BEHAVIOR OF ALFALFA (*MEDICAGO SATIVA* L.) FOR HAY UNDER CONDITIONS IN ROMANIA

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Abstract. *Alfalfa, a plant with multiple uses, grown across the globe and large areas in Europe; in Romania it is gaining ground as a result of CAP policies of EU providing subsidies for this crop and supporting the growth of livestock. Alfalfa feed can be used in animal feed both during summer as a green meal and as hay during the period of stabulation. The quality of alfalfa seed influences the degree of consumability and indirectly the animal health and the level and quality of animal products. Factors affecting the quality of alfalfa meal include: Soil fertility, plant growth and development conditions, variety, degree of fertilization, fertilization, hay handling and storage. However, the harvesting stage is the most impact factor in the management of alfalfa cultivation. As alfalfa plants grow from the vegetative to the generative stage, the lignite content is increased and the protein percentage is reduced, digestibility, metabolizable energy and good animal yield is reduced. In this context, the purpose of this work is to analyze the production of hay for three genotypes of alfalfa (Medicago sativa L.), in the second year of cultivation, cultivated in three different geographical areas of Romania. The experiences were organized in three experimental sites: Timişoara (Timis County), Vinga (Arad County) and Vintu de Jos (Alba County). The same technological links of culture have been respected. The harvesting for hay was carried out when 10 % of the plants were flowering. Research results show that there are differences in the hay crop inAlfalfa genotypes analyzed according to the area of the crop, with crops ranging from 17,8 to 20,91 t.ha^{-1} of hay. The largest productions were recorded on all three alfalfa genotypes on the experimental site at the Vintu de Jos (Alba County). The alfalfa genotypes Palladiana recorded the highest hay yields in all three experimental sites at all four. From the analysis of how the four hay crops influence the total hay crop, it was found that the first crop contributes to the greatest extent, on average around 45 % of total production. All three alfalfa genotypes studied have stable production and can be successfully cultivated in the Center-West area of Romania.*

Keywords: *alfalfa, hay production, cultural technology*

INTRODUCTION

Alfalfa, a plant with multiple uses, due to its yield and good adaptability, is grown throughout the world and on large areas in Europe (STANISAVLJEVIĆ, ET AL, 2012, TUCAK, ET AL, 2014).

In Romania, a European Union state, alfalfa cultivation is gaining ground as a result of the EU Common Agricultural Policies (CAP) which provides subsidies for this crop and supports the increase in livestock numbers.

Due to genetic variability, a number of alfalfa genotypes adapted to extreme environmental conditions have been created and studied (ANNICCHIARICO, ET AL, 2011, GAITIN, SAMFIRA, 2011, SONG, ET AL, 2019), such as drought (KARAMANOS, ET AL, 2009, PETCU, ET AL, 2009), soil salinity (FERREIRA, ET AL, 2015, EL-SHARKAWY, ET AL, 2017) and resistance to diseases and pests.

Alfalfa feed can be used in animal feed both during summer as a green meal and as hay during the period of stabulation (KARAYILANLI, AND, VEYSEL, 2015). The quality of alfalfa seed influences the degree of consumability and indirectly the animal health and the level and quality of animal products. Factors affecting the quantity and quality of alfalfa meal

include: soil fertility, growing and growing conditions of plants, variety (AVCI, ET AL, 2017, OTERO, AND CASTRO, 2019), degree of bathing, fertilization of the crops (MARIAN, ET AL, 2012, STAVARACHE, ET AL, 2012, PACHEV, 2014, HAKL, ET AL, 2016) the pests of the crops, harvesting, handling of hay and storing it.

However, the harvest harvest collection (HAMD, ET AL, 2013) and harvesting stage (KARAYILANLI, AND VEYSEL, 2016) they are the factors with the greatest impact in the management of alfalfa cultivation. A number of studies point out that the optimum harvesting time at alfalfa is the beginning of flowering (AVCI, ET AL, 2017). As alfalfa plants grow from the vegetative to the generative stage, the lignite content is increased and the protein percentage is reduced, digestibility, metabolizable energy and good animal yield is reduced.

