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Agronomic assessment of a genotypes collection of *Melilotus officinalis*

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Abstract. This study is aimed to evaluate the agronomic performance of twenty ecotypes of yellow sweet clover which were collected from the North-West of Morocco and were cultivated in the experimental station of Boukhalef (Tangier). The samplings were realized during the vegetative, budding and flowering stages. The results showed that yellow sweet clover have a high production of dry matter. The dry matter yield (DMY), the leaves on steam report (LSR) and the stem's diameter (SD) depends significantly of the maturation stage and the origin of ecotypes. From the vegetative to the flowering stage, the DMY increased significantly from 6.54 to 10.59 t/ha (P<0.001), from 61.96 cm to 142.36 cm for plant height (P<0.001) and SD from 6.5 to 7.74 mm (P<0.001), while the LSR decreased significantly from 0.82 to 0.61 (P<0.001). Between the ecotypes, DMY, LSR and SD varied significantly from 14.81 t/ha (E34) to 4 t/ha (E3) (P<0.01), 1.18 (E3) and 0.6 (E1 and 9) (P<0.001), from 8.91 (E23) to 6.21 mm (E13) (P<0.01) respectively. The highest values of number of ramifications and foliar area were obtained in the flowering stage with 21.50 and 24.05 mm^2, respectively. The agronomic evaluation showed that the yellow sweet clover presents a sure interest as forage species for animals feeding.

Keywords. Yellow sweetclover – Ecotype – Harvest stage – Dry matter production.

Evaluation morphologique et agronomique d'une collection d'écotypes de mélilot jaune du nord ouest du Maroc

Résumé. *Vingt écotypes de mélilot* (Melilotus officinalis) *des pâturages du Nord-Ouest du Maroc ont été cultivés dans la station expérimentale de l'INRA. L'échantillonnage a été réalisé, au stade végétatif, bourgeonnement et floraison, afin de réaliser la caractérisation agronomique. Le résultat montre que* Melilotus officinalis *est caractérisé par une production en matière sèche importante. Le rendement en matière sèche, le rapport feuille sur tige et le diamètre de la tige varie significativement avec le stade de maturation et aussi en fonction de l'origine de l'écotype. En effet, en allant du stade végétatif à la floraison, le rendement en matière sèche augmente de 6,54 T/ha à 10,59 T/ha, de 61,96cm à 142,36cm pour la hauteur, 6,5 à 7,74mm pour le diamètre de la tige. En revanche, le rapport feuilles/tige RFT diminue de 0,82 à 0,61. Selon les écotypes, le rendement en matière sèche, le RFT et le diamètre de la tige varie significativement de 14,81 T/ha à 4 T/ha, de 1,18 à 0,6 et de 8,91mm à 6,21 mm respectivement. Les valeurs maximales de nombre de ramification et de l'espace foliaire sont obtenues à la floraison avec 21,50 et 24,05mm^2 respectivement. Melilotus officinalis se prête bien au pâturage et présente un intérêt certain dans l'alimentation animale.*

Mots-clés. *Mélilot – Ecotype – Stade de coupe – Rendement en matière sèche.*

I – Introduction

Melilotus officinalis, commonly called yellow sweet clover is an annual or bi-annual herbaceous leguminous plant (Fabaceae). It develops spontaneously in the natural pastures of North Morocco. It presents an interest as fodder, medicinal and aromatic plant and is cultivated elsewhere for the pasture and forage. The yellow sweet clover is a fodder with a good nutritional, offering a large amount of proteins and minerals. Plant height ranges from 1.2 to 1.5 m for the annual plants (Go-

plen et *al.*, 1984). This species shows a good adaptation to the environmental conditions of the North Western Morocco. It can constitute, in fact, a resource of great nutritive interest comparable with Persian and Egyptian clovers (Lahkim Bennani *et al.*, in this volume). The yellow sweet clover improves soils because of its much-ramified roots, which penetrate perfectly in the ground and absorb the non-assimilable nutritive substances by the radicular surface. These roots are also characterized by their fast decomposition that allows a better permeability of the ground. It is also characterized by its action supporting the increase in the content of organic matter and nitrogen of the soil (Goplen *et al.*, 1984). Considering the use of nutritive elements, *M. officinalis* is a very competitive species, (Jacob *et al.*, 2014). To preserve the genetic potential which is exposed to a strong erosion, in 2017, a prospection and collection program of local yellow sweet clover started in North Western Morocco (Tangier), aimed to create of a collection of ecotypes (Ayadi et *al.*, 2017). A field experiment was carried out with the objective to evaluate some morphological traits and the potential forage production, in order to select the most promising ecotypes.

