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Review Article

Corema album (L.) D. Don, the white crowberry – a new crop

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Abstract. *Corema album* (Ericaceae), 'Camarinhas', or the 'white crowberry', is a white-berried perennial adapted to sandy soils in the Iberian Peninsula which has been consumed by humans for many centuries. It occurs naturally on sand dunes and cliffs of the Atlantic coast from Gibraltar to Finisterre, and in the Azores on volcanic lava and ash fields. It has the possibility to become a new niche berry crop, because its fruits have a distinct colour (white), and provide high nutritional value. It has the potential to spread throughout southern Europe and the Mediterranean basin. The round, white, berry-like drupes (0.3–0.5 g), have a strong skin, and usually have three large seeds with a thick endocarp. The fruits can be marketable after five days at room temperature, and some samples have been acceptable after five months at 4°C. Here, the taxonomy, biology, and potential production system are discussed and a potential marketing name, the Beachberry, introduced.

Keywords: Camarinhas production systems, plant selection, beachberry

1. Introduction

'Camarinhas' or the 'white crowberry' (*Corema album* (L.) D. Don) is a fruit that has been eaten by people in the Iberian Peninsula since the Islamic period (500 P.E.) [9]. The local population still harvests the fruit from the sand dunes. Although it has been eaten for a long time, the fruit has never become a commercial crop, although it is sold fresh in a few public markets in Galicia [20]. Also, it has been cultivated as an ornamental plant [20].

Archaeological studies in Lisbon have found seed remains amongst other organic debris inside a modified Roman cetária [9]. Most of the seeds were figs (*Ficus carica*), 97%, and grapes (*Vitis vinifera*), 2.4%, mulberry (*Morus nigra*), 0.07%; raspberry (*Rubus idaeus* L.), 0.02%; plum (*Prunus domestica*), 0.02%, strawberry (Fragaria vesca), 0.02%; and Camarinhas, 0.01%, were also present. Since *C. album* did not grow in Lisbon, the fruit must have been collected from nearby populations and transported to Lisbon, and this activity was continued until the 16th century [47].

Recently, there have been renewed efforts to commercialize different fruit species that have not been commonly used in Europe or North America. This has been done successfully with kiwifruit and saskatoon berries, which has encouraged scientists to examine other fruit species.

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Although existing berry crops are mostly are red, they can be found in many colours. Raspberries exhibit the widest range of colours, with many shades from red through purple to black, and peach and yellow [28]. However, at the present time there are no white berries marketed on a large scale.

Corema album, a blueberry-like fruit, is white fruited, and would fill a market niche for berries of that colour. This paper reviews the biology and possible agronomic and market possibilities for this species.

2. Taxonomy, and biogeography

2.1. Taxonomy

Corema album is one of two species in the genus *Corema,* in the tribe Empetraceae, of the subfamily Ericoideae, of the Ericaceae. It contains two subspecies: subsp. *album* and subsp. *azoricum* P. Silva [46]. It has 26 chromosomes [45].

Corema conradii (Torr.) Torr. ex Loudon, the only other species in the genus, is found in eastern North America. It can be distinguished from *C. album* by its very small fruit which are devoid of fleshiness and covered with eliasomes (oily appendages associated with ant dispersal) [36].

The tribe Empetraceae contains two other genera, *Ceratiola* and *Empetrum*, which are morphologically very similar. Studies of their phylogenetic relationships indicate that *C. conradii* might be a hybrid between ancestral populations of *C. album* and *Ceratiola* [32].

2.2. Geographical distribution

Corema album subsp. *album* occurs on the Atlantic coast of the Iberian Peninsula from Gibraltar to Finisterre, and subsp. *azoricum* in the Azores [12, 44]. There are large populations in the three large dune systems, Aspeillo in Doñana National Park in the south of Spain, from Sines to Troia in south-west of Portugal, and from Nazare to Ovar in central-north Portugal. Disjunct populations exist on cliffs and isolated sand dunes throughout the rest of the range [12].

C. album subsp. *azoricum* exists on six of the nine islands of the Azores, and below 200 m [18]. Recently the range has extended to the dunes of Spanish Province of Alicante, and into France [20].