In this context, the purpose of this work is to analyze the production of hay, at four harvests, for three varieties of alfalfa (*Medicago sativa* L.) grown in three different geographical areas in Romania.

MATERIAL AND METHOD

Location

The experiences were organized in three experimental sites, from the areas with tradition in the cultivation of alfalfa, namely the commune of Vinţu de Jos (Alba County), the commune of Timişoara (Timis County) and the commune of Vinga in Arad County (Figure 1.).

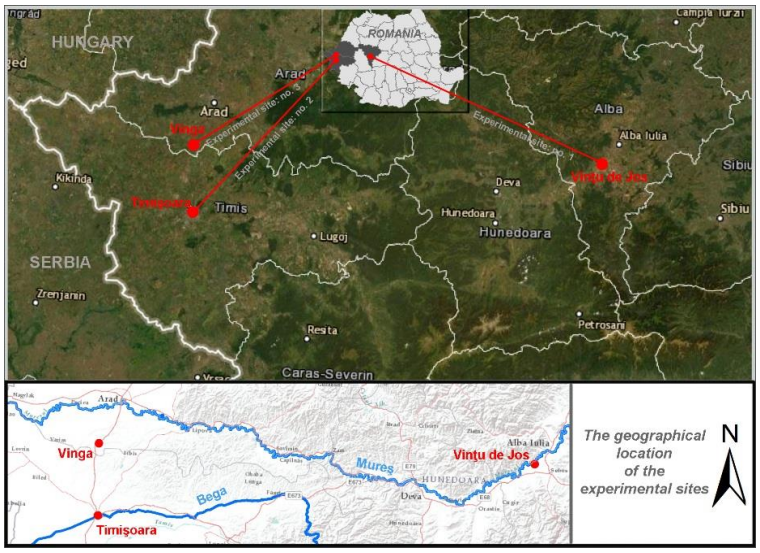

Figure 1 Location of study areas
(processing after Archive of the Office of Cadastre and Real Estate Advertising Timiș; Romania: general vector data sets)

Plant Material and Experimental Design

Three alfalfa genotypes (Palladiana, Elena and Lucrezia) were evaluated in the second year of cultivation at four hay crops in three experimental sites.

The area of the plot was 5000 m^2 for each variety. The sowing was mechanized at 12,5 cm between rows, with a 16 kg ha^{-1} standard. Alfalfa plants were sown in spring 2018 under a non-irrigated system.

The same technological links of culture have been respected. Experimental plots were cut three times in the first growing season (in 2018) and four times in the second year of cultivation (2019).

Harvesting alfalfa in experimental sites was mechanized, when 10% of plants were flowering and hay was collected in bales (16% moisture).

Soil and climatic conditions in experimental sites

The average monthly air temperatures in the vegetation season of alfalfa in 2019, between March and October, were fluctuating with slight deviations from the five-year average, (2015 – 2019) in all three experimental sites (Figure 2). With regard to atmospheric precipitation (2019) it is noted that in the sites at the Vinţu de Jos and Timişoara they were less than the average for the last five years, except in May when they were higher. In the experimental site at Vinga precipitation in the 2019 experimental year, it exceeded the multiannual average, except in August and October (Figure 2).

