EVALUATION OF THE GERMINATIVE ENERGY OF *MEDICAVO SATIVA* SPECIES CULTIVATED ON SALTY SOILS

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Abstract

The present paper is an attempt to approach the problems related to the possibility to plant the *Medicago sativa* species on soils polluted with salty solution, in the context of the intensification and extension of the actual preoccupations concerning the relation between man and his environment. In order to study the influence of the salty solution on the herbaceous species *Medicago sativa*, soil samples have been collected from the Târgovişte Plain – the point Priseaca, from an uncultivated area (a lawn). We need to mention that the collected soil was not polluted with salty solution.
The salty solution concentrations for irrigating were: 1%, 10%, 20%. During the first experiment, the soil used as substrate was treated with salty solution from the moment when the seeds were sawn. The seeds germinated, obviously in different proportions depending on the concentration of the salty solution used for irrigation, yet they did not manage to resist in time. During the second experiment, the samples sawn were watered with potable water for 21 days, after which we irrigated a salty solution with 10% concentration. All the samples were affected by the pollution produced through the watering with salty solutions. The soil used in the third experiment was leachated every three days for two weeks, after which the seeds were sawn. Seven days from sawing, 1% of the seeds had germinated.

Key words: germinative energy, *Medicavo sativa*, salty soil.

The area covered by salty soils in Romania is totals 484835 ha, representing 2% of the total area of the country, 3% of its agricultural area and 5% of its arable area (Ţopa E., 1954).

The location of the salty soils in Romania is correlated to the arid areas, where the following determining factors can be found: highly mineralized underground water, situated at small depths (1-2m) (Ivan Doina, 1983) ; the existence of a flat or depressionary-accumulative relief and microrelief with an insufficient drainage; the existence of a phenomenon of evaporation-transpiration more significant than the precipitations; the existence of a sum of soluble salts (rock, underground water, other allochthonous sources) (Şerbănescu I., 1965).

The rational use of the land in general, for different human activities, and especially of the soil, to assure food, in agreement to the demands of sustainable development and environmental protection is a require.

To the category of salty and alkaline soils belong all the soils whose content of easily water-soluble salts is much higher than the limit admitted by spontaneous or cultivated species (Muică, Cristina, Sencovici, Mihaela, Dumitraşcu, C., 2004). Known in literature as halomorphic and hydrohalomorphic soils, and in the agricultural practice as salts, salty soils, saline soils, they support a lawn vegetation, being weakly productive and yielding a poor hay production (Muică, Cristina, Geacu S., Mihaela Sencovici, 2006), (Coste I. şi colab., 1993). The alkaline reaction is much more difficult to bear by cultivated vegetation (Doltu M.I, Sanda V., Popescu A., 1979). A certain tolerance to alkalinity is manifested by: sunflower, sugar beet, Sudan grass, sorghum etc. (Şerbănescu I., 1963)

MATERIAL AND METHODS

The research was carried out during the period of March-June 2011. In order to study the influence of the salty solution on certain herbaceous species, we collected soil samples from the Plain of Târgovişte – the point Priseaca, from an uncultivated land (lawn) on March 2, 2011. We need to mention that the collected soil was not polluted with salty solution.

For this experiment we used one herbaceous species, namely alfalfa (*Medicago sativa*). It is a perennial plant, with a stem going up to 30-70 cm high, with branches and rich foliage. It flourishes from May to October. Due to its importance as fodder, it is considered the “queen”

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of fodder plants; it gives large quantities of fodder, of high quality: rich in protein, calcium, other nutrients; high resistance to drought, freezing temperatures; high longevity: it can be collected several times a year; it can be used in different ways: fresh, dried, alfalfa flour, alfalfa grains, silo, semi-silo; it represents one of the main components of the plant mixes (containing grasses and leguminous plants) used to create temporary lawns(Grigore St. şi colab., 1965).