2.3. Ecology

Corema album grows mainly on sand dunes, but will also inhabit rocky sites and cliffs, and in the Azores Islands, volcanic lava and ash fields [11]. In the sand dunes, it occurs in partially fixed dunes both pioneer and mature stages of scrub succession [21]. Vegetation consists of native dune scrub of *Halimium halimifolium* (L.)Wilk*., H. Commutatum* Pau*, Cistus libanotis* L*., C. salvifolius* L*., Rosmarinus officinalis* L*., Lavandula stoechas* L*., Cytisus grandiflorus* (Brot.)DC*., Stauracanthus genistoides* (Brot.) G. Sampaio*, Corema album, Juniperus oxycedrus* L. and *J. Phoenicea* L., together with *Pinus pinea* L. *Corema album* is the dominant scrub in some areas [7, 16].

In the syntaxonomical classification of vegetation, *C. album* occurs in two vegetation categories: the heathland, dwarf scrub and scrub vegetation, and the Eurosiberian and Mediterranean climatic zonal and potential natural vegetation. In the scrubland it is the characteristic species of the alliance *Coremation albi* Rothmaler 1943, and a dominant species in the two associations: the *Festuco-Corematetum albi* M.A. Giménez & J.M. Losa in J.M. Losa 1975, and the *Stauracantho genistoidis-Corematetum albi* Br.-Bl., P. Silva & Rozeira 1965. In the Mediterranean climatic zonal vegetation it is a dominant species in the association *Coremato albi-Juniperetum macrocarpae* ass. Nova (alliance *Juniperion turbinatae* Rivas-Martínez 1975 corr. 1987) [42].

While *C. album* grows in protected dune systems e.g. Doñana National Park in Spain, and the Southwest Alentejo and Vicentine Coast Natural Park in Portugal, it itself is not an endangered species [37]. However, in the Azores, it is one species considered a priority for conservation and is one of the one hundred endangered species with priority for conservation in the Macaronesia region (Azores, Madeira, Savage islands, Canary islands and Cape Verde) according to the European project BIONATURA [1].

The soils have at least 70% sand and at the most 30% clay. Organic matter varies between 0 to 2.6%, and pH can vary from 5.6 to 7.8 [25, 35]. Inorganic nutrients are usually low to very low, although Mn and K can be high [25].

The climatic range for the species is coastal Atlantic from Galicia (mesomediterranean) to Huelva and Algeciras (thermomediterranean) with moderate temperatures and high rainfall in the winter, low in summer [41] In Galicia, the average daily temperatures in August are minimum, 16.0°C, mean, 19.2°C, and maximum 22.5°C, with 35 mm rain, and, in January, are minimum, 7.6°C, mean, 10.4°C, and maximum 13.1°C, with 128 mm rain [2]. In Huelva, the average daily temperatures in August are minimum, 19.3°C, mean, 25.5°C, and maximum 31.8°C, with 4 mm rain and in January, are minimum, 6.6°C, mean, 11.4°C, and maximum 16.1°C, with 73 mm rain [3].

Seed ecology has been studied extensively, and germination is improved when the fruits are ingested by animals, and when they carry the seed to suitable sites [11]. Seed germination in controlled studies on sand dunes was low (<10%), but significantly higher (<20%) when the seeds had passed through the gut of various mammals and birds, especially foxes [17], gulls, blackbirds and rabbits [11]. There were two peaks which coincided with two rainy seasons [17]. Also they germinated better under mother plants after being ingested by foxes [17], but in open sites after being ingested by gulls, blackbirds and rabbits [11].

Rabbits selected fruits with smaller seeds which could be a selective pressure exerted by them [31].

Seed taken from fruits is viable (87%). It is dispersed during the summer but seed germination occurs in winter, after a dormancy period of at least 1 or 2 years in natural habitats; none in first season, highest in third season (year) [10, 11]. There is no information on the dormancy mechanisms in seed [11]. Seedlings emerge in spring and there is often high mortality in summer [10].

