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Growth Study of Three Local Populations of Graminaceous Fodder According to Bioclimatic Index of Sum Temperatures (Σθ)

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Abstract: The yearly growth study (accumulated growth elongations, the number of leaves and tillers by plant as well as the output of dry matter) of three local Graminaceous fodder, has been achieved according to bioclimatic index of sum temperatures (Σθ). The obtained results showed that during the last growth phase, the rye-grass was characterized by a higher increase of both accumulated growth elongations of the initiated leaves and of dry matter production, compared to the tall fescue which has the weakest of such characters. With regard to the broadcast of new tillers, the rye-grass comes in the second position after the tall fescue which marked the most elevated growths. It should mentioned that the accumulated growth of the studied parameters is proportional to the sum temperature index (Σθ) and follows the same evolutionary manner at the three studied species, but the differences are of quantitative order.

Key words: Growth, accumulated growth, sum temperatures, climate forages

INTRODUCTION

The rational use of grass in the exploitations of animal raising requires a good knowledge of the fodder availabilities to the different seasons. To this effect, the research of model type "climate-yield" stays one of the major preoccupations to study these problems. However, different types of models exist nowadays. The statistical models make less call to the explanation of the biologic laws of the growth, but are simple to use. They are often correlative between a production of Dry Matter (DM) and one or several climatic variables. Other multi-variance models want to explain the effect and the hierarchy of the climatic factors on the production of DM for long enough growth times[1,2]. Some calculated climatic indexes also exist every day, or week or decade to be added on intervals of variable times to give account of the different growth lengths. Thus, the Sum of Temperatures Index (STI) is used for the beginnings of vernal growth of the graminaceous and phenologic stages[3]. While the summer growths are returned to a water deficit or the heap of water consumption (Real Evapo-Transpiration (RET)[4].

The objective of the present work is to determine the growth kinetics (output components) on the one hand and on the other hand, to evaluate the potentialities of biomass production (DM) according to the sum temperatures index (Σθ), of three local graminaceous fodder; the red canary grass *Phalaris arundinacea* L, the rye-grass *Lolium multiflorum* Lamk and the tall fescue *Festuca arundinacea* Schreb.

MATERIALS AND METHODS

The test was achieved in the Fetzara station, situated at around 36°46' North latitude and 7°36' East longitude (North East Algeria). The seedling has been made during 2000/01, on a soil of balanced texture (sandy-clay-silt) with a light depth of 3.5 cm and with a seedling density of 940 plants.m^{-2}. The region is known by its Mediterranean climate Table 1, characterized by a yearly rainfall of between 600-700 mm and an average yearly temperature of 17.5°C. The experimental protocol is constituted of two different and independent experiences. The first one is made to characterize the species growth which was studied on the soil by a non destructive method, the biometric assay. However, the second experience is achieved to determine the potentialities of (DM) yield according to the number of cuts by the destructive method.

The experimental device is constituted of completely randomized three blocks. Every block contains three parcels of 16 m^2 (4×4m). Every population occupies three parcels. Every parcel consists of seven lines of four meters of length spaced of 80 cm and oriented toward the

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Table1: Climatic data of fetzara station during 2000/01

	Rainfall (mm)	T max (°C)	T min (°C)	T average (°C)
January	102.8	15.5	6.6	11.05
February	78.7	16.8	6.5	11.5
March	53.9	18.2	7.8	12.9
April	45.3	20.4	9.9	15.15
May	32.1	23.6	12.6	18.10
June	13.8	26.9	16.1	21.5
July	2.7	29.9	18.3	23.2
August	10.3	30.9	19.6	25.25
September	34.7	28.9	18.0	23.5
October	71.7	25.3	14.4	19.7
November	89.4	20.7	10.5	15.7
December	101.7	16.7	7.9	12.3
Year	637.1	22.8	12.3	17.5

R: Rainfall (mm), Tmax: Maximal temperature, Tmin: Minimal temperature Taverage: Middle temperature (°C)

West-East. The distance that separates the parcels is of two meters and the one that separates the blocks is of six meters.

For the experience 1, the sampling has been made on 60 plants by population[5]. The extreme lines are eliminated to avoid the problems of border[6]. The known quoted plants have been marked at the first stage of growth and rung with the thread of coloured wool. The measurements are achieved monthly, which means a regular cycle of 30 days and that for a period of 4 months. The last measure has been done rightly before flowering.

On the other hand, the sampling of the experience 2 consists in achieving the cuts, which have been dried, weighted and finally to estimate the global yearly output by cut. During the entire test, three cuts by species and by parcel have been done; in other words a cut every three months. To mention otherwise, that after every cut, an appendage of a nitrogen dose has been conducted for every parcel by 40 units/hectare, to facilitate the resumption.

