

## THE BEHAVIOR OF THE *LOLIUM MULTIFLORUM* L. SPECIES UNDER THE INFLUENCE OF TEMPERATURE IN THE WESTERN PART OF ROMANIA

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**Abstract:** As a result of global warming, in our country, especially in the West Plain where we conducted our experiment, the effect is clearly visible. In this situation, the autumn crops start their vegetation earlier in spring and are better in facing the summer drought. The paper aims at assessing the growth and development of species *Lolium multiflorum* L. under the influence of the temperatures recorded in Timișoara until the coming of winter. Thus, The *Lolium multiflorum* L. crop, SPRINT variety, was set up on the 25<sup>th</sup> September 2014. The sprouting took place 12 days after that, in which time the average maximum temperature was 15°C and the average minimum temperature was 12°C. The first assessment of the externalization of some characteristics (parameters) of *Lolium multiflorum* L. under the influence of the temperatures in the vegetation period took place 16 days after that, and the following four assessments were performed at successive seven days intervals. The research revealed that all parameters studied of species *Lolium multiflorum* L. increased, irrespective of the daily temperature variations in the vegetation periods analysed, and that these parameters are, to a larger or lesser extent, directly influenced by the average daily temperature (AT). Under the conditions in Timisoara in the timeframe of the experiment, there is positive correlation between the sum of temperature degrees (AD) and most characteristics assessed at *Lolium multiflorum* L. The total sum of temperature degrees (ADT), recorder in Timișoara, in the period under analysis, is correlated with the development of *Lolium multiflorum* L. plants, respectively with the increase in the main characteristics evaluated: clump height - BH, number of tillers in the clump - SN, clump weight - BW, number of leaves in a clump - LN and of course with the growth of the main root - LPR. In conclusion, the temperatures recorded at Timișoara, between September and November 2014, on a background of optimal moisture conditions, assured the growth and development of *Lolium multiflorum* L. plants, so these can begin winter well-rooted, with suitable height and number of tillers to survive the harsh winter conditions.

**Key words:** *Lolium multiflorum* L., average daily temperature, sum of temperature degrees, total sum of temperature degrees

### INTRODUCTION

The intensification of fodder grass production (HORABLAGA M. ET AL., 2009; MIHAELA CORCHES ET AL., 2011; LUMINITA COJOCARIU et al., 2012a,b) is a topical issue, it being a means of increasing both the numbers of animals and animal production in Romania.

Increasing fodder crop yields requires an open, positive attitude towards intensive but environment-friendly technologies (LUMINITA COJOCARIU et al., 2008). Thus, some studies reveal that *Lolium multiflorum* L makes good use of cattle manure and biostimulators. Although the yield is lower than the one obtained through chemical fertilization, manure can be used successfully in sustainable agriculture (DAREN D. ET AL., 2002; DECAMPS C., ET AL., 2002; TAPANI K. AND BOSWALL P., 2005; ERIKSEN J. ET AL. 2008; LUMINIȚA COJOCARIU ET AL. 2010, A,B.; LEHMANN J. ET AL. 2010; LUMINITA COJOCARIU, M. HORABLAGA, 2013).

Other studies prove that species *Lolium multiflorum* L. can be a good choice for annual mixes (MARIAN FLORIN ET AL. 2011; IRINA JURMESCU ET AL., 2012).

Species *Lolium multiflorum* L. is a fodder plant that develops very well on fertile, well-processed soils, in a temperate climate: under these conditions it manifests its yield capacity to the fullest, both for forage and for seed production (HORABLAGA M. ET AL., 2009; IRINA JURMESCU ET AL., 2012).

Starting from these arguments, the paper assesses the growth and development of species *Lolium multiflorum* L., in winter crop, under the influence of the temperature factor.

## MATERIAL AND METHOD

### 1. Experimental site

The experiments were performed at the Experimental Didactic Station from Banat University of Agricultural Sciences and Veterinary Medicine „King Michael Ist of Romania” from Timișoara, in the period from 2008 to 2011.

The location of the area is in the West Plain of Romania, and the soil where the experiment was placed is cambic chernozem.

### 2. Work methodology

The *Lolium multiflorum* L. crop, SPRINT variety, was set up on the 25<sup>th</sup> September 2014. The first ryegrass plants started sprouting after 8-9 days (approximately 40%), but complete sprouting took place 12 days after (7<sup>th</sup> October 2014). We considered that the sprouting was complete when 90-98% of the plants sprouted.

The first assessment was performed on 23<sup>rd</sup> October 2014 (16 days after), and the next four assessments at intervals of 7 days, with the last assessment taking place on 20<sup>th</sup> November 2014 (Table 1). After this date, the temperatures dropped dramatically, especially those registered at night; winter came in the area under analysis.

