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Chamaecytisus palmensis (Christ) Hutch. cultivated in Sardinia with different planting density

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Abstract. A population of *Chamaecytisus palmensis* (Christ) Hutch. was evaluated for its homogeneity and forage production. 300 cuttings were planted in September 2013 in 3 m spaced rows, at a row distance of 0.5 m and 1 m, with a resulting density of 6600 and 3300 plants per hectare. In the first year the trial was irrigated until March, 2014 owing to winter drought. The plant development was rather slow: planting was very water exigent and in 2015 suffered from winter cold. First utilization was possible in February 2015 and other four samplings were made until September 15, 2016, attaining an overall yields of 1 t ha^{-1}, with a better production in the highest plant density thesis. Regarding biological cycle and morphological traits, the *Chamaecytisus* population showed a large variability.

Keywords. Mediterranean habitat – Forage production.

Chamaecytisus palmensis *cultivé en Sardaigne avec différentes densités de plantation*

Résumé. *Une population de* Chamaecytisus palmensis *(Christ) Hutch. a été évaluée selon son homogénéité et son production fourragère. En septembre 2013, 300 boutures ont été plantées en rangées espacées de 3 m, les rangées espacées de 0.5 m et 1 m, avec une densité totale de 6600 et 3300 plants par hectare. Les conditions météorologiques de sécheresse de la première année ont obligé à irriguer jusqu'en mars 2014. Le développement a été plutôt lent: les plantations ont été très exigeantes en eau et ont souffert du froid hivernal en 2015. La première utilisation a été possible en février 2015 et quatre échantillonnages additionnels ont été effectués jusqu'au 15 septembre 2016, atteignant des rendements globaux de 1 t ha^{-1}, avec une meilleure production dans la thèse ayant la densité de plantes la plus élevée. La population de* Chamaecytisus *a montré une grande variabilité dans le cycle biologique et dans les traits morphologiques.*

Mots-clés. *Habitat méditerranéen – Production fourragère.*

I – Introduction

Mediterranean regions are characterized by dry-hot weather conditions in summer, resulting in lacking natural pastures and forage crops during this season. Therefore, evergreen shrubs could reduce this productive gap.

Chamaecytisus palmensis (Christ) Hutch., formerly known as tree lucerne or tagasaste, is a fast-growing, perennial, evergreen, leguminous shrub 5-6 m tall at maturity. Native from the Canary Islands, it grows well in a wide precipitation range of 350-1600 mm (Frame *et al*., 1998). It is adapted to sandy well drained soils in the pH range 5-7 and is very susceptible to root rot fungus on poorly drained soils (Gutteridge, 1990). It is susceptible to frost damages, particularly at early stages, thereby jeopardizing its potential widespread utility in the drought-prone areas (Sheppard and Bulloch, 1986). It successfully adapted to the natural conditions and is currently utilized as supplementary forage for sheep and cattle, particularly in summer and early autumn, in: (i) several temperate countries (*e.g.* New Zealand); (ii) in Mediterranean climate regions (*e.g.* Western Australia); (iii) in long, hot and dry summer regions (*e.g.* Ethiopia) (Frame *et al.*, 1998).

It is generally well branched and characterized by grey bark, hairy-velvety trifoliate leaves, fragrant whitish-coloured flowers gathered in small clusters and green flat pods that darken to maturity along with seeds.

After transplanting, the young cuttings can be grazed by livestock. Thus, they should be protected for the first years to allow a proper development. During this period, inter-row areas could be cropped for grain or hay in an alley cropping system, which could continue even after shrubs maturity (Snook,1982).

The feeding value is similar to other conserved forages but lower than intensively managed temperate pastures (Borens and Poppi,1990).

There is a considerable genetic variation within and between populations for a range of morphological and physiological traits including: production, growth habit, frost and disease tolerance. Hence, different selection programs are carried out for each trait (Douglas *et al*., 1998).

The purpose of this study was to evaluate the edible dry matter (EDM) production and the homogeneity of shrub supplied by a Sardinian farmer with the goal of registering the population in the National Register of Varieties.

II – Materials and methods

Chamaecytisus palmensis was planted in an experimental farm located in southern Sardinia (39°10' N, 3°20' E, 150 m asl), Italy, on September 24, 2013 and fertilized with 100 kg ha^{-1} of triple superphosphate.The site is characterized by a medium-deep soil limited in nutrients except for potassium (typic palexeralf soil, USDA Soil Taxonomy) and Mediterranean climatic conditions. Long term rainfall of 460 mm is distributed from October to May with a large annual and seasonal variability. Winter temperatures seldom reach 0°C, while maximum temperature average is 32°C in July.

300 rooted cuttings were placed on six rows 3 m spaced, according to the distances on the row of 1 m and 0.5 m, resulting in a plant density per hectare of 3300 (D1) and 6600 (D2), respectively.

Due to the unusual autumn-winter drought conditions, the cuttings were irrigated until March 2014. On September 16, 2014, one year after transplanting, the pruning was performed by topping and hedging the rows at 60 cm. Vegetative development was very different among plants, so they were classified in three growth degrees (good, medium and poor).

In a randomized block design, according to the two plant densities and the three observed development degrees, the test areas were settled consisting in four consecutive plants each, in order to determine the edible dry matter (EDM) production. Data on forage yield were statistically analysed with MSTAT-C software using two-way ANOVA procedure.