In a first time on the soil, the elongations, the number of tillers and the number of leaves by plant have been measured to deduct the growths thereafter.

In a second time, the determination of dry matter output has been conducted while making cuts of parcels in a height of 10 cm of the soil level; their weight represents the output in Fresh Matter (FM). The plants are placed then in a steam room in 80°C during 48 h[7]. Their weight after this length represents the output in dry matter.

The sum temperature's index ($\Sigma\theta$), is calculated from the daily averages of the minima and maxima, of the monthly climatic data from the meteorological station of Annaba, added to the monthly intervals of the seedling date until the growth periods (t_1, t_2, t_3) for the four measures and also between cuts[8].

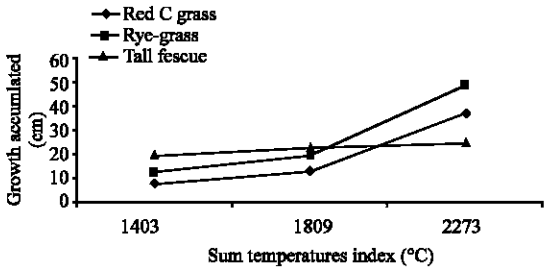

Fig. 1: Growth accumulated of elongation according to sum temperatures

RESULTS

The highest accumulated growth elongations of the first growth phase have been observed in the tall fescue compared to the red canary grass with 19.5 and 7.8 cm, respectively Fig. 1. On the other hand, it has been found that during the last growth phase, the tall fescue distinguished itself by the weakest growth values (24.8 cm), while the most important growth (48.53 cm) characterized the rye-grass. However, is it to mention that the rye-grass and the red canary grass have the same evolution manner according to the sum temperatures index.

According to the results of Fig. 2, it is noted that in the first growth stage, the rye-grass has distinguished itself by the recorded higher values compared to the weakest values of the red canary. It is also clearly that the red canary grass kept its first ranking for the tiller numbers, followed by the tall fescue and then the rye-grass.

With regard to the accumulated growths of the number of leaves according to (STI), the rye-grass recorded the highest number (15 leaves), followed by the smallest number (9 leaves) for the tall fescue and that during all growth phases Fig. 3.

Concerning the growth accumulated of the fresh matter harvested Fig. 4, it is noticed that for the 3 species, this one is proportional to the elevation of the STI. The production of F.M. at the end of the growth is 780 and 615 $Qx.ha^{-1}$ for respectively the red canary grass and the rye grass. The tall fescue occupies an intermediate place with 598 $Qx.ha^{-1}$. For the dry matter Fig. 5, it is noted the same thing, an increasing production according to the STI, with a peak of production of 180$Qx.ha^{-1}$ for the rye-grass. The tall fescue and the red canary grass nearly got an identical production (114, 5 and 113 $Qx.ha^{-1}$), respectively. It has also been noted, that most important biomass of the first to the last stage of growth has been harvested by the rye-grass followed by the tall fescue.

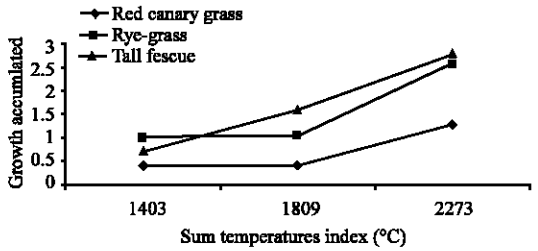

Fig. 2: Growth accumulated of the tillers number according to sum temperatures index

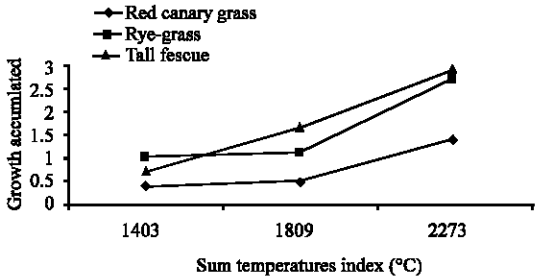

Fig. 3: Growth accumulated of the leaves according to sum temperatures

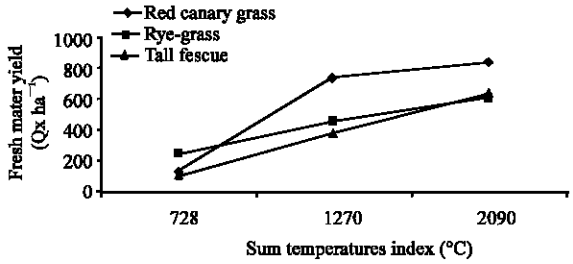

Fig. 4: Growth accumulated of fresh matter yield according to sum temperatures index