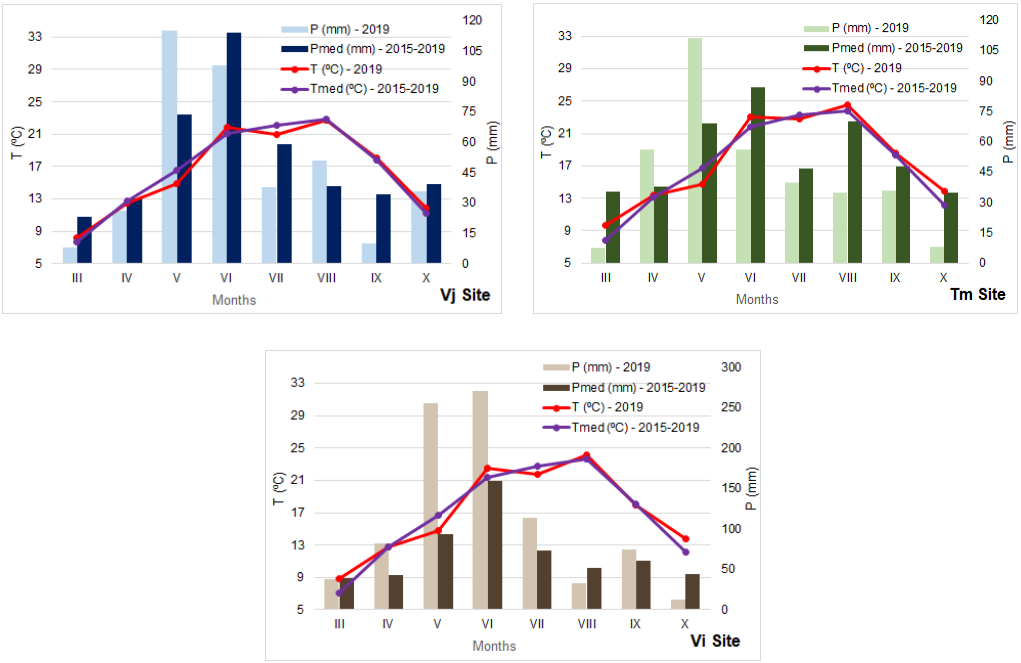

Figure 2. Climatic conditions in experimental sites from March to October and an average of five years (2015 - 2019)
(processing after Climate Databases)

***Legend:** T(ºC) – 2019 – monthly average air temperature values in the year 2019; Tmed (ºC) – 2015-2019 – multi-annual average air temperature values over the period 2015 – 2019; P (mm) – monthly quantities of atmospheric precipitation in the year 2019; Pmed (mm) – 2015 – 2019 – annual average monthly atmospheric precipitation quantities over the period 2015- 2019; Vj – Experimental site in the village of Vintu de Jos; Tm - Experimental site in Timişoara; Vi - Experimental site in the village of Vinga*

In the experimental sites of Timişoara and Vinga soils belong to the type of Chernozem and in the experimental site of the Vinţu de Jos the soil is part of the protisol class (Fluvisol type).

Statistical analyses

The experimental data has been processed using several Excel 2010, with PAST 2.14 software (HAMMER ET AL, 2001)

A clasterial analysis has been carried out, and an analysis in principal components, by which alfalfa genotypes were grouped according to the hay crops obtained at the four smits in 2019 in the three experimental sites.

RESULTS AND DISCUSSIONS

In spring 2018, three alfalfa genotypes (*Medicago sativa* L.) were grown in three experimental sites in a non-irrigated system. Since the spring is dry alfalfa has been hard on the vegetation and production results have not been as high as expected. In the second year of cultivation (2019) four hay crops were recorded (Figure 3) in the genotypes analyzed in all three experimental sites (Vinţu de Jos, Timişoara şi Vinga).

