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HISTORICAL ASPECTS OF THE ORIGIN AND DISTRIBUTION OF TAGASASTE (*CHAMAECYTISUS PROLIFERUS* (L. FIL.)LINK SSP. *PALMENSIS* (CHRIST)KUNKEL), A FODDER TREE FROM THE CANARY ISLANDS

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Abstract

Chamaecytisus proliferus (L. fil.)Link (Fabaceae: Genisteae) forms a taxonomic complex which is endemic to El Hierro, La Palma, La Gomera, Tenerife and Gran Canaria in the Canary Island archipelago. Forms from La Palma are popularly known as "tagasaste" whereas those from the rest of the archipelago are commonly called "escobón". Tagasaste is the only form which is broadly cultivated in the Canary Islands, and since the late 19th century in New Zealand and Australia. It has also become naturalized in Australia (South Australia, New South Wales, Victoria and Tasmania), Java, the Hawaiian Islands, California, Portugal, North Africa, Kenya, Tanzania and South Africa. Dr Victor Pérez, a medical practitioner from La Palma, introduced tagasaste as a fodder tree from La Palma to Tenerife by the middle 19th century. Early introductions of tagasaste from the Canary Islands in the Pacific region confirm the importance of the Royal Botanic Gardens, Kew and the Botanic Gardens of Adelaide in the distribution of this exotic species in this region during the last century.

Introduction

The endemic *Chamaecytisus* from the Canary Islands comprises a taxonomic complex found in the islands of El Hierro, La Palma, La Gomera, Tenerife and Gran Canaria. The form endemic to La Palma is commonly known as "tagasaste" (*Chamaecytisus proliferus* (L. fil.)Link ssp. *palmensis* (Christ)Kunkel) which is broadly cultivated as a fodder tree in the Canary Islands, except on Fuerteventura and Lanzarote which are too dry. It is also the only endemic species from the archipelago which has achieved importance in agriculture around the world, particularly in parts of Australia and New Zealand. Even so, tagasaste is an under-exploited plant although it has proved to be an outstanding fodder species for arid areas (Logan, 1982).

All the other morphological forms of *C. proliferus* found in the archipelago are wild or semi-cultivated but are heavily grazed by goats or pruned by farmers for use as a fodder for livestock. These morphological types are popularly known as "escobón". Occasionally, tagasaste is referred to as "tree lucerne", but Staples (1985) has suggested that this alternative common name should be avoided since another fodder legume, *Medicago arborea*, is also known as tree lucerne.

| Common name | Status | Distribution | Slope orientation | Altitude (m) |
|-----------------------------------------|------------------------------------------|------------------------------------------------------|-------------------|-----------------------------------|
| Tagasaste | Wild in La Palma cultivated elsewhere | All islands except Fuerteventura and Lanzarote | N | 700-1300 |
| White tagasaste | Wild | La Palma | N S | 1300-2000 1000-2000 |
| White escobón of Tenerife | Wild | Tenerife | N | 700-1300 |
| White escobón of Gran Canaria | Wild Semi-cultivated | Gran Canaria | N | 700-1300 |
| Narrow leaved escobón | Wild | Tenerife | N S | 1300-2200 700-2200 |
| Escobón of southern Gran Canaria | Wild | La Gomera Gran Canaria | S N S | 700-1000 1300-2000 500-2000 |
| Escobón of El Hierro | Wild | El Hierro | N | 700-1300 |

Table 1: The seven morphological types of *Chamaecytisus proliferus* (L. fil.) Link and their distribution in the Canary Islands.

The different morphological types of the *Chamaecytisus proliferus* complex have been given several taxonomic treatments, but taxonomists have been unable to agree upon the specific or infraspecific categories. In this paper we are less concerned with formal taxonomy than with the history of tagasaste as a cultivated plant. Table 1 gives a summary of the distribution of the seven morphological types which comprise the complex in the Canary Islands. Francisco-Ortega et al. (1990) have indicated that there are two morphological types of wild tagasaste on the island of La Palma which are clearly distinguishable from all the other forms of *C. proliferus*. Forms from the arid pine forest of La Caldera de Taburiente National Park and from the north of the island have rather silky leaves, pubescent on both surfaces, and usually are pale green in colour. Farmers from this area call these plants "white tagasaste" ("tagasaste blanco") or "blue tagasaste" ("tagasaste azul"). On the other hand, the form which has glabrous and dark green leaves is found wild on the sunny cliffs and within clear areas in the laurel wood, which is the rather humid vegetation of the north of the islands, in which *Laurus azorica* and *Myrica faya* are dominant species. This form is known as tagasaste or "black tagasaste" ("tagasaste negro"), and is the typical tagasaste which is cultivated in the Canary Islands and elsewhere. Since all the herbarium sheets of tagasaste at the Royal Botanic Gardens, Kew of specimens collected outside the Canary Islands have the morphological features of typical black tagasaste, we can surmise that white tagasaste was probably not introduced into Australia or New Zealand until recently. However, Wood (1989) has indicated that trials with this form have been carried out in Australia since 1989, following germplasm collection in La Palma. The introduction and history of tagasaste cultivation in New Zealand have been described by Webb (1980, 1982) and Davies (1982).