3. Description

3.1. Vegetative description

The plant is a dioecious, perennial shrub with numerous branches, usually between 30–75 cm tall, which can reach 1 m (Fig. 1). The male plants are more upright, because they have erect branches, whereas in the female plants the branches are shorter and more procumbent [45]. Vegetative growth is renewed from buds about 25 mm above the ground.

The leaves are in whorls of three or four, with short petioles which tend to lie against the stem. They are 8–10 mm long × 1 mm wide with an abaxial groove. When they are young, they are covered with sessile glands which disappear as the leaf matures [44], and they persist for two growing seasons [48].

The roots are thick and spreading, similar to other members of the Ericaceae. Males are postulated to have a deeper root system, but this has not been examined [15, 48].

Fig. 1. A plant of *Corema album* D. Don in its natural habitat at Aldeia do Meco, Portugal, 12 August 2011.

Fig. 2. A 125 g container of fruits of *Corema album* D. Don, collected in the wild from Pego, Portugal on 4 August 201.

3.2. Flowers and fruits

The species is dioecious. However 1–4% of male plants from the southwest (Vila Real de Santo António and Doñana) have some hermaphrodite inflorescences. The hermaphrodite plants have both male and hermaphrodite inflorescences, and the hermaphrodite inflorescences are fewer than the male inflorescences on a single [48].

The actinomorphic flowers appear in terminal inflorescences of 4–14 flowers. In female plants, the fruits appear in the middle of the branch as the terminal bud continues to grow. Male flowers have three 2–3 mm long, suborbicular, pubescent sepals, three 3–5 mm long, pinkish petals and three stamens 5–6 mm long with conspicuous red anthers. Female flowers are smaller than the male flowers with 1–2 mm long sepals and 1 mm long petals. The ovary is superior with a style present, and the stigma has three reddish lobes [44, 45]. They are wind- pollinated [7].

The fruits are white or pink-white, berry-like drupes, 5–8 mm in diameter, usually with three (ranging from 2–9) pyrenes [44, 45]. The pyrenes (seeds) are c. 0.48 mm long with a thick woody endocarp similar to that of *Rubus ulmifolius* [10, 11, 17]. Fruit is edible, with an agreeable flavour and very refreshing [20].

3.3. Fruit quality and chemistry

Ripe fruit are completely white with a strong skin, and some genotypes can be marketable after five days at room temperature (Fig. 2). However, there is segregation between genotypes for fruits that remain pearly white, and others where the fruit becomes translucent over a 12 day period (Fig. 3). Translucency is where the seeds become visible from the outside of the fruit. Fruit of some genotypes with translucent berries develop a reddish tinge. White fruit can also develop a green tinge, which we associate with the development of low levels of chlorophyll just below the surface.

Berries of *C. album* are considered to be mildly acidic with a lemony flavour, and no reports of the volatiles in *C. album* fruit have been found. Also, they contain many anti-oxidants which have been reported as low amounts of anthocyanins, and high amounts of flavinol, and chloragenic acid derivatives, and phenolic acid. Also, the ratio of ORAC : total polyphenols (20.7 μmol TE/mg gallic acid equivants) was 78% higher than the fruit of a common *Rubus idaeus* cultivar [43]. In a yeast Parkinson's Disease model, *C. album* anti-oxidants may have protective effects, other than radical scavenging, and had a more powerful protective effect than *Ginko biloba* [33].

3.4. Fruit variability

Fruit varies considerably between genotypes, and sites for fruit size [22, 31], translucency and seed size [31], and seed weight is positively correlated with fruit weight [31]. Fruit was collected in August 2011 from 7 locations in Portugal, distributed from Sines (37°58′N, 8°53′W) to Aveiro (40°37′N, 08°38′W). At each location, between 250 and 800 ripe fruits were collected from 12 genotypes, counted weighed and average fruit weight determined. Plants were randomly selected based on high yield, with large ripe fruits, and spaced at least 50 m apart. Fruits were then

Table 1
The Location, Latitude and Longitude of seven sites of *Corema album* D. Don in Western Portugal collected in August 2011, and the Mean berry weight, percent translucency after 19 days at 4°C and individual seed weight of 12 plants at each site plus their standard errors