Table 1

Temperature values recorded in Timișoara, in the period of growth and development of species *Lolium multiflorum* L. (2014)

Period	Average temperature/day (°C)	Temp. sum in the period of the experiment (°C)
Temperatures between sprouting to the first assessment C1 (16 days), 07.10. -23.10.2014	16	256
Temperatures from the first assessment C1- to C2 (7 days), 23.10 - 30.10.2014	7.5	52.50
Temperatures from assessment C2- to C3 (7 days), 30.10 - 6.11.2014	7.9	55.50
Temperatures from assessment C3- la C4 (7 days), 6.11 - 13.11.2014	15	105
Temperatures from assessment C3- la C4 (7 days), 13.11 - 20.11.2014	11.6	81.5
Total	-	550.5

Source:<http://www.accuweather.com/ro/ro/timisoara/290867/month/290867?monyr=10/01/2014>  
4; <http://www.accuweather.com/ro/ro/timisoara/290867/month/290867?monyr=11/01/2014>

The following characteristics (parameters) were determined at *Lolium multiflorum* L.: BW – clump weight (g); BH – clump height (g); SN – number of tillers/clump; LN- number of leaves/clump; LPR – main root length.

### 3. Statistical analysis

The statistical evaluation of the experimental data was made using PAST software, version 2.14.

Cluster Analysis is a statistical method that groups data based on information that describes the objects and their relationship (HAMMER, O. et al., 2011). The cluster analysis was performed using Paired Group Algorithm (MARIA - DESPINA BORDEAN, 2012) and based on the correlation constrained similarity measure.

## RESULTS AND DISCUSSIONS

The germination and sprouting of *Lolium multiflorum* L. required 12 days to take place; during this time, the average of maximum temperatures was 15<sup>0</sup>C and the average of the minimum temperatures was 12<sup>0</sup>C between 25<sup>th</sup> September and 7<sup>th</sup> October 2014.

In the following 16 days, up to the first assessment (C1—23<sup>rd</sup> October 2014), in Timișoara the average temperature per day was 16<sup>0</sup>C, and the cumulated sum of temperatures was 256<sup>0</sup>C. At the first assessment C1, clump height of *Lolium multiflorum* L. was 9.4 cm, the clump already had 2 tillers, clump weight was 0.916 g and the length of the main root pierced the soil 5.96 cm deep (Figure 1-a,b,c,d,e, f).

The next four assessments of the externalization of some characteristics (parameters) of *Lolium multiflorum* L. (BW – clump weight (g); BH – clump height (g); SN – number of tillers/clump; LN – number of leaves/clump; LPR – main root length) were determined at consecutive intervals of 7 days C2 – 30<sup>th</sup> October 2014, C3 – 06<sup>th</sup> November 2014, C4 – 13<sup>th</sup> November 2014, C5 – 20<sup>th</sup> November 2014; after this date, temperatures dropped suddenly in Timișoara, so much that negative temperatures were recorded several days in a row.

At assessment C2, seven days after the first assessment, the clump height of *Lolium multiflorum* L. was 11.89 cm, it had 3 tillers, clump weight was 1.316 g, the number of leaves per clump was 8.7, and the main root length was 6.78 cm, while the average temperature dropped to 7.50C in the period mentioned above (Figure 1-a,b,c,d,e, f).

Other seven days later, at assessment C3, the clump height of *Lolium multiflorum* L. was 13.4 cm, the clump had 4 tillers, the weight of the clump was 1.939 g, the leaf number per cluster had increased to 13.8, and the main root length was 6.93cm. In this period, the average daily temperatures were 7.90C (Figure 1-a,b,c,d,e, f).

At assessment C4, the clump height of *Lolium multiflorum* L. was 15.5 cm, the clump had 5 tillers, the clump weight was 2.337 g, the number of leaves in a cluster was 15 and the length of the main root was 7.84 cm. To our surprise, during this period the average daily temperatures were above 150C, much higher than the normal temperatures in this month of the year. Nevertheless, the *Lolium multiflorum* L. plants did not develop spectacularly (Figure 1-a,b,c,d,e, f).