Samples were subdivided into twigs and leaves in order to assess protein and fiber content regardless plant density effects; near-infrared reflectance spectroscopy method (NIRS) was used. Palatability was evaluated by offering the green fodder to a group of cattle both at grazing and in the stable. Concerning the evaluation of plants uniformity, periodical observations were made during the biological cycle and the phenological phases.

III – Results and discussion

The development of *Chamaecytisus palmensis* was quite slow. After transplanting, it proved to be very exigent for irrigation and suffered from cold in the following winter.

Five samplings were made during the first two years. First sampling was made on February 18, 2015, eighteen months after transplanting. At this date some plants began flowering. The successive samplings were made on: 27 May, 2015 and 15 September, 2015; 13 February, 2016 and 15 September, 2016. The overall EDM production was 0.7 t ha^{-1} on D1 and 1.3 t ha^{-1} on D2.

Statistical analysis did not show any significant difference, both for plant density and development degrees. In contrast, D2 thesis proved to be higher yielding than D1 although this difference in not statistically significant due to the high coefficient of variation (CV) (table 1).

Table 1. Total EDM production of the 5 samplings performed in the first two years

Degree of development and plant density	EDM g m^{-2}	Plant density	EDM t ha^{-1}
Poor D1	16.9	D1 (1 m on the row)	0.7
Poor D2	64.1	D2 (50 cm on the row)	1.3
Good D1	111.4	Statistical significance.	n.s.
Good D2	212.3	CV	28.4
Medium D1	79.8		
Medium D2	103.8		
Statistical significance	n.s.		

Chemical analysis of EDM revealed a medium crude protein content of 12.7% and 17.7% in twigs and leaves, respectively. Conversely, fibre content was higher in twigs (table 2). The protein content does not seem to be very appreciable compared to other typical species of herbaceous Mediterranean legumes (eg. *Medicago polymorha* 25-32%) (Vargiu *et al.,* 2018), but it is important to consider its availability in periods with scarce forage resources such as summer and winter (Papanastasis *et al*., 2008).

Table 2. Crude protein and fibre content (%) of leaves and twigs

Part of plant	Proteins	NDF	ADF	ADL
Twigs	12.7	49.7	36.2	7.6
Leaves	17.7	37.9	25.6	8.5

Forage production did not seem much palatable for cattle: when cut and left on the field for grazing, it was refused. Oppositely it was consumed in stable, although very slowly.

All plants showed great differences in: flowering time, habitus, development and in the green tonality of leaves. North-oriented and wind exposed plants have always shown a more withered and less leafy habitus. Flowering date was very variable, from January to June, both within plants and mostly among plants. Pollinating insects and bees seemed to be particularly attracted by *Chamaecytisus palmensis* flowers.

IV – Conclusions

Regarding plant density and development degree, *Chamaecytisus palmensis* population showed no significant differences in forage yield, between D1 and D2. Moreover, lacking phenotypic and phenological uniformity, will very likely prevent this population to be registered by the Sardinian farmers.

However, further selections of the best biotypes could be carried out for, despite the initial slow development, this population could be attractive as a feed supplement in the periods of shortage of forage resources on conditions that the local cattle get used to its taste.

The interest in multi-use should also be mentioned. As an example, it could be extensively used as a windbreak or protection belt in arid regions. Furthermore, its dense wood suggests an interest for firewood (Gutteridge and Shelton, 1998). Finally, given the long duration of flowering period, it could be interesting both for the furnishings of parks, gardens as well as for honey production.

References

Borens, F.M.P. and Poppi D.P., 1990. The nutritive value for ruminants of foliage of tagasaste a leguminous tree. *Animal Feed Science and Technology, 28,* 275-292.

Douglas G.B., Woodfield D.R. and Foote A.G., 1998. Elite selection of tagasaste (*Chamaecytisus palmensis*) for drought-prone sites. *Proceedings of the New Zealand Grassland Association,* 60, 181-186.

Frame J., Charlton J.F.L. and Laidlaw A.S., 1998. Tagasaste. *In: Temperate Forage Legumes, CAB International,* 304-311.

Gutteridge R.C., 1990. Agronomic evaluation of tree and shrub species in southeast Queensland. *Tropical Grasslands, 24,* 29-36.

Gutteridge R.C. and Shelton H.M., 1998. *Chamaecytisus palmensis*, Tagasaste o Tree Lucerne. *Other Species of Multipurpose Forage Tree Legumes. In: Forage tree legumes in tropical agriculture*, CAB International, Wallingford, UK, 93-94.

Papanastasis V.P., Yiakoulaki M.D., Decandia M., Dini-Papanastasi O., 2008. Integrating woody species into livestock feeding in the Mediterranean areas of Europe. *Animal Feed Science and Technology,* 140(1), 1-17.

Sheppard J.S. and Bulloch B.T., 1986. Management and uses of *Chamaecytisus palmensis* (tree lucerne, tagasaste). *In: Plant materials handbook for soil conservation, Vol 2. Introduced plants, Technical note no. S3, van Kraayenoord C.W.S.; Hathaway, R.L. (ed.) Water and Soil Miscellaneous Publication No. 94. Wellington: National Water and Soil Conservation Authority*, 194-198.

Snook L.C.,1982. Tagasaste (tree lucerne): a shrub with high potential as a productive fodder crop. *Journal of the Australian Institute of Agricultural Science,* 48, 209-214.

Vargiu M. and Spanu E., 2018. *Medicago polymorpha* L.: a natural nitrogen resource for forage eco-systems improvement. *Proceedings of the 27th General Meeting of the EGF, Cork, Ireland,* 372-374.