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MEDICAGO SATIVA L. CULTURE PROPOSALS UNDER THE INFLUENCE OF ECOLOGICAL CONDITIONS IN BIHOR COUNTY

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Abstract

The negative consequences of the manifestation of extreme climatic events (such as storms, short-term heavy rainfall with floods and water stagnating on the farmlands), the extension of pedologic droughts periods and the effects on farmland productivity entails the execution of interdisciplinary studies capable to embody the whole complex of changes registered at the soil-plant-atmosphere level. Thus, we aim to propose crops with medium requirements from ecological conditions, in close relation with the global climatic changes, as well as adaptable and resistant to the fluctuations of the climatic parameters, but most importantly, in line with the needs and demands of the local community. We consider lucerne to be such a species, very adaptable to prolonged drought periods, like those experiences in the recent years, as well as to short periods of water overflow. The main objective of the present study is represented by the preliminary analysis of the average temperatures and rainfall values and relief characteristics (altitude, inclination), aspects which can paint an initial overall picture on the favourability of the lucerne crops.

Key words: *Medicago sativa L.*, favourability, climate change, Bihor county

INTRODUCTION

Global climate modifications affect the whole planet by disrupting an increasing number of activities, as well as decreasing the quality of human life. One of the most impacted sectors is the agriculture, which registers diminishing agricultural production, extinction of certain species and incontrollable prevalence of invasive species. As a consequence, implementing a sustainable management adapted to these recent challenges is more than necessary.

It is expected that, at a European level, the negative effects of climate change will accentuate the water deficit in the warm areas, will intensify the economical differences between states, increase the degree of abandonment of farming land (due to diminishing of production and of the periods with agricultural activities, as well as due to an increase in regional marginalization).

Therefore, the necessity of modernizing the irrigation systems becomes a crucial objective to be accomplished on a short and medium term. This should intervene and reduce to a minimum the water loss from crops, loss which appeared as a consequence of diminishing rainfall quantities on a yearly and seasonal level.

The scenario of warmer and dryer summers, with reduced water supplies in the soil, determines the necessity of an effective planning of the crop technologies, of the funds allocated, as well as the careful selection of the species with requirements

adapted to the new environmental factors. (Hamidov et al., 2018)

The species of Medicago sativa L. is known as one of the crops with low to medium requirements in terms of soil, with very good adaptability to climatic variations and, most importantly, with a high production per hectare, which provides a significant resource in the animal sector in both green and dry mass.

The purpose of the present study is to analyse the surfaces cultivated with lucerne crops in the Bihor county, in order to obtain up to date and tangible information on people's degree of awareness with regards to the advantages of cultivating this type of crop and a preliminary analysis on the ecological factors which can influence the productivity of lucerne on a county level.

Lucerne is cultivated on a large scale for the production of fodder, but, as a consequence of climate change and, more specifically, of the increase of the period with a deficit in rainfall during summer, conducting studies to determine this species capacity to adapt to new climatic parameters becomes necessary. It is important to assess its reaction to the lack of water, to the salt stress, which influences lucerne's performance, productivity, and characteristics related to seed germination, mineral absorption and assimilation, carbon fixing etc. (Al-Farsi et al., 2020).

Lucerne is renowned for the high quality of fodder and positive effects on soil fertility (Campiglia and collab., 1999), as well as its resistance to long periods with water deficit by preventing its vegetative growth (Annicchiarico and collab., 2010) and accessing water given its deep roots. (Volaire, 2008).

MATERIAL AND METHOD

In order to achieve the main objective of the present study, in a first stage, we'll review data obtained from APIA Bihor about the surfaces cultivated with lucerne during 2013-2019, as well as the productions obtained on these specific surfaces.

To identify the climatic characteristics, we will analyse the variations of the climate parameters in Bihor county, using data obtained from the main meteorological stations which monitor the studied area.

In what concerns the efficiency of dry mass obtained per hectare, after studies on experimental parcels it was found that the values were between 7-9 t /ha/year and 11 t /ha/year, values influenced by the humidity of the soil.

According to the Rastgar report, from 2005, the lucerne presents deep, vertical roots, capable of extracting humidity from the depths of soil, a characteristic which makes it resistant to droughts in comparison with other species.

The differences of productivity for dry mass can vary up to 22 t/ha/year during droughts, compared to periods considered normal from a rainfall point of view. (Bauchan and Greene, 2000).

