Effects of plant development phases on some morphological, agronomical and chemical traits of Bituminaria bituminosa genotypes

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Effects of plant development phases on some morphological, agronomical and chemical traits of *Bituminaria bituminosa* genotypes

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Abstract. This study was conducted with 25 *Bitbit* genotypes collected from Central Black Sea Region of Turkey in order to determine the effects of plant development phases on some morphological, agronomical and chemical traits of *Bituminaria bituminosa* genotypes. The highest plant height and hay yield values were determined at the seed setting development stage as 118.7 cm and 205 g/plant, respectively. A sharp decrease in leaf ratio was observed from elongation stage (78.5%) to blooming stage (30.8%). Crude protein content also linearly decreased from 23.41% (pre-elongation stage) to 7.28 % (seed setting stage). ADF and NDF proportions were measured as 19.80 and 27.37%, respectively, at the pre-elongation stage. RFV values decreased from 249.7 to 86.0 through the following growth stages. Except calcium and magnesium, mineral contents of *Bitbit* genotypes decreased at each following stage. Considering K, Ca and Mg relations, no possible problem on K/(Ca+Mg) rates, but Ca/P rates over than recommended level of 2 at all stages. In consideration to all aspects, *Bitbit* plants should be harvested at the beginning of blooming stage to obtain ideal hay yield.

Keywords. *Bituminaria bituminosa* – Nutrients – Agronomic traits – Quality.

***Effet des phases de développement végétal sur certains caractères morphologiques, agronomiques et chimiques des génotypes de* Bituminaria bituminosa**

Résumé. *Cette étude a été menée sur 25 génotypes Bitbit collectés dans la région centrale de la mer Noire en Turquie pour déterminer l'intervalle de variation de: hauteur de la plante, rendement en foin, protéine brute, ADF, NDF et certains composants minéraux et valeurs alimentaires relatives (RFV) aux stades pré-élongation, élongation, bourgeonnement, floraison et formation de graines en 2014; ce sont les paramètres étudiés. Les plus fortes valeurs de hauteur des plantes et de rendement en foin, déterminées au stade formation des graines, sont de 118,7 cm et 205 g/plante, respectivement. Une baisse très nette du ratio foliaire fut observée du stade élongation (78,5%) au stade floraison (30,8%). La teneur en protéines brutes diminue linéairement, de 23,41% (au stade pré-élongation) à 7,28 % (au stade formation de graines). Les proportions d'ADF et NDF mesurées au stade pré-élongation sont de 19,80 et 27,37%, respectivement. Ces deux valeurs augmentent continuellement en parallèle aux phases de croissance et atteignent 47,17 et 56,38% au stade formation de graines. Les valeurs de RFV diminuent au cours des stades de croissance en passant de 249,7 à 86,0. Excepté pour le calcium et le magnésium, les teneurs en minéraux des génotypes Bitbit diminuent avec les stades de croissance successifs. Vues les relations de K, Ca et Mg, pas de problème possible pour les taux de K/(Ca+Mg), mais les taux de Ca/P dépassent le niveau recommandé de 2 à tous les stades. En tenant compte de ces résultats, les plantes de Bitbit doivent être récoltées au début du stade floraison pour obtenir un rendement idéal en foin.*

Mots-clés. *Bituminaria bituminosa – Nutriments – Caractères agronomiques – Qualité.*

I – Introduction

Bituminaria bituminosa is a perennial herbaceous species in *Bituminaria* genus. Its origin is Mediterranean environment and distributed to all Mediterranean basin (Davis, 1970). In the last decade *Bitbit*s ability to stay green in dry summer conditions has attracted attention from the scientific community (Acar *et al*., 2001; Ventura *et al*., 2004). In northern parts of Turkey, *Bitbit* plants keep their greenery all over the year and livestock graze on the pastures of this plant

(Kumbasar, 2015). Nutritive values and chemical composition of forage crops are alterable when environment and harvesting stages change (Tan and Serin, 1996). Chemical composition, agronomic traits and quality properties of *Bitbit*'s hay could change at different development stages and at different parts of plants (Ventura *et al*., 2004). Nutrient contents and RFV values considerably change in the leaves and stems of *Bitbit* plants (Gulumser *et al*., 2010).

In the scope of this study, morphological, agronomical traits and nutrient contents of *Bitbit* genotypes collected from Central Black Sea region of Turkey were determined at pre-elongation, elongation, budding, blooming and seed setting development phases in order to determine the effects of plant development phases on those traits of *Bitbit* genotypes.

II – Materials and methods

Seed samples of *Bitbit* genotypes were collected from Middle Black Sea Region in 2012. Measurements and observations were realised at pre-elongation, elongation, budding, blooming and seed setting stages of 25 genotypes in the second year of the plants (2014). Morphological and agronomic traits were determined on samples of 10 plants for each genotype. The samples were analysed by using Near Infrared Reflectance Spectroscopy (NIRS Foss 6500) device with IC-0904FE package program with 3 replicates. All data obtained from this study was analysed by using SPSS 17.0 program. The differences amongst the mean values were calculated according to DUNCAN test.