Our aim in this paper is to review the origin and history of tagasaste as a cultivated plant. This information could help focus future genetic resource studies and research on this species as a fodder tree for arid and semi-arid regions.

History of tagasaste as a cultivated plant

Early reports on the distribution and utilization of tagasaste in the Canary Islands

Within the genus *Chamaecytisus*, tagasaste is the only form which is reported as cultivated and of value for agriculture (Usher, 1974). Wolfel (1965) has stated that the name "tagasaste" had a Berber origin, suggesting that the plant was well known by the pre-Hispanic population of the island of La Palma. The oldest known reference to this name can be seen on a herbarium specimen from the Herbarium Webbianum in Florence (Fig. 1A, B). It is unclear where this specimen was collected. However, it appears to be white escobon of Tenerife and must have been collected on that island, since this form is not found in La Palma. Unfortunately it is not clear who was the collector of this specimen, as many botanists contributed to the Canarian collection of the Herbarium Webbianum (Steinberg, 1973). Neither does comparison of the handwriting of this label with those given by Steinberg (1973, 1977) and Burdet (1979) identify an obvious collector for this specimen. Four other herbarium specimens of *C. proliferus* from this collection also have a label with what appears to be the same handwriting, although only one of them is clearly dated as having been collected in Tenerife in 1845 (Fig. 1C).

Pérez de Paz et al. (1986) suggested that tagasaste might not only be endemic from La Palma but also from other islands in the archipelago, namely El Hierro, La Gomera and Tenerife. All the early reports found in the literature (Pérez & Sagot, 1867; Christ, 1888; Morris, 1893; Schenck, 1907; Burchard, 1911; 1929) do not agree with this point of view. Burchard (1929) has indicated that although tagasaste was planted in many areas of the north of El Hierro, farmers did not know of any wild populations of tagasaste in this island. During field studies carried out in 1989 (Francisco-Ortega et al., 1990) we were able to confirm that populations of wild tagasaste could only be found in La Palma.

Pérez (1879a) claimed that tagasaste had been cultivated in La Palma for a long time. However since many well-known naturalists such as Frutuoso (1590), Viera y Clavijo (1808), Webb & Berthelot (1836-1850), Berthelot (1837) made no mention of tagasaste in the cultivated areas of La Palma, we must assume that tagasaste has been under cultivation only from the 19th century. Before this it is likely that wild tagasaste plants were heavily pruned and grazed to feed cattle and goats in the same way that Pérez de Paz et al. (1986) and Francisco-Ortega et al. (1990) reported on the utilization of wild escobon and other wild endemic legumes in the archipelago.

The work of Dr Victor Pérez in the 19th century in Tenerife

The first reports concerning the utilization of tagasaste as a fodder tree were given by Victor Pérez (1862a, b) a native of La Palma who worked in Puerto de La Cruz (Tenerife) as a medical practitioner (Pérez-García, 1985). He considered it to be a native species from La Palma where it was considered a rather important fodder plant. He also observed that seeds and fodder from tagasaste were sold in markets and he gave an extensive account of traditional procedures for tagasaste cultivation. The earliest seed collections of tagasaste were mainly carried out by him and his son Dr Victor Pérez-Ventoso. They were the first to disseminate information about tagasaste as a fodder plant outside the Canary Islands.

Pérez (1862b) suggested that tagasaste should be planted as a fodder crop in the island of Tenerife. Morris (1893) indicated that tagasaste was introduced into Tenerife by Pérez in 1863, but Pérez-Ventoso (1892) stated that the plant had been introduced by his father in 1856. By 1912 tagasaste could be found growing on the lowest slopes in many parts of Tenerife (Sprague & Hutchinson, 1913).



Figure 1: A & B. Herbarium specimen of *Cytisus proliferus* (= *Chamaecytisus proliferus*) probably of white escobon of Tenerife from Herbarium Webbianum, Florence. Its label probably represents the oldest known reference to tagasaste in the Canary Islands (undated); C. Herbarium specimen of white escobon of Tenerife, collected in 1845.