Therefore, to capture the areas which present favourable condition for the lucerne crops, we will use GIS technology, which allows to model the pedological, climatic and relief parameters, as well as identify any correlations between the classes of these factors and the production of lucerne obtained.

RESULTS AND DISCUSSION

According to this data, we can remark extended surfaces of farmland, specific to a county with large areas of plain (these are extended on 41,51% of the territory on Bihor county). Also, territories occupied with permanent pastures currently account for 845 km^2.

Due to expansive areas of the mountainous sector and favourable pedological and climatic conditions, the forest vegetation occupies 2379 km^2 which represents 31,55 % of the analysed territory.

Reviewing the areas cultivated with lucerne crops in Bihor county, according to the data monitored by Romania's Agency for Payment for the Environment, reduced variations were observed in the period between 2013-2019, when the production per hectare was over 24 tonnes/hectare (Table 1).

Table 1

Statistical data on alfalfa production in Bihor County

Year	**2013**	**2014**	**2015**	**2016**	**2017**	***2018***	***2019***
Alfalfa production Tons / year	181.133	241.657	321.335	216.019	246.762	1.109.920	1.107.124
Cultivated area (Ha)	7.127	8.849	8.594	8.796	10.186	27.748	27.543
Average production per hectare	24.415	27.309	26.918	24.559	24.226	40.000	40.200

Alfalfa is characterized by a great ecological plasticity for Romania's territory, thus, local agriculturists establish pure crops, as well as mixed crops with other herbage species for fodder. The current associations are made with cocksfoot grass (Adrian variety), hybrid ryegrass (Cătălin variety) or Italian ryegrass and Alexandria clover (Viorel variety). (www.samanta.ro)

Following the studies conducted by the Fudulea Institute of Research for Agricultural Development, the only national centre of plant amelioration in Romania, it was determined that, at the time being, the agriculturists can use 12 varieties of lucerne which are in line with the requirements in terms of quantity and quality, in pure or mixed crops. In addition to these, they can choose between Ileana variety, with a quantity of green mass fodder of 100 t/hectare and 20 t/hectare of dry mass fodder, Pampilia variety, with a quantity of green mass fodder of 95 t/hectare and 19,1 t/hectare of dry mass fodder and Liliana variety, with a quantity of green mass fodder of 95 t/hectare and 19,1 t/hectare of dry mass fodder. (www.incda-fudulea.ro)

The climatic data used in the present study are available for free on the platform: http://rp5.ru/weater_archive. In order to have an up to date view and capture the modifications on the lucerne production, we used values of the climatic

parameters from the last few years.

Analysing the average temperature values in the period 2005-2019 captured by the meteorological station in Oradea, it was observed an average value of 12,15^{o} Celsius, specific for a temperate climate with western, oceanic influences.

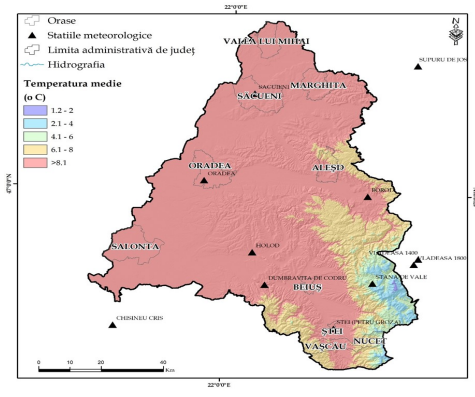

Fig. 1. Multiannual average temperature map from Bihor county

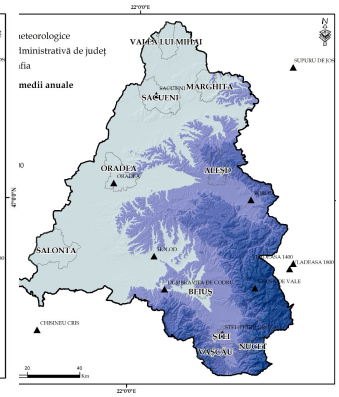

Fig. 2. Map of the average multiannual precipitations at the level of Bihor county

Seasonal variations are recorded in what concerns the average air temperature, January being a month characterized by values below 0.5 ^{o}C, which marks the presence of winters with temperatures that seldom reach the freezing point. In the next months, towards end of winter and spring, the average air temperature raises slightly, with values of +2,4 ºC in February, 7,1 ºC in March, 12,9 ºC in April, 16,9 ºC in May. The lucerne crops are usually established early in spring, (1st-15th of March in the plain areas, 5th-25th of March in the hill areas), but they can be sowed also in the autumn (25th of August-5th of September) on dry soil, to avoid the uneven emergence of lucerne.