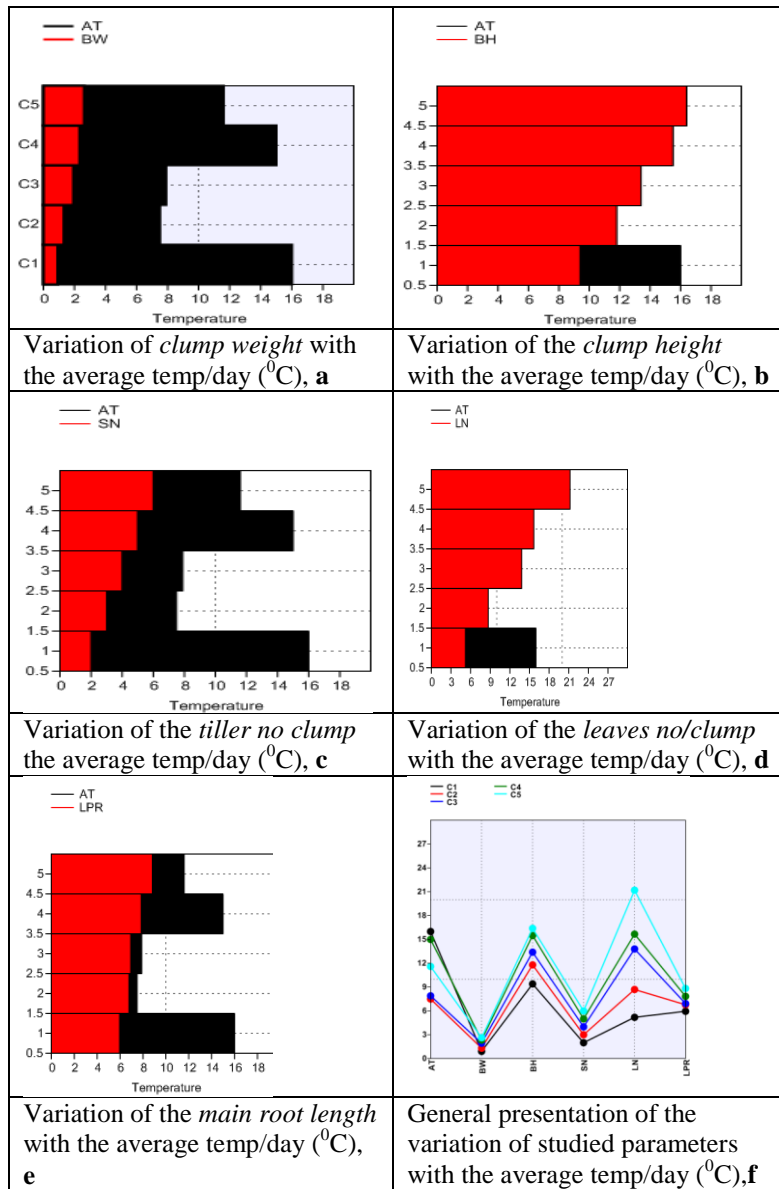


Figure 1. a, b, c, d, e, f - Variation of the studied parameters with the average temp/day ( $^{\circ}\text{C}$ ) during the development of *Lolium multiflorum* L.

Legend: C1, C2, C3, C4, C5 – measurement date (C1 - 23.10, C2 - 30.10, C3 - 06.11, C4 - 13.11, C5 - 20.11); AT - Average temp/day ( $^{\circ}\text{C}$ ); BW - Clump weight (g); BH - Clump height (cm); SN - Tiller no/clump; LN - Leaf no/clump; LPR - main root length

The last assessment, C4, was performed on 20.11. 2014. On that day, the clump height of *Lolium multiflorum* L. was 16.4 cm, the plant had 6 tillers, the weight of the clump was 2.625 g, the number of leaves in a clump increased to 21.2, and the main root length was 8.83

cm. In the last seven days of our experiment, in Timișoara, the average daily temperature was 11.6<sup>0</sup>C, with clear tendencies towards dropping (Figure 1-a,b,c,d,e, f).

The analysis of Figure 1(a,b,c,d,e, f) reveals that all studied parameters of species *Lolium multiflorum* L. are on the rise, irrespective of the variations in the daily temperatures in the vegetation periods analysed. Another finding is that, to a greater or lesser extent, these parameters are directly influenced by AT - average daily temperatures (Figure 2). The most constant increase of *Lolium multiflorum* L. under the given conditions is found in the root development, which is in direct correlation with plant development. For the cluster analysis we used the Paired Group Algorithm and correlation constrained similarity measure (Coph corr AT =0.9994).