II – Materials and methods

The seeds of 20 ecotypes of *M. officinalis* collected in 2017 from various ecological areas of North Western Morocco were sown in the Experimental Field of Boukhalef on 13th November 2017. Each ecotype was established on a plot of 10x2 m with 1m separation from each other. The plot was subdivided in 5 lines; each line is a replication, with a line space of 40 cm. Each line was sown with an amount of 10 g corresponding to a seed dose of 25 kg/ha. See Lahkim Bennani *et al*. (in this volume) for more information on climate and soil.

The plants were taken from each line at the vegetative (March 12, 2018), at the budding (March 26, 2018) and at the flowering stages (April 18, 2018). The aim was to measure: plant height, dry matter yield (DMY), leaves/steam ratio (LSR), the stem diameter (SD), number of stems and foliar area.

III – Results and discussion

The results obtained show that the origin of genotypes affects considerably the LSR ($P<0.001$). This ratio varies from 0.6 recorded for E1, E9 and E17 to 1.18 recorded for the E3 ecotype (Table 1). This last ecotype showed an important potential biomass's foliar production compared to the stem (approximately 20%). E3 ecotype stands significantly out from the rest of the collection by a thin diameter of stem (6.30 mm). Overall, it is shown that yellow sweet clover plant is characterized by a more massive stem compared to the leaf. Indeed, the majority of the ecotypes (80%) have a LSR which varies between 0.66 and 0.80 (Table 1). Luo *et al*., (2016) reported a superior LSR with 0.96 and a larger stem with 1.69cm.

In term of dry matter's yield, the totality of the ecotypes showed an important production potential varying from 4 to 14.81 DMY/ha ($P<0.05$). The highest DMY was recorded by E34, E2a, E22 and E21 with respectively 14.81; 13.50; 13.49 and 11.93 t/ha. These ecotypes showed more interesting results in terms of production's potentiality, but are characterized by an important LSR (0.70 on average) and a less thin stems (on average 7.05 mm). To keep the hay's production successful, the seedling dose should be studied to improve these parameters.

When the plants were at the vegetative stage, no significant difference concerning the height of the plant was noticed between the ecotypes. However, it is noted that at this early stage, 50% of the ecotypes reached a height exceeding 100 cm (Table 1). At the flowering stage, the plant reaches 142 cm height. Similar results were reported by Goplen *et al.,*(1984).

Table 1. Agronomic and morphological measurements of collection of yellow sweet clover ecotypes (average of stages ± standard error)

