Pseudogley (*Planosol*) collected from the site in Varna (West Serbia) is marked as conditionally productive soil
- Dystric brown soil (*Dystric Cambisol*) collected from the site in Vlasina (South-East Serbia) is marked to serious restrictions

Soil properties:

Soil type	Textural class	Chemical properties					
		pH					
		in H_2O	in $CaCl_2$	AL-P_2O_5 mg kg^{-1}	AL-K_2O mg kg^{-1}	Total C %	**Total N %**
Planosol	Sandy loam	5.73	5.07	19.8	115.1	1.37	0.16
Dystric Cambisol	Clay loam	5.10	4.18	6.7	63.0	1.10	0.096

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- The pots were filed with 2 kg of air-dried soil
- Italian ryegrass seed was sown on December 2013. at a rate of 50 seeds per pot
- Plants were were thoroughly watered
- Plants were cut back three times in all the individual experimental pots, about 3 cm above soil level

Planosol

Dystric Cambisol

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Number of seedlings (Standard Deviations appear in parentheses)

	Control	CLI	NH_4^+– CLI	CAN
Planosol	44.5^a (1.12)	43.5^a (1.80)	44.5^a (1.50)	44.8^a (2.86)
Dystric Cambisol	41.2^a (2.86)	46.8^a (2.05)	43.0^a (1.22)	44.5^a (1.11)

Means with differing superscripts are significantly different (P<0,05)

Planosol

Dystric Cambisol

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Plant height (Standard Deviations appear in parentheses)

	Control	CLI	NH_4^+– CLI	CAN
Planosol	24.33^a (0.78)	24.82^a (2.68)	24.45^a (0.35)	24.10^a (1.02)
Dystric Cambisol	22.60^b (1.35)	22.2^b (1.30)	22.13^b (0.62)	22.31^b (0.62)

Means with differing superscripts are significantly different (P<0,05)

- In relation to the plants grown on Dystric Cambisol the plants grown on Planosol were 8.3 % higher in average
- Soil acidity of Dystric Cambisol could have an inhibitory effect on plant growth and leaf elongation

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Dry matter yield, in grams (Standard Deviations appear in parentheses)

	Control	CLI	NH_4^+– CLI	CAN
I cut / I otkos				
Planosol	0.2649^{a} (0.0197)	0.2423^{a} (0.0295)	0.2847^{a} (0.0082)	0.2652^{a} (0.0153)
Dystric C.	0.1835^{b} (0.0087)	0.1888^{b} (0.0209)	0.1455^{b} (0.0259)	0.1571^{b} (0.0026)
II cut / II otkos				
Planosol	0.4628^{a} (0.0121)	0.4166^{a} (0.0482)	0.4948^{a} (0.0518)	0.4565^{a} (0.0664)
Dystric C.	0.2381^{b} (0.0211)	0.2677^{b} (0.0269)	0.2504^{b} (0.0155)	0.2321^{b} (0.0248)
III cut / III otkos				
Planosol	**0.5071^{b} (0.1143)**	**0.3748^{b} (0.0444)**	**0.7684^{a} (0.1006)**	**0.6841^{a} (0.0773)**
Dystric C.	**0.3827^{c} (0.0438)**	**0.4103^{c} (0.0198)**	**0.4247^{b} (0.0265)**	**0.5053^{b} (0.0615)**

Means with differing superscripts are significantly different (P<0,05)

- The delayed effect of the treatments could be explained by the limiting effect of irradiance
- Both the total level of irradiance and the photoperiod, spectral composition and direction of the light affect plant development