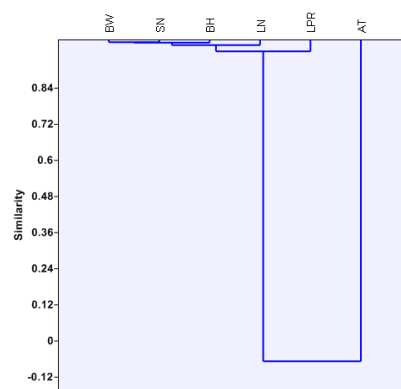


Figure 2. Cluster analysis of the studied parameters data based on the average temp/day (<sup>0</sup>C) variation, during the development of *Lolium multiflorum* L. (Coph corr AT =0.9994)

Legend: C1, C2, C3, C4, C5 – measurement date (C1 - 23.10, C2 - 30.10, C3 - 06.11, C4 - 13.11, C5 - 20.11); AT - Average temp/day (<sup>0</sup>C) ; BW - Clump weight (g); BH - Clump height (cm); SN - Tiller no/clump; LN - Leaf no/clump; LPR - main root length

The highest sum of temperature degrees (AD) was recorded in 2014 in Timișoara (256<sup>0</sup>C) up to the first assessment (C1) of the main characteristics of species *Lolium multiflorum* L., followed by the period between the third and the fourth reading (C4) when, as an effect of the high temperatures, 105<sup>0</sup>C were cumulated, and then the period between the fourth and the fifth assessment (C5), Figure 3. Figure 4 reveals that in the last period under analysis the sum of temperature degrees (AD) is in direct correlation with clump height and with the number of tillers per clump. Cluster analysis, presented in Figure 5, shows that there is positive correlation between the sum of temperature degrees (AD) and most characteristics of *Lolium multiflorum* L. assessed.

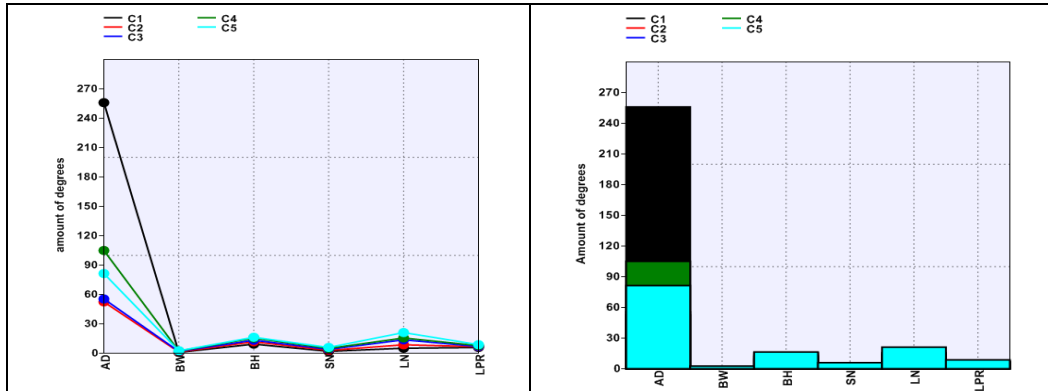


Figure 3. Variation of the studied parameters with the amount of degrees ( $^{\circ}\text{C}$ ) during the development of *Lolium multiflorum* L.

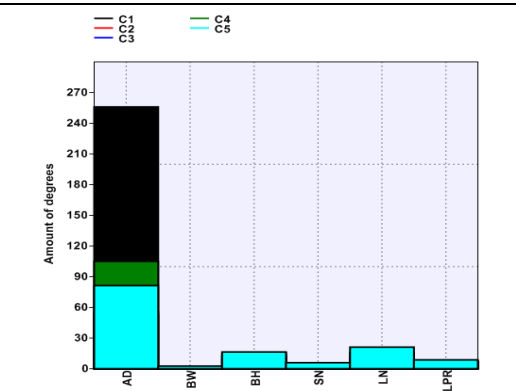


Figure 4. Barchart representation the *Lolium multiflorum* L. development with the temperature