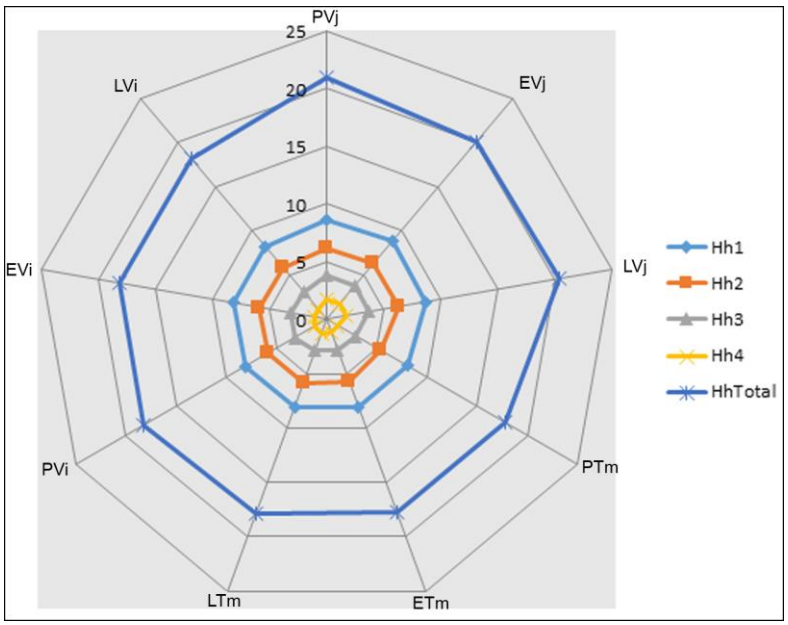

Figure 3. Graphical representation of data

***Legend**: Harvest: Hh1 - Harvest 1 of hay, Hh2 - Harvest 2 of hay, Hh3 - Harvest 3 of hay, Hh2 - Harvest 4 of hay, HhTotal - total harvest; Medicago sativa L. variety: PVj – Palladiana (Vinţu de Jos), PTm – Palladiana (Timişoara), PVi – Palladiana (Vinga), EVj – Elena (Vinţu de Jos), ETm – Elena (Timişoara), EVi – Elena (Vinga), LVj – Lucrezia (Vinţu de Jos), LTm – Lucrezia (Timişoara), LVi – Lucrezia (Vinga).*

The hay yields of the alfalfa genotypes analyzed in the second year of the crop were between 17,8 t.ha^{-1} and 20,91 t.ha^{-1} of hay in four crops. Hay was harvested when 10% of

plants were flowering. The largest productions were recorded under the conditions of the Vinţu de Jos (Alba county), between 20,12 and 20,91 t.ha^{-1}. The lowest alfalfa hay yields, under the conditions of 2019, were recorded under the conditions of Timişoara. The highest value has been recorded at the Palladiana genotype in all three experimental sites.

The production results recorded at alfalfa in the three experimental sites were similar to those obtained at Tucak M., and colab. (2014) which studied tens of genotypes under conditions in Croatia (Europe), but less than the productions recorded by Romanian varieties grown in Romania (SCHITEA, 2010, SCHITEA, ET AL, 2014).

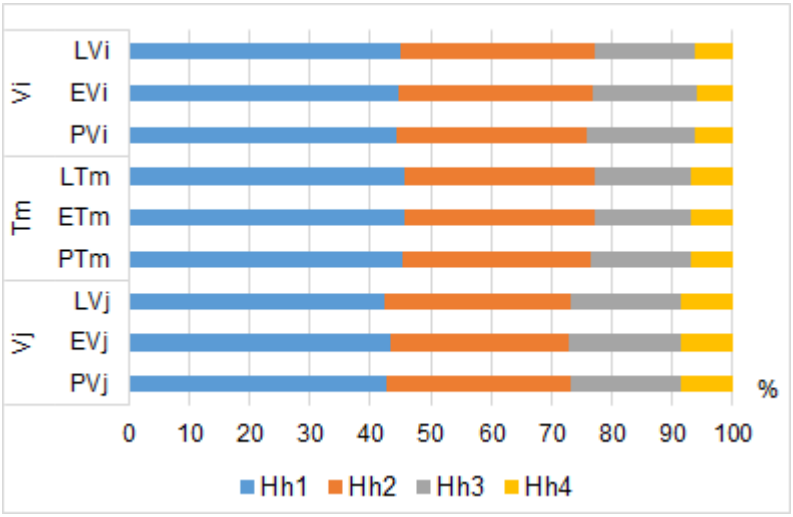

Figure 4. Representation of alfalfa production on the harvests (%)