Location	Latitude/ longitude	Date harvested	Mean berry weight g	% Translucency after 19 days	Individual seed weight mg
St Andre Lagoa	38°07′11″N 8°47′40″W	4 Aug	0.31 ± 0.08	30.4 ± 26.5	14.8 ± 2.1
Pego	38°17′31″N 8°46′38″W	4 Aug	0.41 ± 0.05	21.3 ± 12.8	15.2 ± 2.3
Carvalhal, Comporta	38°18′04″N 8°46′40″W	4 Aug	0.38 ± 0.06	49.7 ± 34.4	12.5 ± 1.7
Aldeia do Meco	38°28′07″N 9°11′09″W	12 Aug	0.42 ± 0.07	27.6 ± 18.8	12.5 ± 2.0
Ste. Pedro de Moel	39°47′57″N 8°59′23″W	16 Aug	0.49 ± 0.06	38.3 ± 19.8	12.3 ± 2.2
Duna de Quiaios	40°13′43″N 8°52′02″W	16 Aug	0.36 ± 0.06	36.5 ± 26.3	10.4 ± 1.8
Dunas do Mira	40°26′22″N 8°17′06″W	16 Aug	0.40 ± 0.06	28.4 ± 24.5	9.3 ± 1.9
LSD ($P = 0.05$) between populations			0.052	19.6	1.63
Mean			0.39	33.0	12.4
Minimum			0.21	7.1	5.7
Maximum			0.55	100	19.9

held at 4°C and the number of translucent fruit determined after 6 and 19 days. This was used to determine the percentage of translucent fruit after 19 days. Seeds were extracted from 100 fruit of each genotype and weighed and counted. The weight was divided by the number to give average individual seed weight. The data were analysed by Proc Anova in SAS (SAS Institute, Cary, North Carolina, USA) and the least significant difference between sites and the correlation coefficients between the three variables calculated.

Average fruit weight, percent translucency and individual seed weight varied independently ($r = 0.052$ for av. Fruit wt. vs. % translucency, $r = 0.099$ for av. Fruit wt. vs. individual seed wt., and $r = -0.085$ for % translucency vs. 100 seed wt; $n = 84$ P 0.05 = 0.21).

Fruit weight and seed weight varied significantly between sites whereas percent translucency did not. There was considerable variability within sites. Seed weight became smaller the further north the sites were (Table 1). The fruit of two genotypes were still presentable after five months at 4°C.

4. Life cycle

4.1. Phenology

The plants grow vegetatively from late Feb–July, reaching a peak between April and June. Vegetative growth can reach 2.5 mm/day from May to late June [7]. The plants flower from February through April, fruit ripens June-July in the south and August-September in the north, and they remain on the plants until October through December depending on the geographical location [6, 10, 46]. Flowering phenology is synchronous between males and females [22]. The longevity is not known, but *C. conradii* is thought to live 25–35 years [36].

4.2. Physiology

It is a drought-adapted Mediterranean shrub and will tolerate low moisture levels in the soil. Its shoot growth typically occurs during a short period in late spring and early summer. In comparative studies, where plants had

access to water from the water table of the soil, *C. album* was the only species where ecophysiological functioning was completely uncoupled from access to ground water. During a drought the leaf water potential (ψ) can reach −3.95 Mpa [6, 34].

Photosynthetic efficiency can reach the optimum for woody plant species. Net assimilation rates (A) reach a peak at midday in winter (9.49 μmol m^{-2} s^{-1}) and a low in midday in July (−2.0 μmol m^{-2} s^{-1}). This annual pattern of photo inhibition was thought to be typical of a cold-sensitive species [6].

Fruit productivity and dry matter content varied with gender. Except for leaf water potential, all photosynthetic parameters do not differ with gender. In female plants, leaf water potential can reach −2.17 MPa compared to −1.89 MPa in males. Ripe fruit from female plants (20% dry matter) were fleshier, and had 3.5 times, by weight, more dry matter, than those of hermaphrodites (35% dry matter) [5].