Alfalfa is part of the family of *leguminous plants*, having longevity of 7-10 years; it has a tap root, branched, erect sprouts; species: *Luxin*, *Luteti*, *Gloria*, *Triumf*, *Adonis*, *Europe.* Climate and soil demands: alfalfa is resistant to drought, but sensitive to high ground temperatures; it assures a large production only in the areas with precipitations > 500 mm annually. It cannot bear the excess of humidity; it can bear low temperatures, even as low as –25^{O}C, when the soil is not covered by snow; the best results are obtained on calcium-rich and humus-rich soils (deep, permeable, well aired soils, with a neutral to weakly acidic reaction). Rotation: good precursors: cereals, winter fodder and annual fodder cultures; it should not be cultivated after itself except after a 4-6 year period, to avoid the appearance of the "soil fatigue" phenomenon, caused by the macro and micro-elements depletion of the soil; cultures that can follow it: alfalfa can very well precede most cultivated plants.The laboratory analyses were carried out in the Applied Biology laboratory of the Faculty of Environmental Engineering and Biotechnologies. *The weighing of the plain soil samples* was carried out using a precision *KERN 572 electronic balance with two digits*. This type of balance is meant for gravimetric measurements for large quantities of samples of up to 600.00 g. *The drying of the plain soil samples* to remove their humidity was realized using a *Binder* drying system at a 60^{o}C temperature, for several hours. This drying system was especially designed for research and is applied for an optimal functioning of the apparatus in the context of the satisfaction of the demands pertaining to the approach of the tests, in order for the results to be valid. *The pH determination* was realized with a *3110 WTW pH-meter*, this apparatus being meant for the measurement of the pH of different liquids obtained through the processing of environmental samples, and of environmental solids which, however, need to be prepared beforehand in a special way by mixing them with bi-distilled, de-ionized water in certain proportions, according to the standardized work instructions.

The pH determination finds out the hydrogen content, which is measured as the logarithm of the opposite of this value and can have values between 0 and 14. Out of the soil sample, using the randomization method, we extracted 2 samples for which the pH was determinate. The pH measurement represents the most efficient and easiest to apply method for the determination of the soil's pH. The finely ground soil is put into a Berzelius glass (150-200ml) over which one adds a quantity of 50 ml KCl, 0.1N, Tt=0.0056g/ml, F=1.0000. It is agitated for 15 minutes using a magnetic agitator, and then it is left to rest for an hour at room temperature to clarify. Then the pH is read using the pH- meter, after the previous calibration of the equipment.

We organized a number of three experiments.

Experiment I

The experiment began by going out in the field to collect the soil samples from the point Priseaca. We weighed two soil samples of 143.6 g each. The two soil samples were then dried for a week at 60^{0} C and after that we determined the soil's humidity and pH. After having dried them, we weighed the two samples again and we noticed that the water loss recorded was 21.7g for the first sample and 21.8g for the second. So, calculating an average for the two samples, we obtained a loss of 21.75g after the drying of the soil.

As far as the pH determination is concerned, it is known that the water in the soil, full of different mineral and organic substances, under the form of colloidal, molecular and ionic dispersion, constitutes what is known as "soil solution" or "must (unfermented wine) of the soil". This soil solution plays a special role in the development of the plants, as it constitutes the direct source providing them with nutrients. Among the ions encountered in solution (Ca, Mg, K, H, Cl, SO, CO, COH, OH ions), an important role goes to the H^{+} cation (the hydrogen ion) and to the OH anion. When, in the soil solution, the hydrogen ions are predominant compared to the OH^{-} ions, the solution is considered acid. This situation is frequently encountered in the alpine regions, on siliceous rocks (grit stones, mica-schists, quartzite, and granite). On the contrary, when in the soil solution the hydrogen ions are exceeded by the OH^{-} ions, the solution is alkaline (basic). Such situations are encountered in some steppe soils and in the soils made up of calcareous rocks. If in the soil solution the H^{+} and OH^{-} ions represent equal quantities, the solution is considered neutral. The soil's fertility is influenced by the soil solution's *acid, neutral or alkaline character*. That is why it is necessary to apply a practical criterion when appreciating the concentration of the hydrogen ions, namely the soil's pH. We determined the pH of the two samples under analysis, obtaining values of 6.93 and 6.96. We calculated the average of the samples and obtained a pH of 6.94**.** The soil samples used for the experiment were very well homogenized beforehand. The specialized literature mentions that the pH values under 7 (excess of hydrogen ions compared to the OH^{-} ions) represents the acid domain, the acidity being higher as the numbers indicating the pH decrease. A soil with a pH under 6 is considered strongly acid. The pH values over 7 (excess of OH^{-} ions compared to hydrogen ions) represents the

alkaline (basic) domain, the alkalinity growing as the number indicating the pH increases. A soil with a pH over 8 is considered strongly alkaline. When the soil solution has values around pH = 7, the soil is considered neutral. So, the pH of the soil sample under analysis – namely 6.94 – indicates that this soil belongs to the category of the neutral soils.

By determining the soils' pH, one can draw a series of practical conclusions related to their use in cultures. In a multiple plastic recipient, the soil was arranged as follows: we constituted three witness samples and three experimental samples for the species *Medicago sativa*. *(photo 1).* The witness soil was irrigated with potable water. The soil used as experimental sample was treated with a solution made up of distilled water and salt in different concentrations. The first of the samples was treated with a salty solution whose concentration was 1%, the sample number 2 was treated with a 10% salty solution, and the third experimental sample was treated with a 20% salty solution.