***Legend**: Harvest: Hh1 - Harvest 1 of hay, Hh2 - Harvest 2 of hay, Hh3 - Harvest 3 of hay, Hh2 - Harvest 4 of hay; Medicago sativa* L. *variety: PVj – Palladiana (Vinţu de Jos), PTm – Palladiana (Timişoara), PVi – Palladiana (Vinga); EVj – Elena (Vinţu de Jos), ETm – Elena (Timişoara), EVi – Elena (Vinga); LVj – Lucrezia (Vinţu de Jos), LTm – Lucrezia (Timişoara), LVi – Lucrezia (Vinga)*

As regards the yields per harvest of Figure 4 it can be found that the first harvest is the highest yield of hay on the alfalfa genotypes analyzed, on average around 45% of total production. The explanation is also based on the fact that the climate conditions in Romania favor plant growth and development in the spring (March, April, May).

In the second crop, the obtained hay yields, on average, around 31% of total production and in the third crop 17% as alfalfa comes from summer drought. At the fourth harvest, production falls very much, below 10% of total production, so in certain areas of Romania it is only harvested for green meal or silage.

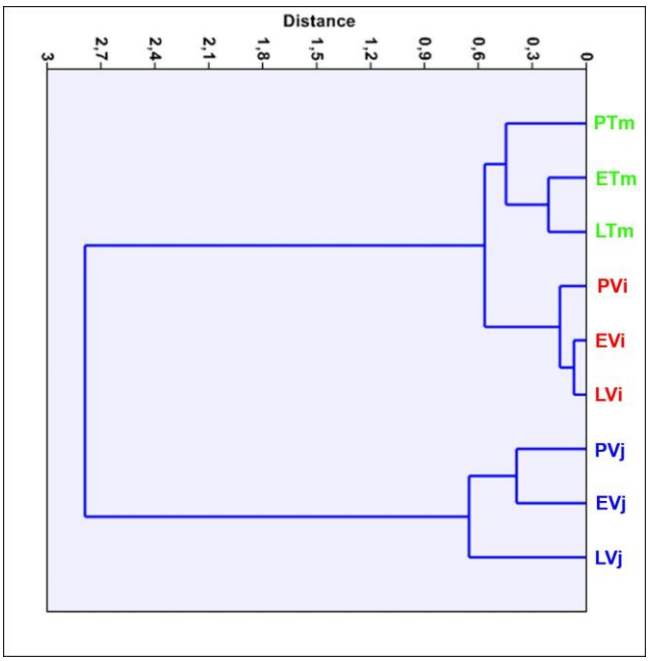

Figure 5. Cluster analysis for the production of hay recorded in the second year of cultivation by the three alfalfa genotypes, cultivated in three geographical areas

Legend: *Medicago sativa* L. *variety: PVj – Palladiana (Vinţu de Jos), PTm – Palladiana (Timişoara), PVi – Palladiana (Vinga); EVj – Elena (Vinţu de Jos), ETm – Elena (Timişoara), EVi – Elena (Vinga); : LVj – Lucrezia (Vinţu de Jos), LTm – Lucrezia (Timişoara), LVi – Lucrezia (Vinga).*

From the cluster analysis (Coeph corr = 0.9773) it is noted that the second year's hay crops in alfalfa are grouped according to the growing area in two large groups (Figure 5).

In the first group, two sub-groups are quantitatively distinguished showing similarities, namely alfalfa genotypes cultivated under the conditions of Timişoara and Vinga, but there are also small differences in production, i.e. the highest hay yields were recorded in Vinga. The alfalfa seed genotype Palladiana is differentiated in the production of hay per crop but also in the total average production under the conditions of 2019.

