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Growth rates, biomass yield and forage quality of three local Poaceae in Annaba's region, North East Algeria

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Abstract. In the Algerian context, the development of durable fodder agriculture and breeding require complex strategies of which one of the elements consists in developing the use of fodder species adapted to the local biotope characteristic of Mediterranean climate. The aim of this work consisted to study and cultivates 3 Algerian varieties of Poaceae fodder, reed canary grass *Phalaris arundinacea*, rye grass *Lolium multiflorum* and tall fescue *Festuca arundinacea* in order to evaluate their agronomic performance; the growth rates and the field biomass output. The obtained results showed that the biomass production was more important for the reed canary grass in compete cycle than in incomplete cycle of vegetation, contrary to rye grass and tall fescue. Moreover, the analysis of growth kinetics showed that it is the spring growth which presented the best characteristics of the plant development and dry matter (DM) yield production. From fodder value, the reed canary grass and the tall fescue are well provided in Total Nitrogen Matter (TNM) and relatively low in Fodder Units (FU). Contrary, the rye grass is rich in energy compounds (EU) but contains low protein content.

Keywords. Poaceae – Fodder-growth – Kinetics-biomass – Yield-fodder value.

Le taux de croissance, le rendement en biomasse et la qualité fourragère de trois Poaceae locales dans la région de Annaba, Nord-Est algérien

Résumé. *Dans le contexte algérien, le développement d'une 'agriculture fourragère et d'un l'élevage durables exigent des stratégies complexes dont l'un des éléments consiste à développer l'utilisation d'espèces végétales adaptées aux biotopes locaux à climat Méditerranéen. Le but de ce travail a consisté à étudier et cultiver 3 variétés algériennes de Poaceae fourragères, l'alpiste Phalaris arundinacea, le ray-grass Lolium multiflorum et la fétuque élevée Festuca arundinacea, afin d'évaluer leurs performances agronomiques, les rythmes de croissance et le rendement de la biomasse aérienne.. Les résultats obtenus ont montré que la production de biomasse a été plus importante chez l'alpiste en en cycle complet qu'en cycle incomplet de végétation, contrairement au ray-grass et à la fétuque élevée. Par ailleurs, l'analyse de la cinétique de croissance a montré que c'est la croissance printanière qui a présenté les meilleures caractéristiques du développement des plantes et la production de matière sèche (MS)). Concernant la valeur fourragère, l'alpiste et le fétuque élevée sont bien pourvues en matière azotée totale (MAT)) et relativement faible en unités fourragères (UF). Contrairement, le ray-grass est riche en composés énergétiques (UF)), mais contient une faible teneur en protéines.*

Mots-clés. *Poaceae – Fourragères – Croissance cinétique-biomasse – Rendement-valeur fourragère.*

I – Introduction

In Algeria, the fodder forage deficit is still pronounced and chronic, as feeding of livestock is mainly based on grazing and natural fodder resources (Adem and Ferrah, 2001). Indeed, studies of prospecting collection and evaluation were interested in these local forage species that are already adapted to our climate and local environment (Boudelaa, 1992; Abdelguerfi and Laouar, 2001).The aim of this work is to evaluate the potential production of DM biomass of three species (*Lolium multiflorum* Lamk, *Festuca arundinacea* Schreb and *Phalaris arundinacea* L). The objective was to determine i) the growth rates of DM in these species based on local climatic conditions, ii) the potential production of DM over several years in complete and incomplete cycle of vegetation and iii) the nutritive value of forage species.

II – Materials and methods

Trial was performed at the Fetzara station, situated at around 36°46'North latitude and 7°36'East longitude (North East Algeria). The study was carried out from September 2007 to June 2011 in four years. The experiment was set up on a balanced soil texture (sandy clay loam) with a seedling density of 940 plants/m^2. The soil chemical characteristics were pH: 7, N: 0.10% (relatively poor), P_2O_5: 20 ppm (poor in P), K_2O: 30 ppm (poor in K), organic matter (OM): 2.5% (medley relatively rich). The experiment was arranged in completely randomized block design with three replication. Parcel dimension was 4 m by 4m with seven lines and 80 cm row spacing. The climate is Mediterranean, characterized by an annual rainfall between 600 and 700 mm and an average yearly temperature of 17.5°C. Two experiments were conducted, one in an annual cycle of growth from seedlings (October), until the final harvest in (June) and the other in cutting cycle by making three cuts per year (i.e. incomplete cycle of vegetation). The yields of fresh material (FM), dry matter (DM) were calculated by cuts of plots. Parcel weight was geren matter yield. The plants sampled were then placed in an oven at 80° C for 48 hours; their weight after this period was dry matter yield, DM yield, (Cornet, 1984). Specific leaf weight was determined from the ratio dry weight / leaf area of a subsample of 20 leaves per species (Araus *et al*., 1998). for forage analysis, the total nitrogen content is determined by the method of Kjeldahl nitrogen digestible matter are determined by the formula of Demarquilly. For energetic value, the approach is to estimate digestibility of organic matter (OM) and then to calculate according to Leroy formula. Les FUMi and FUMe are calculated sequentially from the estimated gross energy (EB), the digestible energy (DE) and metabolizable energy (ME) and net energy (NE) (Andrieu *et al*., 1988).