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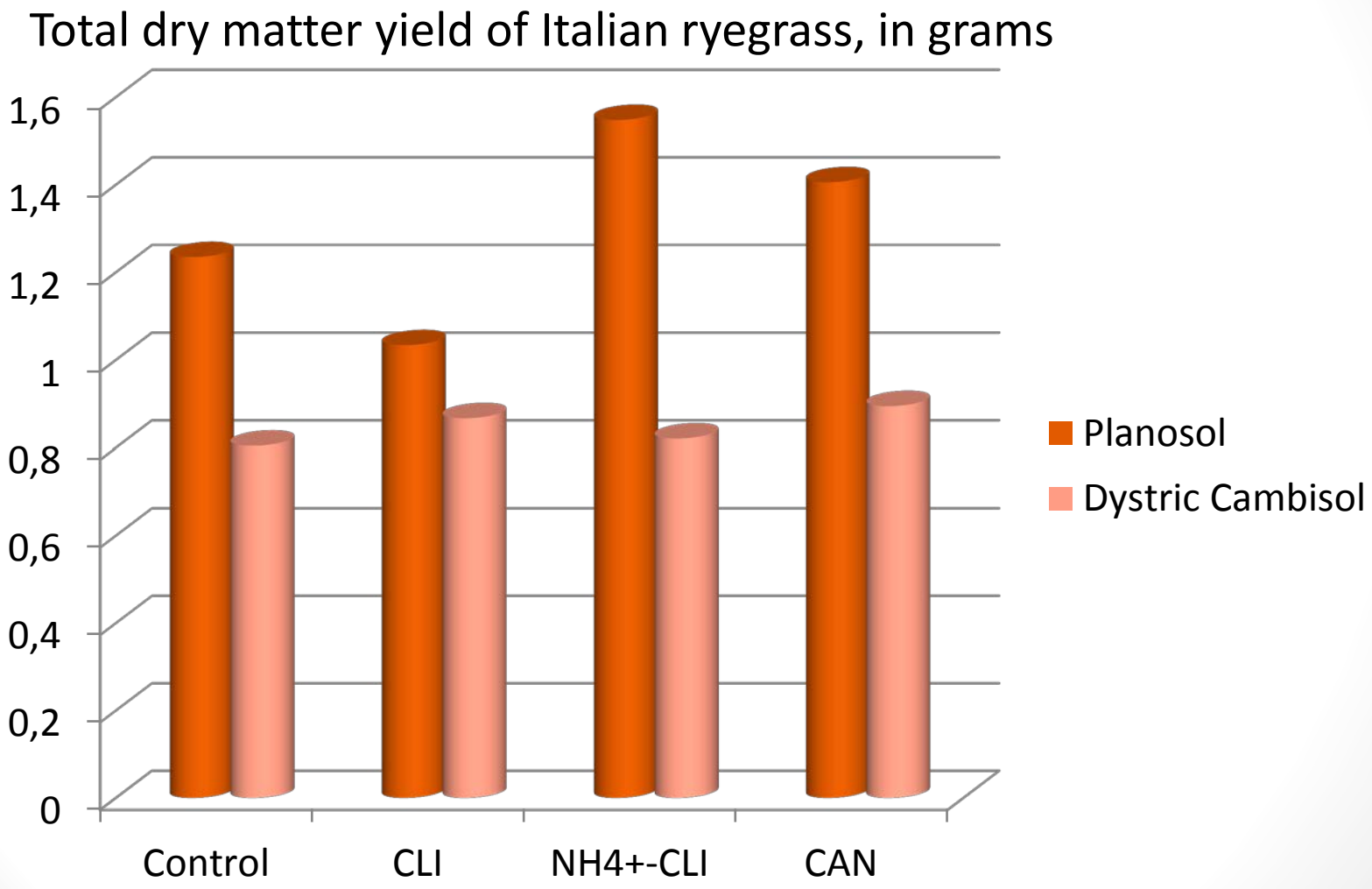

- Plants may have a good response if clinoptilolite is used as a nitrogen fertilizer carrier
- Obtained results suggest that Italian ryegrass reacts to N supply increasing the yield of dry weight in relation to control
- Italian ryegrass dry matter quality is yet to be analysed
- The next stage of our research will be testing the results in field conditions.