III – Results and discussion

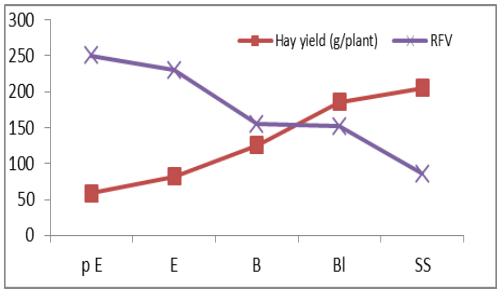
Table 1. Mean values about morphological, agronomic and some chemical properties of Bitbit genotypes*

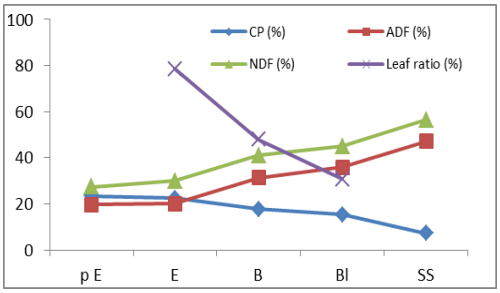
Traits/Harvest stages	Pre-longation	Elongation	Budding	Blooming	Seed setting
Plant height (cm)	26.3 d	36.5 c	79.2 b	116.4 a	118.7 a
Hay yield (g/plant)	58.4 c	81.6 c	125.3 b	185.6 a	205.0 a
Leaf ratio (%)	-	78.5 a	48.0 b	30.8 c	-
Crude protein (%)	23.41 a	22.55 b	17.70 c	15.29 d	7.28 e
ADF (%)	19.80 d	20.16 c	31.46 b	35.84 b	47.14 a
NDF (%)	27.37 e	29.90 d	41.05 c	44.90 b	56.38 a
RFV (%)	249.7 a	229.5 b	154.8 c	151.5 d	86.0 e
Ca (%)	1.87 a	1.61 b	1.35 d	1.30 e	1.41 c
K (%)	2.33 c	2.55 b	2.59 a	2.01 d	0.51 e
Mg (%)	0.40 a	0.39 a	0.37 b	0.35 c	0.37 b
P (%)	0.39 a	0.40 a	0.39 a	0.33 b	0.18 c
Ca/P	4.78 b	4.15 c	3.42 e	3.74 d	7.98 a
K/(Ca+Mg)	1.03 d	1.27 c	1.58 a	1.30 b	0.29 e

There are no differences amongst the mean values indicated the same letter at the same line at 0.05 probability level.

Mean values about some morphological, agronomic and chemical traits obtained from 25 *Bitbit* genotypes are shown on Table 1. The increase of plant height almost stopped at the blooming stage, while dry matter accumulation reached to maximum level at seed setting stage. The highest plant height and hay yield values were determined at the blooming and seed setting development stages (Table 1 and Fig. 1). In the region, *Bitbit* plants keep their greenery throughout summer period, thus they continue their growing more or less (Acar *et al*., 2001; Gulumser *et al*., 2010).

Leaf ratios of *Bitbit* genotypes decreased continuously through the each following stage. A sharp decrease in leaf ratio was observed from elongation stage (78.5%) to blooming stage (30.8%). Similar to leaf ratio, crude protein content also decreased linearly from 23.41% at pre-elongation stage) to 7.28% seed setting stage. Due to the increase of stem and branch ratio at last development stages (Gulumser *et al*., 2010), leaf and crude protein rates were declined (Table 1, Fig. 2).



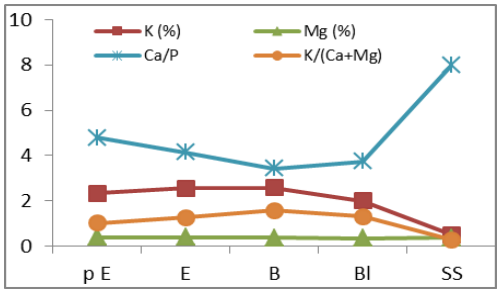


(pE-pre-elongation, E-Elongation, B-Budding, Bl-blooming, SS-Seed setting)

Fig. 1. Hay yield and RFV of *Bitbit* genotypes at different development phases.

Fig. 2. Crude protein, leaf ratio, ADF and NDF rates of *Bitbit* genotypes at different development phases.

ADF and NDF proportions were measured as 19.80 and 27.37%, respectively, at the pre-elongation stage. These two values increased continuously in parallel to growth phases and they reached 47.17 and 56.38% at seed setting stage (Table1 and Fig. 2). As a consequence of increasing stem ratio at each following stage (Ventura *et al*., 2004; Gulumser *et al.,* 2010) ADF and NDF values were decreased. The most important factors affecting RFV values are ADF and NDF proportions of feed. Contrary of ADF and NDF, RFV values decreased as plants growing stages increased (Table 1 and Fig. 1). Regarding all values of CP, ADF, NDF and RFV, hay quality of *Bitbit* genotypes were considered as prime or premium (NRC, 2001) from pre-elongation to blooming stages. However, after blooming stage, hay quality was dramatically decreased.