The loss of lucerne seedlings can raise up to 50% in the situation when, after sowing, the temperature drops down to -7 ºC.

Analysing the variation of the monthly rainfall from the data provided by the meteorological station in Oradea, it was determined that the lowest value of rainfall is registered during wintertime (December, January and February), but also in April and October, while the highest values are specific to end of spring (May) and summertime (June and July).

Thus, April and September, months with low quantities of rainfall, are problematic to lucerne crops at the beginning of the vegetation period, influencing the degree of emergence in case of spring sowing, as well as the last harvest.

Table 2

Monthly variation of average annual temperature and rainfall in period

Average annual temperature	Month											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
	-0,5	2,4	7,1	12,9	16,9	21,3	22,3	23,5	17,9	12,3	7,8	2,0
Rainfall average annual	344	323	388	340	748	884	776	407	331	416	427	405

From the analysis of climate data from the meteorological stations across Bihor county, it was observed that summers are becoming increasingly hot and benefit from high quantities of rainfall in 24 hours (which often exceed 50 mm), winters are becoming gentler, with less and less snowy days.

For example, in the Bulletin of the Romanian Meteorological Society, year IV, 2017, it is highlighted an increase in the yearly average temperature with over 2 degrees Celsius in the southern side of Bihor county, compared to the multiannual average value in the period 1980-2010 and 1 degree Celsius over the northern part.

A reduction in the quantity of rainfall was also observed, compared to the multiannual average of the period 1981-2010, with values over 75 mm in the outskirts of the city of Oradea, with approximately 50 mm in the plain area of Bihor county. The quantity of rainfall in the hill sector also decreased, with approximately 25 mm.

Analysing the variation on climatic elements at national level, a trend of reduction of the yearly average rainfall value was observed, compared to the values of the last 100 years, and an increase of the daily rainfall, with values between 5-20 mm, in detriment of rainfall values higher than 20 mm.

It is recognized that daily rainfall with a quantity between 0,1-4,9 is mostly lost as a consequence of evapotranspiration, therefore, the water deficit identified on a territorial level remains of major importance.

In addition to these, there are territories affected by soil erosion, which represent one of the factors to contribute to a drop in the agricultural production on significant territories in the studied area (Domuța and Brejea, 2010). Solutions are being sought to improve the irrigation systems on the territories which do not cover the necessary amount of water, as well as to recommend crops of species with a higher degree of resistance and adaptability to drought, in order to reduce the dysfunctionalities which appear on a regional level in these fragile territories.

From an altitudinal point of view, Bihor county is characterized by altitudes varying between 82 m in the plain area and 1829 in the mountain area. (Table 3).

Table 3

Distribution of altitudinal and slope classes in Bihor county

Altitude class (m)	***Characteristic forms of relief***	***Areas***	
		(Km²)	**%**
82-200	Terraces, meadows, plains	3766.7	49.8
201-500	Low and medium hills	2264.9	30.0
501-750	High hills	877.8	11.6
751-1000	Very high hills	286.0	3.8
1001-1250	Low altitude mountains	177.8	2.4
1250-1829	Medium altitude mountains	187.6	2.5
Slope groups (%)	***Name of slope groups***	**(Km²)**	**%**
≤2	Horizontal	1787	23.7
2,1-5	Very low declivity	1818	24.1
5,1-10	Low declivity	990	13.1
10,1-25	Medium declivity	1840	24.4
25,1-50	High declivity	942	12.5
50,1-100	Very high declivity	169	2.2
>100	Abrupt	1	0.001

Analysing the distribution of relief in Bihor county on altitude classes, we captured a series of observations in relation to the stratification of the vegetation, the variation of rainfall and soil types. The lower altitude class is the most significant in terms of expansion, with terrace and river meadows near the main rivers which cross the county (Crișul Negru, Crișul Repede, Barcău and their tributary rivers).