Distribution and use of tagasaste outside the Canary Islands

Pérez (1862b) gave the first reports on the distribution of tagasaste from the Canary Islands. Seeds were sent to Algeria in order to evaluate its value for arid zones. Later he also sent tagasaste seeds to the south of mainland Spain, Corsica and California (Pérez & Sagot, 1892). Soon afterwards the plant was utilized and naturalized in California (Greene, 1891). Fairchild (1930) also reported that he brought seeds of tagasaste from the Canary Islands to California after his stay in the archipelago. Pérez became so enthusiastic with the spread of tagasaste that he published several papers (Pérez & Sagot, 1867; Pérez, 1879a, b, 1888) describing the procedures for its establishment and cultivation.

The first report from outside the Canary Islands on the value of tagasaste as a cultivated plant is from peninsula Spain (Colmeiro, 1871). This author gave a brief mention of this plant in his dictionary of "common names of useful plants from the Old and New World". Later, other agronomists from mainland Spain gave similar accounts about tagasaste and its utilization as a fodder tree (Garrido, 1902; Rodrigáñez, 1905). Despite the reports of these two authors on the use of tagasaste as a fodder plant which could be cultivated in the south of the Iberian peninsula, we have found no reports about its present utilization in the mainland Spain. Only Pereira-Coutinho (1913) has claimed that plants of tagasaste were naturalized in Tavira in the south of Portugal.

Between 1905 and 1915 several authors from the Canary Islands described the cultivation methods and advantages of tagasaste as a fodder species for arid zones (Benítez de Lugo, 1905; Pérez-Ventoso, 1910; 1916; Aganilob, 1915; Anon., 1915). Aganilob was the pseudonym of J. Bolinaga, who was the head gardener at La Orotava Botanic Garden in Tenerife. All these authors made similar recommendations on the use of tagasaste, and they considered that it should be utilized in summer when there were no other fresh forages available. They basically followed the recommendations given by Dr Victor Pérez. In these papers are given details of plant management such as restricting pruning to older branches. Procedures for breaking seed dormancy are discussed, and also the possibility of producing strains adapted to sandy or clay soils.

In 1879, Pérez sent seeds of tagasaste to India, South Australia (the Botanic Gardens of Adelaide) and South Africa via the Royal Botanic Gardens, Kew (Anon., 1891). A series of reports between 1879 and 1891 (Anon., 1879; 1880; 1881; 1882; 1891) indicated that the plant quickly became adapted to local conditions in South Africa and Australia, whilst the seedlings planted in Madras in India died shortly after germination. Apart from this first despatch of seeds by Pérez in 1879, more tagasaste seeds were received in Australia from Paris and Las Palmas de Gran Canaria (Anon., 1891). By 1907 tagasaste had escaped from cultivated areas and could be found naturalized in several parts of South Africa (Anon., 1907; Orpen, 1907). However, tagasaste was not successful as a cultivated plant in South Africa where Macowan (1904) indicated that it was toxic to horses and Orpen (1907) and Macmillan (1913) observed that seeds did not germinate rapidly. We have found no reports on the present utilization or distribution of tagasaste in southern Africa and it seems that early naturalized populations of this plant may have disappeared.

Tagasaste in Australia and New Zealand

In the years 1880-1883 and 1888-1890, Dr R. Schomburgk, the Director of the Botanic Gardens of Adelaide, briefly reported the advantages of tagasaste as a fodder plant, and seeds were offered to Australian farmers, although as he indicated in 1889, "pastoralists and agriculturists have hitherto shown a most remarkable degree of apathy". Schomburgk (1889) also claimed that tagasaste was cultivated in Madeira. However we do not believe that tagasaste was utilized on this island, and his account about tagasaste cultivation procedures probably referred to La Palma or Tenerife.

By 1919 the first report of tagasaste as an introduced plant in New Zealand was published (Anon., 1919). Nevertheless Davies (1982) considered that tagasaste had been being utilized as a forage species in New Zealand from the late 1800s, which is probably true since the Botanic Gardens of Adelaide had received the first request for seeds of tagasaste from "the neighbouring British colonies in 1882" (Schomburgk, 1883). Maiden (1908) observed that specimens of tagasaste were planted in Tasmania in 1908. It is likely that the first plantings throughout the Pacific region were established from seeds originally supplied from Australia. The role of Australia as a source of seeds of tagasaste for the area is clearly indicated by Degener (1946) who found naturalized tagasaste in pastures at Mouri in the Hawaiian Islands in 1927. He claimed that a Mr F.G. Krauss introduced tagasaste from Australia together with other forage plants between 1910 and 1912.