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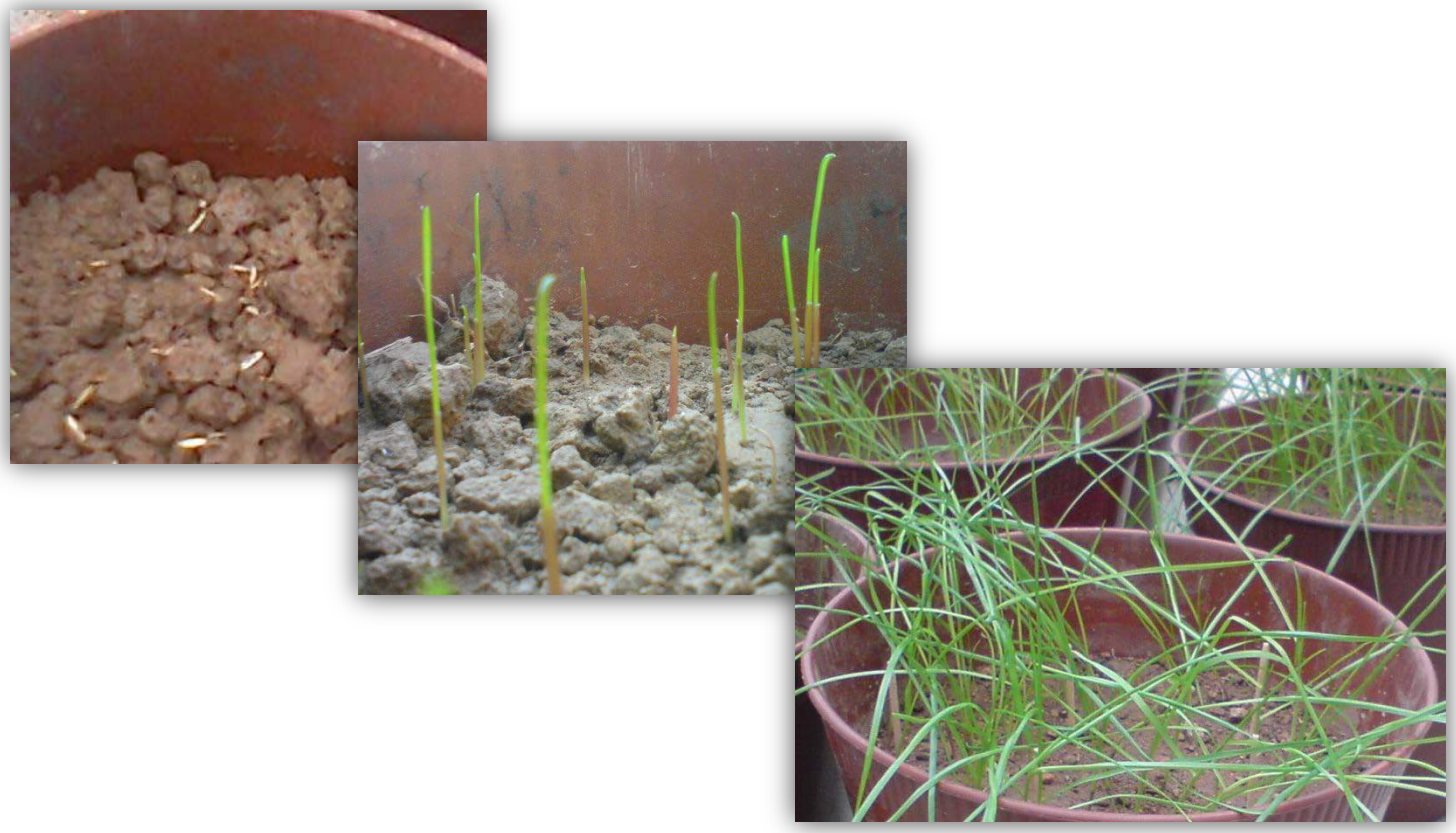

Thank you