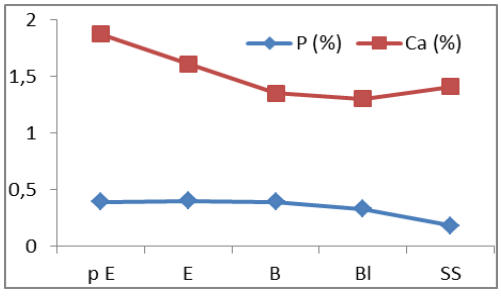


Fig. 3. K and Mg rates; Ca/P and K/(Ca+Mg) of Bitbit genotypes at different development phases.

Fig. 4. P and Ca rates of Bitbit genotypes at different development phases.

Calcium content of *Bitbit* genotypes sequentially decreased till blooming stage and then it slightly increased. On the other hand, phosphorus content stayed stable up to budding phase and then it started to decrease. While there was a little change on magnesium content of *Bitbit,* potassium content were almost at the same level from beginning to budding stage, however it

sharply decreased after budding stage. K/(Ca+Mg) values followed a similar path to potassium content. Ca/P rates started to decrease from beginning to budding phase then it increased. The increasing between blooming and seed setting phases was very sharp depending on Ca and P contents (Table 1, Fig. 3 and 4). Calcium, phosphorus, magnesium and potassium contents of hay samples were over the recommended values for livestock (NRC, 2001; Tekeli and Ates, 2005). K/(Ca+Mg) values did not exceed the value of 2.2 at the all stages; thus it cannot cause tetany problem (Jefferson *et al*., 2001). Ca/P rate should be between the values of 1 and 2 (Miller and Reetz, 1995). If this ratio is over 2.0, milk fever could possibly observed in livestock (Acikgoz, 2001). Ca/P rates of *Bitbit* hay samples were over 2 at the all stages.

IV – Conclusions

There were significant changes on morphological, agronomical and chemical traits of *Bitbit* genotypes according to growth stages. While hay yield, plant height, ADF and NDF values increased, crude protein, leaf ratio, and RFV values decreased at subsequent stages. Except calcium and magnesium, mineral contents of *Bitbit* genotypes decreased at each following stage. In consideration to all aspects, *Bitbit* plants should be harvested at the beginning of blooming stage to obtain ideal hay yield.

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References

Acar Z., Ayan İ. and Gülser C., 2001. Some morphological and nutritional properties of legumes under natural conditions. In: *Pakistan Journal of Biological Sciences* 4 (11), 1312-1315.

Acıkgoz E., 2001. *Forages*. Uludag University, Faculty of Agriculture, Department of Field Crops, Bursa-Turkey.

Davis P.H., 1970. *Flora of Turkey and the East Aegean Islands*. Vol. 3. Edinburgh.

Gulumser E., Basaran U., Acar Z., Ayan I. and Mut H., 2010. Determination of some agronomic traits of *Bituminaria bituminosa* accessions collected from Middle Black Sea Region. In: *Options Mediterraneennes* 92, p. 105-108.

Jefferson P.G., Mayland H.F., Asay K.H. and Berdahl J.D., 2001. Variation in mineral concentration and grass tetany potential among Russian wild rye accessions. In: *Crop Sci*. 41, p. 543-548.

Kumbasar F., 2015. *Determination of yield and quality properties according to growing phases of Bitbit genotypes*. Ms Thesis, 93 p., OMU, Samsun, Turkey.

Miller D.A. and Reetz-Jr H.F., 1995. Forage fertilization. In: Forages Vol. I: *An Introductioın to Grassland Agriculture*. (Eds.): R.F. Barnes, D.A. Miller and C.J. Nelson. Iowa State Univ. Press, Ames, Iowa, p. 79-91.

NRC, 2001. *Nutrient Requirements of Dairy Cattle*. 7th edn. NAS-NRC, Washington.

Tan M. and Serin Y., 1996. Değişik fiğ+tahıl karışımları için uygun karışım oranı ve biçim zamanının belirlenmesi üzerine bir araştırma. Atatürk Üniv. In: *Zir. Fak. Der.* 27 (4), p. 475-489.

Tekeli A.S. and Ates E., 2005. Yield potential and mineral composition of White clover (Trifolium repens L.)-tall fescue (*Festuca arundinacea* Schreb.) mixtures. In: *J. Cent. Eur. Agric*. 6, p. 27-34.

Ventura M.R., Castanon J.I.R., Pieltain M.C. and Flores M.P., 2004. Nutritive value of forage shrubs: *Bituminaria bituminosa*, *Rumex lunaria*, *Acacia salicina*, *Cassia sturtii* and *Adenocarpus foliosus*. In: *Small Ruminant Res*earch 52, p. 13-18.