Other places where tagasaste has been seen as a naturalized plant are Java (Backer & Bakhuizen, 1963), Kenya and Tanzania (Milne-Redhead & Polhill, 1971; Lock, 1989) and North Africa (Quezel, 1987). Although there is no information concerning their origin, it does seem likely that the stands in Java and East Africa originated from seeds from Australia or New Zealand, whereas North African populations probably had their origin in germplasm from the Canary Islands. Recent reports on the introduction of tagasaste in the Asiatic region (Anon., 1990) indicate that tagasaste cultivation was started in some areas of China from germplasm provided by Australian nurseries.

The first experimental plots of tagasaste in New Zealand were established in 1977 (Davies, 1982). Results from various agronomic trials in New Zealand have been reported by Logan (1982) and Logan & Radcliffe (1985) who indicated that as a legume species, tagasaste could play an important role in agroforestry systems for arid regions. These reports considered tagasaste as one of the most appropriate species for these systems as it not only seems free of toxic compounds but also is highly productive. Wheeler & Hill (1990) indicated that despite its low dry matter digestibility, tagasaste has such a high growth rate that it could be utilized as fodder as early as 12 months after planting. They regarded tagasaste as the most suitable shrub for temperate zones of Australia. As with other trees and shrubs, tagasaste has advantages over many herbaceous species since it provides better control of soil erosion and a reserve of fodder throughout the whole year. Once established it is resistant to overgrazing and can be utilized in association with other species leading to an efficient use of land resources.

In 1987, Woodfield and Forde reported the first study of variability in tagasaste (Woodfield & Forde, 1987). They found that considerable variation existed both within and between populations from New Zealand, and that broad-sense heritability values ranged between 35 and 84%, suggesting that much of the variation found in some characters is highly heritable. They did not find any correlation between patterns of variation and geographical origin of these populations. This indicates that almost one century after its introduction into New Zealand, there has been little or no population differentiation in that country.

Results of this study, and of the reproductive biology of the plant obtained by Webb & Shand (1985) suggested that although tagasaste is self-compatible, allogamy plays an important role in its breeding system. They found that the species has a long flowering period and produces a large number of flowers. They observed that honey bees do visit the flowers although they are not able to trip them. They usually rob nectar through the side of the flower or visit flowers already tripped by other insects. These results indicate that the species could be considered more as a source of nectar than of pollen for honey bees.

Problems with tagasaste as a cultivated fodder species

There are perhaps two principal reasons why tagasaste has not been exploited more widely. First, it has been reported to have low frost tolerance (Anon., 1907; Morris, 1893; Davies, 1985). Our recent field studies indicate that populations of white tagasaste and narrow-leaved escobon are found in areas of La Palma and Tenerife where periodic frosts occur, particularly at high altitudes in the Las Cañadas del Teide National Park in Tenerife. Whilst tagasaste seems to be the form with the best nutritional quality, there may be other forms with other attributes such as frost tolerance which should be evaluated for fodder quality.

Secondly, seeds can be difficult to germinate. It has been claimed that farmers in La Palma had problems in establishing tagasaste fields due to lack of seed germination, and that seeds sown the first year usually germinated the following year (Pérez, 1879a, b). This poor germination has been reported as a common feature of the Genisteae by Polhill (1976). Details about the problems caused in the establishment of tagasaste as a crop by the lack of germination and procedures to overcome this were given by Pérez (1879a, b), Snook (1986) and Pérez de Paz et al. (1986). All these authors suggested that seed dormancy could be broken either by scarification or by immersing the seeds in boiling water for a few minutes. This latter treatment if prolonged could lead to low viability and germination. Further research is needed in this field in order to determine which factors control the germination physiology of *C. proliferus*.

Conclusions

The history of tagasaste as a cultivated plant is another example of the important role that botanic gardens had in the distribution of exotic species during the last century (Plucknett et al., 1987). Introduction of this fodder shrub from the Canary Islands to the Pacific region was made possible by the early accounts and seed collection by Dr Victor Pérez and through the links which existed between the Royal Botanic Gardens, Kew and the Botanic Gardens of Adelaide.

One consequence of the early successful introduction into Australia and New Zealand is that the present gene pool of tagasaste is rather narrow compared to that which exists in the Canary Islands. However, the range of genetic variation now available in genebanks following recent germplasm collection in the Canary Islands (Francisco-Ortega et al. 1990) should lead to greater utilization of the plant genetic resources of the endemic *Chamaecytisus* from these islands.

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