The second group consists of alfalfa genotypes grown under conditions of the Vinţu de Jos, the county of Alba, where the largest hay crops were recorded and includes the following distinct subgroups, namely: sub-group a comprises: the alfalfa genotype Palladiana and Elena, which are quantitatively dominant under the conditions of the Vintu de Jos, and the genotype of Lucrezia is added.

As can be seen from Figure 5, even if they are combined in the same groups and subgroups, between the three alfalfa genotypes studied in three different areas, there are smaller or larger quantitative differences.

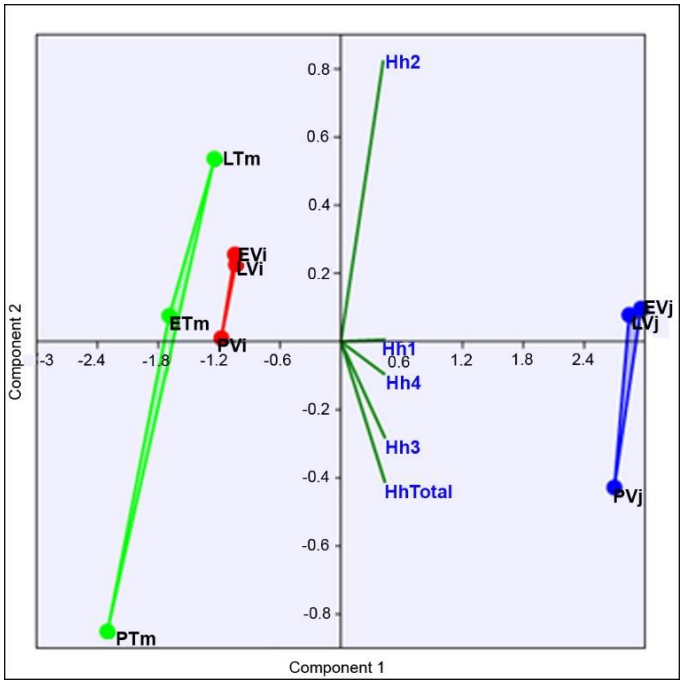

Fig.6. The graph regarding the analysis in principal components at the alfalfa in the three experimental sites

***Legend**: Harvest: Hh1 - Harvest 1 of hay, Hh2 - Harvest 2 of hay, Hh3 - Harvest 3 of hay, Hh2 - Harvest 4 of hay, HhTotal - total harvest; Medicago sativa* L. *variety: PVj – Palladiana (Vinţu de Jos), PTm – Palladiana (Timişoara), PVi – Palladiana (Vinga); EVj – Elena (Vinţu de Jos), ETm – Elena (Timişoara), EVi – Elena (Vinga); LVj – Lucrezia (Vinţu de Jos), LTm – Lucrezia (Timişoara), LVi – Lucrezia (Vinga).*

Figure 6 shows that there is a clear difference between the recorded hay yields in alfalfa genotypes (Palladiana, Elena, Lucrezia) cultivated under the soil and climatic conditions of the Vinţu de Jos compared to the yields of the same genotypes in the Timişoara and Vinga sites. The first crop has a large influence on the total hay production in the alfalfa genotypes analyzed.

CONCLUSION

Research results show that there are differences in the production of hay in alfalfa genotypes analyzed according to the growing area. In all the studied areas, four should have been observed in alfalfa since the second year of cultivation.

The analysis of the total hay crops, in alfalfa genotypes studied in the second year of the crop shows that, under the conditions of 2019, they were between 17,8 and 20,91 $t.ha^{-1}$ of hay from four crops. In all the three genotype of alfalfa, the largest productions were registered in the experimental site of Vinţu de Jos (Alba county), located in the meadow area in a micro-depression with a climate favorable to the alfalfa culture.

The alfalfa genotype Palladiana recorded the highest hay yields in all three experimental sites, with the maximum value recorded on the experimental site at the Vinţu de Jos (20,91 $t.ha^{-1}$).

From the analysis of how the four hay crops influence the total hay crop, it was found that the first crop contributes to the greatest extent, on average around 45 % of total production.

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