4.3. Symbiotic relationships and pests and diseases

Mychorrhizal associations have not been reported, although mychorrhizae are common in Ericaceous plants. We have been unable to find any reports of pests and diseases.

5. Uses

The fruit has been consumer fresh for many centuries and they are sold fresh in a few public markets in Galicia [20]. The fruit has been used in traditional medicine to reduce fevers and to kill intestinal worms (Lombrinas) [20].

The plant was used in Iberian Peninsula to make rustic brushes [20], which may explain the origin of the generic name which came from Greek verb 'korema' which means a broom [26].

6. Potential horticultural distribution

White berries are relatively rare. The only commercial white fruit we know is the white currant, which is a red currant (*Ribes rubrum* L.) which contains an allele which prevents anthocyanin production in the fruit. This is grown in northern Europe, in areas where winter chilling is required. Also, the white-fruited form of the Chilean strawberry (*Fragaria chiloensis* (L.) Duch.) is grown on a small scale for local markets in Chile [23]. Recently, a white-fruited blueberry (*Vaccinium mryrtillus* L.) has been found in the Ukraine [30]. Other edible white fruits we know of are: *Flueggea virosa* (Roxb. ex Willd.) Royle, (Phyllanthaceae), white berry, native to Africa, Indonesia and Australia. The fruits of *Symphoricarpus* spp. (Caprifoliaceae), snowberry, are white, but are considered poisonous [45].

Corema album has been reported to grow very well near London, England [8] and be hardy in European Plant Hardiness Zone 8 (−12.2 to −6.7°C) [26]. Its natural distribution is mostly within European Plant Hardiness Zone 10 and a portion of Zone 9. European Plant Hardiness Zone 8 includes most of France, Spain, Portugal, United Kingdom, Italy and Greece.

Based on its present geographical and ecological distribution, *C. album* would be grown initially in sandy soils in the coastal areas of the Iberian Peninsula. Its eventual spread could be on sandy soils from coastal areas in southern France, around the Mediterranean into southern Morocco.

7. Potential production systems

As we have been unable to find any comprehensive reports on breeding, propagation or cultivation of *C. album*, the following section contains our suggestions for the initial steps needed to domesticate the species.

7.1. Cultivars and breeding

7.1.1. Cultivars

There are no known cultivars. Initial plantations will need to be established from seed of wild populations, followed by vegetative propagation of selected clones. This is similar to the situation that for lowbush blueberries (*Vaccinium angustifolium* Ait.) where initial plantings were established in forest clearings with existing clones, and empty spaces filled with unselected seedlings from selected clones. Only later were named cultivars released [19].

7.1.2. Breeding

Initial breeding would be by mass clonal selection on plants grown from seed collected from populations in their native habitat. Plants in the wild from which fruit is collected need to be characterized, and plants selected for their large fruits, small seed and low translucency.

Once plants have been established in a breeding population, clonal selection can proceed. First, plants need to be characterized by gender, then females selected for high productivity and large fruits with low translucency, good fruit quality, and smaller seeds. Good fruit quality includes firm skin, acceptable flavour, and sweetness. Also, clones need to be selected with a range of harvest seasons to spread harvest.

Initially, males need to be selected for flower number and flowering seasons which match selected females. Thereafter, they need to be selected for their ability to influence fruit traits in their offspring. Test crosses to selected female plants will be needed to detect genetic variability in the male plants for fruit traits [44].

There is the potential for hermaphrodism as some populations have hermaphrodite plants [48]. However, at present this hermaphrodism would be considered weak, and will require a considerable breeding effort for hermaphrodite cultivars to be competitive with dioecious plants.

7.2. Propagation

7.2.1. Seed propagation

Seed germination is improved when fruits are ingested by animals, and then the seeds need a dormancy period of 1-2 years [Section 2.3]. They will germinate after warmth for 5 months followed by 5°C for three months before they are sown [26]. This suggests that a pre-treatment similar to that used for raspberries (*Rubus ideaus* L.): concentrated H_2SO_4 for 20 min. followed by 1week in 1% $CaOCl_2$ in excess $CaOH_2$ and 6 weeks at 5°C [29]. Also, fruits with hard seed coats can be prevented from becoming dormant if the seeds are kept moist [27]. This has been successfully applied to raspberries, where seeds kept moist and pre-treated immediately after harvest germinated successfully [13]. This approach may also work with *C. album*.