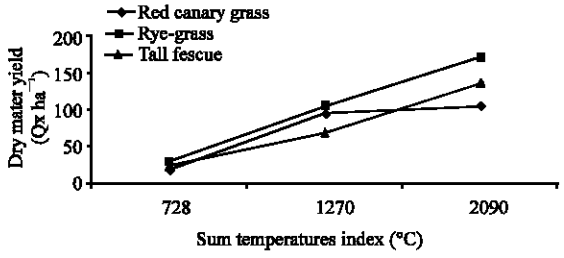

Fig. 5: Growth accumulated of dry matter according to sum temperatures

Otherwise, the calculation of the FM/DM ratio, shows that the fodders of the red canary grass and the tall fescue were rich in water, whereas that the rye-grass gave a better DM rate.

DISCUSSION

Relations between sum of the temperatures index and the growth have been put often in evidence by several authors, by controlled conditions studies and also tests into the field[9,10].

The species growth characterization according to the (STI) indicates that broadly speaking, the red canary grass and the rye-grass have a similar development manner. The curves of kinetics are identical enough for the accumulated growth elongations and tillers. With regard to the accumulated production of (DM), it is noticed that the one follows an increasing order here on the whole of the three species, with a slight reduction for the red canary grass in the last phase of growth. In a manner of conclusion, it is therefore possible to express the vegetative growth according to a simple climatic parameter; the sum of the temperatures. Many studies done on Graminaceous fodder, showed that the growth (DM) is a linear regression to the sum temperatures index since the last cut of the autumn, when the nitrogenous nutrition is not limiting[9] and also during the winter an the beginning of spring[8]. In other studies, the (STI) has been used to characterize the regrowth of several graminaceous fodder[3] and for the characteristics of reproductive development of some cultivars. It was noted that the most sensible genotypes for improvement of winter, early spring growth are those which initiate reproductive development early but do not flower correspondingly early[11].

The effect of the physiological stage appears to be determinant on the answer to the temperature for the plant elongations, the broadcast of new tillers and the rhythm of apparition of the leaves, as well as the (DM) production. Otherwise, the differences between species that have been analyzed with regard to the answer of the plant table setting or the leaves to the temperature cannot exclude the hypothesis of the botanical composition effect[12,13].

REFERENCES

1. Meriaux, S. and R. Delecolle, 1980. Hierarchy between the physical factors of the middle intervening on the rate of conversion of the solar energy by some gramineous fodder. C.R. Acad. Agric. Fr., 66: 1159-1575.
2. Montard, F.X., 1984. Integration of climatic factors in analyzing experimental results in grassland and boring plantation production ~ Hill Land Symposium Galway 9-12/10/1984. Ed. M.A. Tool, Year Drilled Taluntais Ireland, pp: 100-117.

3. Lemaire, G. and J. Salette, 1981. Consequences of the rhythm of growth of the grass on the conduct of grazing in the spring. Possibilities of forecasting. Rev. Fourrages N°85, pp: 23-27.
4. Morlon, P.F., B. Porquet, D.E. Sermage and E. Vaubernier, 1985. Meteorology and vernal growth of the permanent prairie in Lorraine. Rev. Fourrages N°101, pp: 47-83.
5. Veronesi, F. and M. Falc1nelli, 1988. Evaluation of an Italian Germoplasm Collection of *Festuca arundinacea* Schreb. Through a multi variate analysis. Euphytico, 38: 211-230.
6. Dagnelie, P., 1984. Principles of agricultural experimentation. Ed.Press.Agron Gembloux, pp: l12.
7. Cornet, M., 1984. Determination of the content in DM of fodders. Ser. Stat Ed. ITCF 05029, pp: 1-3.
8. Duru, M. and A. Langlet, 1986. Climate, rhythm of cut and growth of the tall fescue. Reproductive cycle and vegetative regrowth. Rev. Fourrages N°107, pp: 49-80.
9. Lemaire, G. and J. Salette, 1984. Study of the variability between populations genotypes of Graminaceous fodder. Rev. Agron, 4: 431-440.
10. Kemp, D.R, M.O. Humpreys and C.F. Eagles, 1989. Improvement of winter, early spring growth in temperate pasture grasses. XVI International Grassland Congress, Nice, France, pp: 375-376.
11. Peacock, J.M., 1976. Temperature and leaf growth in four grass species. J. Appl. Ecol., 13: 225-232.
12. Lemaire, G. and J. Salette, 1981. Analysis of the temperature influence on the spring growth of Graminaceous fodder. C.R. Acad. Sci. Paris, t 292, pp: 843-846.
13. Duru, M., A. Langlet and S. Rouzes, 1989. Stand characteristics of irrigated cocksfoot regrowths and leaf area increasing. XVI International Grassland Congress, Nice, France, pp: 509-510.