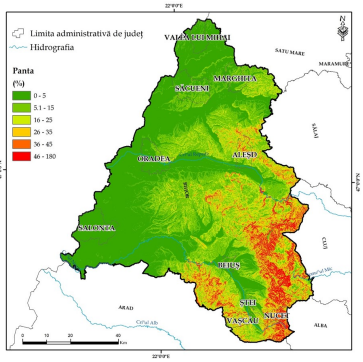

Fig. 3. Map of the land geodeclivity of the county

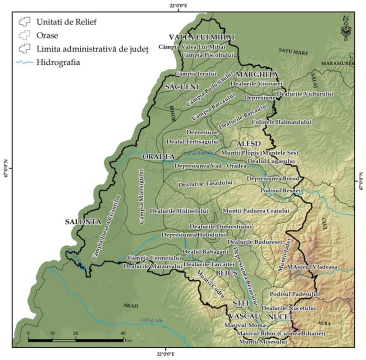

Fig. 4. Geographical position of the study area and major relief units

This sector encompasses low areas from an altitude point of view, which offer favourable conditions to crop cultivation, even intensive ones. The soil in these areas are often favourable, and the high density of the draining also

constitutes a contributory factor for agriculture. In addition to this extended sector, the area of low and medium hills, with altitudes between 201-500m, are also very prosperous to farmland for 30% of the analysed area. (Table 3)

These two altitudinal spacings, which are characteristic to the low plain and low and medium hills area, are surfaces favourable for the pure lucerne crops and would allow good harvests for this type of activity.

The sector of high and very high hills, with altitudes between 501-750 m and 750,1-1000 m, are characteristic to 15,4% of the territory of Bihor county. These two sectors contain areas with features less favourable to lucerne crops, limited to sectors affected by soil erosion and restrictions induced by stagno-gleying features of the soil and the extension of soils with a limitative texture in what concerns the agrotechnical activities.

However, the before mentioned sector, as well as the sectors of low and medium altitude mountains (1001-1250 m and over 1250 m) are favourable for mixed crops (lucerne and other varieties of herbage) and obtaining higher quantities of green mass on the pastures in the mountainous area, if sowed with lucerne.

Another important indicator from the family of relief features is the geodeclivity. In case of low values of geodeclivity, the areas will show a high level of favourability for the crops, mainly for the ones which require technical activities of preparing the soils or maintaining it (Moţoc and Mircea, 2002, Moţoc and Mircea, 2005, Dârja and collab., 2002), while high values in terms of inclination will lead to restrictive access for the agricultural machineries, modifications in the hydric regime of the soils and, lastly, favouring the erosion of the soils, mainly in the first year of lucerne crops.

In what concerns the distribution of the relief in Bihor county on inclination classes, the most prevalent one is the group of very low slopes, under 2%, characteristic to plain areas, territories with a high degree of mechanization of the sowing and harvesting activities, like the cases of lucerne crops. These occupy 23,7% of the analysed territory, being exceeded as surface by the class of slopes 2,1-5 %, which represents the slopes with the lowest degree of inclination, also favourable for crops.

CONCLUSIONS

According to the forecasts conducted at a European level, it is expected that, in Romania, in the upcoming period, the trend will be one of intensifying the alternation between periods of high temperatures, especially in summertime, through diminishing quantities of rainfall on the territories which are already characterized by water deficit, and periods with large quantities of rainfall, in a very short time.

The adjustment measures to climate change are reflected also in the action plans to adapt to the best technological measures applicable, in the proposals to rotate the crops in order to balance the rainfall deficit, in the proposals to review the sowing periods when establishing the crops, taking into consideration the new

environmental conditions, dependent on the current climatic variability.

Following the in-depth analysis of the environmental factors which can have an influence on lucerne crops, together with GIS technology, which offers the possibility of qualitative and quantitative framing of all parcels currently used as pastures or grasslands, we conclude that landowners can benefit from such an in-detail analysis of the restrictive factors for the productivity of pure or mixed lucerne crops in their respective areas. Thus, it is important to understand if the restrictive factors are related to pedological features, when measures dedicated to diminishing their negative effect can be taken, or if it is the case of climate factors, when the possibility to intervene is limited. Following such an analysis, the specialists can propose different agricultural activities to ameliorate the state of the soil, or propose new ways of usage of the terrains so every determinant ecological factor can be properly highlighted, and visible through the economical valence of the territory.

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