Photo 1. **The preparation of the cultivation vases for sawing and the preparation of the salty solutions**

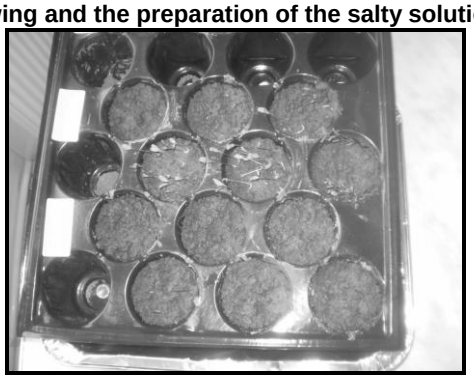

Photo 2**. Appearance of the cotyledons with the plants in experiment I**

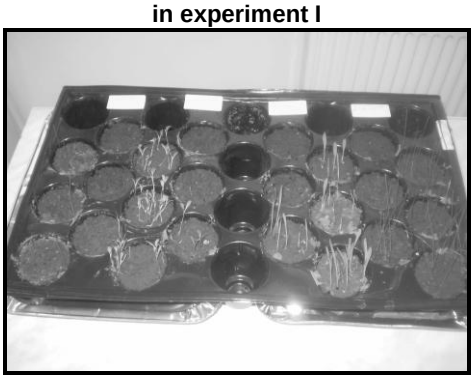

Photo 3. **The phenophase of the formation of the true leaves**

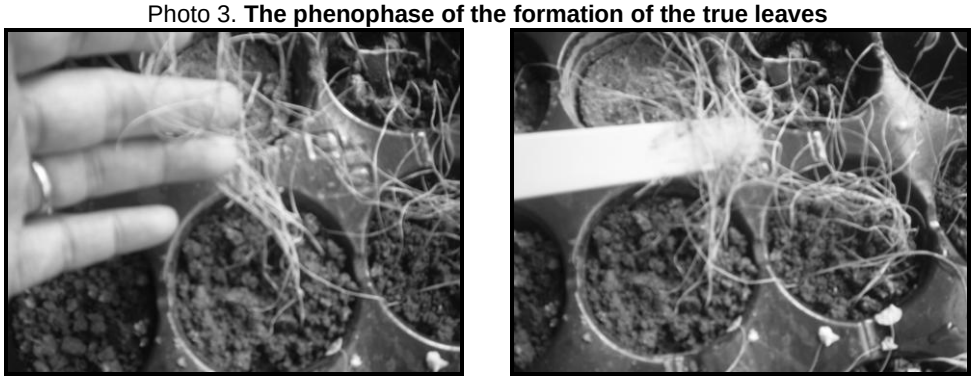

Photo 4, 5. **Aspects of the *Medicago sativa* plants after the administration of the 10% salty solution**

The experimental samples and the witness samples were sawn using 100 seeds for each of them. So, we planted 300 seeds on the witness samples and 300 seeds on the experimental samples (namely 100 seeds on the sample watered with 1% salty solution, 100 seeds on the sample watered with 10% salty solution and 100 seeds on the sample watered with 20% salty solution).

The experimental conditions were maintained at the same environmental parameters during the entire experimental period, namely a temperature of 21-23 ^{0}C, breaking up the soil every two days to homogenize it, and irrigation using the same water quantity. Every two days, we looked at the evolution of the species sawn and we put down what we observed in the annexed tables.

Table 1

Situation of the seeds' germination 3 and 7 days after sawing – average of the results

Herbaceous species	Germinated seeds											
	after 3 days						after 7 days					
	Witness sample			Experimental samples: I	II	III	Witness sample			Experimental sample: I	II	III
Alfalfa	I	II	III	1%NaCl	10% NaCl	20% NaCl	I	II	III	1% NaCl	10% NaCl	20% NaCl
	43s	40s	46s	8s	2s	0s	60s	55s	65s	10s	3s	0

Table 2

Germinative energy and germinative capacity – average of the results

Herbaceous species	Germinative energy						Germinative capability					
	after 7 days						after 14 days					
	Witness sample			Experimental sample			Witness sample			Experimental sample		
	M1	M2	M3	1% NaCl	10% NaCl	20% NaCl	M1	M2	M3	**1%** NaCl	10% NaCl	20% NaCl
Alfalfa	60%	55%	65%	**10%**	**3%**	**0%**	97%	95%	96%	**25%**	**10%**	**0**