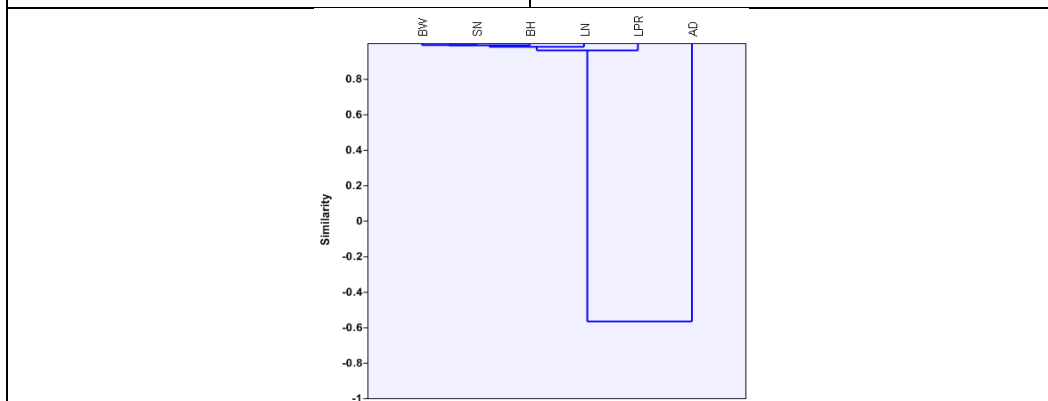


Figure 5. Cluster analysis of the studied parameters data based on the amount of degree ( $^{\circ}\text{C}$ ) variation, during the development of *Lolium multiflorum* L. (Coph corr AD =0.9996)

Figures 3, 4 and 5 present the assessment of the parameters under analysis, which ensure the growth and development of *Lolium multiflorum* L. plants, in relation to the sum of temperature degrees (AD), cumulated at Timișoara, in the timeframe of our experiment (Table 1).

Legend: C1, C2, C3, C4, C5 – measurement date (C1 - 23.10, C2 - 30.10, C3 - 06.11, C4 - 13.11, C5 - 20.11); AD – amount of degrees ( $^{\circ}\text{C}$ ) /study point; BW - Clump weight (g); BH - Clump height (cm); SN - Tiller no/ clump; LN - Leaf no/clump; LPR – Main root length

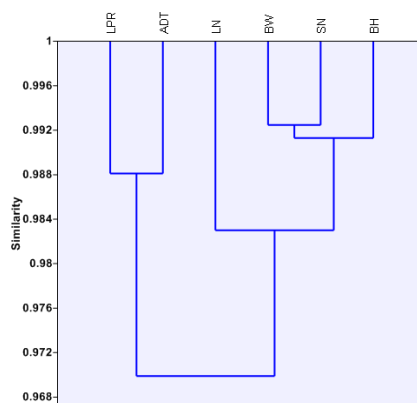


Figure 6. Cluster analysis of the studied parameters data based on the total amount of degrees ( $^{\circ}\text{C}$ ) variation, during the development of *Lolium multiflorum* L. (Coph corr AD =0.683)  
 Legend: C1, C2, C3, C4, C5 – measurement date (C1 - 23.10, C2 - 30.10, C3 - 06.11, C4 - 13.11, C5 - 20.11); ADT – total amount of degrees ( $^{\circ}\text{C}$ ); BW - Clump weight (g); BH - Clump height (cm); SN - Tiller no/ clump; LN - Leaf no/clump; LPR – Main root length

After analysing Figure 6 one might conclude that certainly the number of leaves in a clump - LN will increase together with the growth of *Lolium multiflorum* L. plants (clump height -BH, number of tillers in a clump - SN and clump weight - BW, respectively) These parameters are directly correlated with the total sum of temperature degrees - ADT (in the period of our experiment) but also with plant rooting (growth of the main root - LPR); the root playing both the part of supporting the plant and the part of storing spare substances required for the growth and development of the plant.

### CONCLUSIONS

Species *Lolium multiflorum* L. is a fodder plant cultivated successfully in the west of Romania, where it finds good conditions for growth and development. Because of the droughty springs and long autumns in this region, it is advisable to sow in autumn. The variable temperatures from this period are not a limiting factor if the other factors are optimal. The research makes it possible to see that, if there is enough soil moisture, the sprouting at variety Select of *Lolium multiflorum* L., takes place in 12 days, if the average air temperature is  $15^{\circ}\text{C}$ .

Successive assessments of the main characters highlight the fact that all parameters studied of species *Lolium multiflorum* L. are on the rise, irrespective of the daily temperature variations in the vegetation periods analysed. Another finding is that these parameters are directly influenced by the average daily temperature (AT), to a larger or lesser extent. It is also worth noting that, under the conditions in Timișoara in the timeframe of the experiment, there is positive correlation between the sum of temperature (AD) and most characteristics assessed at *Lolium multiflorum* L.

The total sum of temperature degrees (ADT), recorder in Timișoara, in the period under analysis, is correlated with the development of *Lolium multiflorum* L. plants, and respectively with the increase in the main characteristics evaluated: clump height-BH, number of tillers in the clump – SN, clump weight - BW, number of leaves in a clump – LN and of course with the growth of the main root – LPR.

We can state with certainty that the temperatures recorded at Timișoara, in the period September – November 2014, helped by optimal moisture conditions, ensured the growth and development of *Lolium multiflorum* L. plants, so these can begin winter well-rooted, with the appropriate height and number of tillers to survive the harsh winter conditions.

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