III – Results and discussion

1. Biomass production, DM yield

Dry matter yields varied s among the species studied. In annual cycle of vegetation, it is the canary grass that produced the largest production (223 q.ha^{-1}). Ryegrass and tall fescue performed almost similarly 164 and 154 quintals per hectare respectively (Table 1). In Incomplete cycle of vegetation, i.e. operating section and three sections produced during the four years from 2007 to 2011 (Table1), red canary grass gave the highest production (327.5 qx.ha^{-1}), followed by ryegrass (305 q.ha^{-1}). Fescue produced a low yield equal to nearly half of the two before mentioned species with a value of 164 quintals per hectare. However, the DM production of the year 2009/2011 by cutting (Table 2) showed that this was the second cut that produced the most DM for ryegrass and canary grass and subsequently decreased in the third cut. The other species, fescue had a constant production of DM and a marked increase from the first to the last cut with a highest peak of 70 quintals per hectare. The results of DM showed that the canary grass produced more biomass in the annual cycle than the incomplete cycle of vegetation, in contrast to ryegrass and tall fescue. The dry matter accumulation of plant cover or species can be represented as a function of absorbed radiation useful for photosynthesis (Eckardt *et al*., 1977). Indeed, this incident radiation absorbed varies from one species to another and at the vegetation itself. It also depends, leaf area index and the angle of insertion of the leaves and also the structure of the foliage, which is very different in species of the architectural and optical point of view (Gosse *et al*., 1986). In incomplete cycle of cutting operation of plant, we note that is the second cut, which gave a high yield in the red canary grass and ryegrass. This cut was made in the period were climatic conditions are again favorable (good rainfall and adequate temperatures). It is the spring growth (Ollerenshaw *et al*., 1982; Kemp, 1988; Kemp 1989; Duru *et al*., 1995; Kyle 2006). The drop in biomass in the third cut is explained by Gillet (1980) by "cutting effect", depletion of root reserves in response to repeated cuts made or overexploitation.

Table 1. Dry matter yields of species over four years (q.ha^{-1})

Species	DM in complete cycle Value ± SD	DM in incomplete cycle Value ± SD
Ryegrass	164 ± 46.3	305 ± 100.8
Tall fescue	154 ± 57.3	164 ± 15.7
Canary grass	223 ± 24	327.5 ± 100.6

SD: Standard deviation.

Table 2. Dry matter yields of species according to cuttings in incomplete cycle of vegetation during the 2009/2010 year in (q.ha^{-1})

Species	1th cut	2nd cut	3th cut	Total yield Mean value ± SD
Rye-grass	100	150	70	320 ± 33
Tall fescue	24	50	70	144 ± 18.83
Canary grass	27	80	13	120 ± 28.85

SD: Standard deviation.

2. The fodder value of forage

The analysis of the feed value was made at the heading stage of the complete cycle of vegetation. The results showed that ryegrass was more energy-rich compounds (FU 0.94, 0.81 and 0.77 FUMi, and FUMe) (Table 3). Reports TNM/FU and L/S respectively 54.8 and 0.22 are relatively small compared to the other two species. In contrast, tall fescue and reed canary grass are poor in crude FU but filled with respective values of 73 and 39.5 g.kg^{-1} of DM and an L/S is 0.4 and 0.3 in the fescue in the canary. Moreover, the best leaf specific weight (LSW) is observed in ryegrass with an average weight of 0.52 g.cm^{2}.Tall fescue introduced through a LSW. By cons, the LSW the lowest was recorded in the canary with 0.3 g.cm$^{.2}$.From fodder value point of view, the red canary grass and tall fescue are well provided in Total Nitrogen Matter (TNM) and relatively low in Fodder Units (FU). Contrary, the ryegrass is rich in energy compounds, but contains low protein content report by the ratio TNM/FU and L/S, which are indices of forage quality.

Table 3. Forage quality parameters of species

	Ryegrass	Tall fescue	Red canary grass
FU in (g.kg^{-1}of DM)	0.94 ± 0.02	0.7 ± 0.08	0.55 ± 0.1
FU milk	0.81 ± 0.02	0.68 ± 0.07	0.52 ± 0.07
FU meat	0.77 ± 0.02	0.65 ± 0.04	0.07
TNM in (g.kg^{-1} of DM)	51.5 ± 7.5	73 ± 12	39.5 ± 2.5
Ratio TNM/FU	54.8	110.6	71.8
LSW in (g.cm^{-2})	0.5 ± 0.01	0.4 ± 0.01	0.3 ± 0.15
Ratio L/S	0.2	0.4	0.3

IV – Conclusion

These studied species, appear to have interesting characteristics in biomass production. In optimum conditions and proper, they can increase forage production and there by improve the livestock feed, but, they can never by themselves solve the problem of feeding in Algeria.

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