Ecotype	DMY (t/ha)	Plant height (cm)	LSR	Stem diameter (mm)	Stems (no.)	Foliar area (mm^2)
E1	6.14±0.26	93.98±10.13	0.60±0.03	6.44±0.35	15.22±4.49	21.92±4.45
E2a	13.50±1.29	104.28±12.89	0.68±0.04	7.08±0.58	20.33±4.53	24.41±5.09
E2	6.78±0.62	107.98±11.28	0.71±0.08	8.03±0.41	15.33±3.28	26.94±8.93
E3	4.00±0.17	80.47±9.12	1.18±0.09	6.30±0.39	14.78±4.87	21.14±2.77
E34	14.81±0.53	103.57±7.74	0.67±0.06	7.28±0.63	20.67±4.47	22.68±8.89
E9	5.14±0.21	93.85±7.81	0.60±0.05	6.21±0.34	15.56±1.81	22.71±5.37
E10	7.81±0.66	96.12±12.58	0.74±0.07	7.16±0.36	17.11±6.31	25.27±6.59
E11	5.71±0.42	105.55±14.47	0.73±0.06	7.37±0.39	16.67±3.94	28.20±6.64
E12	7.48±0.33	101.88±11.12	0.68±0.06	6.80±0.42	16.56±3.43	27.37±6.07
E13	4.10±0.73	92.68±13.58	0.69±0.06	6.27±0.49	15.63±4.14	22.93±6.07
E14	6.01±0.32	78.3±11.16	0.80±0.05	7.06±0.26	15.00±2.92	24.41±6.64
E15	5.84±0.53	104.25±10.89	0.66±0.03	6.69±0.34	15.56±3.24	24.93±7.11
E16	9.35±0.58	99.58±13.25	0.68±0.04	7.31±0.33	15.00±3.32	27.02±5.95
E17	10.30±0.54	104.69±12.94	0.60±0.02	6.38±0.27	16.75±4.03	23.99±5.38
E18	10.91±0.45	106.7±13.00	0.71±0.02	7.21±0.35	18.89±5.37	23.17±4.96
E19	7.34±0.59	96.98±12.72	0.75±0.05	7.06±0.33	17.11±3.66	21.98±4.36
E20	9.35±0.62	98.73±15.22	0.71±0.08	6.66±0.56	18.00±5.36	21.23±5.63
E21	11.93±0.76	112.25±14.81	0.67±0.03	7.11±0.46	19.00±4.90	24.82±4.97
E22	13.49±0.72	106.45±10.88	0.78±0.09	6.73±0.36	19.11±4.62	21.47±4.34
E23	10.58±0.46	98.85±13.05	0.68±0.06	8.91±0.33	18.00±3.39	24.52±5.73
Moy.	8.53±1.84	99.36±35.36	0.71±0.20	7±1.32	17.71±4.10	24.06±5.80
Pro.	0.0046	0.9581	<0.0001	0.0014	0.1929	0.3262
Sig.	*	**N.S**	***	**	**NS**	**NS**

The growth of the plant affects very significantly all the studied parameters. All of those parameters increase with the vegetative stage (Table 2). At the flowering stage, *Melilotus officinalis* reaches, on average, a production in biomass of 10.59 TDM/ha, a LSR fairly high and a thin stem (7.7 mm). This yield is higher than that obtained by Hadj Omar *et al*. (2018) for the alfalfa at the stage of flowering. These results make *M. officinalis* a good fodder plant. However, more work should be undertaken in order to improve these characteristics, in particular a finer stem and a higher foliar biomass.

Table 2. Agronomic and morphological measurements of yellow sweet clover by stage of growth

Stage	DMY (t/ha)	Plant height (cm)	LSR	Stem diameter (mm)	Stems (no.)	Foliar area (mm^2)
Vegetative	06.44±0.13	61.96±1.42	0.82±0.02	6.5±0.19	14.54±3.24	22.72±4.61
Budding	08.57±0.1	93.75±1.57	0.72±0.02	6.78±0.16	17.08±2.74	23.55±5.24
Flowering	10.59±0.23	142.36±1.77	0.61±0.02	7.74±0.1	21.50±3.68	25.89±7.46
Average	8.53±1.84	99.35±35.36	0.71±0.2	7±1.32	17.71±3.22	24.05±5.77
Pro.	<0.001	<0.001	<0.001	<0.001	<0.001	0.0104
Sign.	***	***	***	***	***	*

IV – Conclusions

According to these results, it is shown that the yellow sweet clover could be a plant with strong potential of fodder production with a maximum production of 14.81 DMY/ha. Among the studied collection, a group of 4 ecotypes (E34, E2a, E22 and E21) reached on average a very high yield (13.43 DMY/ha). The majority of the ecotypes carried out a variable yield between 6.01 and 10.91 DMY/ha. Considering its height varying between 0.6 and 1 m at the vegetative stage, and its foliar mass which is moderately high, it has a huge interest for animal feeding.

In spite of its poor yield, E3 ecotype stands out by an important foliar area and a moderate stem diameter. These specificities confer to this ecotype, the ability of being utilized for obtaining a good quality hay.

However, these observations need to be improved and the results should be considered as preliminary in view of extend the collection of data for 2-3 years.

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