Table 3

Germinated seeds until day 14 for the *Medicago sativa* species

	day 3	day 5	day 7	day 9	day 11	day 13	day 14
witness I	43	50	60	76	85	90	97
1%solution	8	8	10	20	23	25	25
witness II	40	43	55	87	90	92	95
10%solution	2	2	3	7	9	10	10
witness III	46	55	65	88	90	95	96
20%solution	0	0	0	0	0	0	0

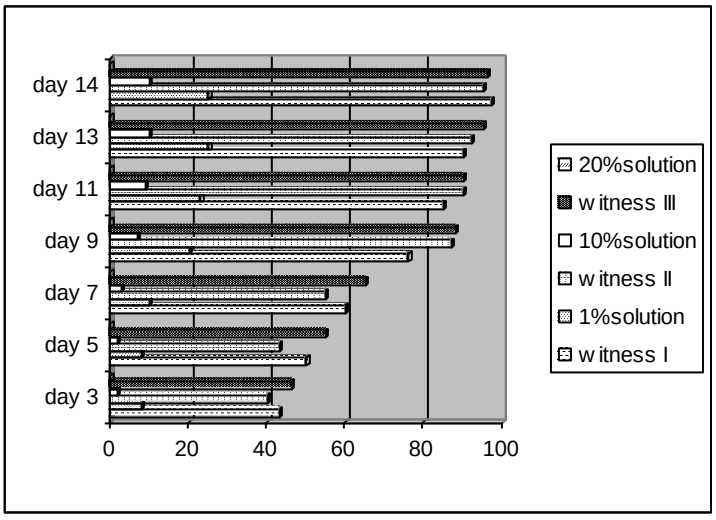

Figure 1. **Germinated seeds until day 14th for *Medicago sativa* species**

Experiment II

For this experiment, we used the same plain soil as for the experiment 1 and the same number of seeds. The samples were watered with tap water for 21 days (86% of them germinated), after which we administered a 10% salty solution.

Experiment III

The third experiment began on May 5, 2011. The soil from the previous experiment was irrigated every two days of a week, after which we sawed 100 seeds of the *Medicago sativa* species in each vase. The cultivated vases were irrigated using drinking water.

RESULTS AND DISCUSSIONS

For the first experiment, one can notice in table no. 1 that three days after sawing, on the witness samples with alfalfa 129 germinated seeds were recorded (out of 300, namely 43%), while on the experimental samples with alfalfa we could count only 8 sprouted seeds (out of 100 seeds sawn and treated with 1% salty solution), 2 seeds (out of 100 seeds sawn and treated with 10% salty solution) and in the experimental sample irrigated with a 20% salty solution, no seed germinated out of the 100 seeds sown. Seven days after sawing, the situation recorded was as follows:

- 180 seeds germinated on the witness sample (namely 60 % of the number of seeds sawn);

- 10 seeds sprouted on the experimental sample watered with 1% salty solution (sawn with 100 seeds);

- 3 seeds sprouted on the experimental sample watered with 10% salty solution and no seed germinated on the experimental sample watered with 20% salty solution. Following this analysis, one can calculate: *the germinative energy*, indicating the speed of the start of the germination process and the *germinative capability*, indicating the number of seeds able to germinate in a lot (Busuioc Gabriela, Frăsin Loredana, Necula Cezarina, 2002) (*Tab.2*). In the second experiment, all the *Medicago sativa* plants, although quite vigorous, got dry after the administration of the 10% salty solution *(foto. 4, 5).* In the third experiment, we noticed that three days after sawing, just one alfalfa seed had germinated, and seven days after that, the situation remained unchanged. On May 12, namely seven days after sawing, in the cultivation vases was added a solution made up of water and nitrogen whose concentration was 1%. The subsequent observations showed that the nitrogen solution did not help the alfalfa seeds to germinate.

CONCLUSIONS

By the end of the three experiments made in the Applied Biology Laboratory of the Faculty of Environmental Engineering and Biotechnologies, we reached the following conclusions:

In the experimental sample where the 1% salty solution was administered, the seeds germinated and the plants developed after that.

In the experimental samples irrigated with a 10% salty solution, the plants did not manage to resist, although 10% of the alfalfa seeds germinated. The fact that they did not resist was caused by the phytotoxicity induced by the $NaCl_2$.

In the second experiment, we noticed that the plants were affected by the pollution triggered by the watering with the 10% salty solution.

The third experiment showed that the alfalfa did not manage to grow on a soil irrigated with a 10% salty solution (after the soil had been irrigated for a week and then treated with a solution made up of water and 1% nitrogen, seven days after sawing).

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