7.2.2. Vegetative propagation

Cuttings of half-ripe wood, taken in July and August placed in a frame, and cuttings of mature wood of this year's growth taken in November and placed in a frame have been reported to root successfully [5]. Our experience has been that cuttings of mature or current season's growth from wild plants rooted poorly (c.2%) when taken in June 2011. Therefore, more work is needed to establish a suitable protocol for vegetative propagation.

7.3. Planting system

7.3.1. Soil type

In wild, *C. album* grows in sandy soils, and there is one report that they grow well in sandy peat near London, England [8]. The pH range is uncertain, but probably somewhat acidic about pH 6.5. In its natural habitats, pH can vary from 5.6 to 7.8 [25, 35].

Since, the species grows naturally on sand dunes, plants may tolerate moderate to high levels of sodium, and there may be genetic variation for this trait.

Fig. 3. Fruits of *Corema album* D. Don, which illustrate the translucency which can develop after harvest.

7.3.2. Plant and row spacing

Bushes are reported to reach 1 m wide. So single plants in row with a spacing of 1 m within the row and 1.5 m between rows. There should be a ratio of 9 : 1 females : males and the male plants spread through the plantation in a diagonal pattern. This ratio is similar to other wind-pollinated species, such as hazelnuts [38].

7.3.3. Plant covers

Ground covers and mulches are used widely in the cultivation of highbush blueberries and may be beneficial with *C. album*. Landscape fabric is used as a mulch in blueberries in Spain, and sawdust/pine-bark is also used in North America and elsewhere [14, 39].

C. album is reported to have high photosynthetic rates in the wild winter, but lower ones in summer [6]. Two possibilities arise from this, either the plants are extremely drought stressed in summer, or their photosynthetic capacity is reduced by high light levels in summer. Consequently the effect of shade should be investigated.

7.3.4. Pruning

Since vegetative growth is renewed from buds about 25 mm above the ground, plants may well benefit from pruning as the plants age. Pruning systems for highbush blueberry may be appropriate. Here canes reach their maximum productivity after 5 years and start to lose their productivity after 8 years, when they are removed. New canes are pruned to 2–3 each year for 10–20 canes of different ages in a mature plant [39].

7.3.5. Fertility

Corema album responds to increased soil fertility. In one study, *C. album* growing under an *Acacia longifolia* stand, compared to outside the stand, had higher leaf nitrogen (1.7% vs. 0.8 %), and longer shoots (11 vs. 2.5 $cm \cdot year^{-1}$). The soil N-content was nearly 7× higher for NH_4^+ and over 2× higher for NO_3^- under the stand than outside [25].

Many species of the Ericaceae have low to undetectable levels of the enzyme, nitrogen reductase, including *Empetrum nigrum* which is closely related to *C. album* [24]. So although the status of *C. album* is not known, it is reasonable to conclude that it also has low levels of nitrate reductase, so usually only takes up N as ammonium ions.

Initial fertility recommendations could follow those for highbush blueberry where nitrogen is applied as ammonium sulphate or urea in multiple applications to ensure it is taken up efficiently [39].

7.3.6. Water relations

On sand the plants will need to be irrigated during the growing season. Again, recommendations could follow those for highbush blueberry where drip irrigation is used [38]. Since the natural ecology is dry sand dunes whereas

highbush blueberries grow on hummocks in swamps, we would expect water usage to be lower in *C. album* than in highbush blueberries. This would need to be ascertained once plantations have been established.

7.3.7. Yield

Fruit weight in the wild has been calculated as 0.385 g·fruit^{-1} (dry weight of 0.077 g·fruit^{-1} and 20% dry matter), on an average of 2,200 fruits per plant and a crown size of 0.96 m [48]. With a plant spacing of 1 m within the row and 1.5 m between rows this equates to 5.6 t·ha^{-1}.

Since fruit size is a function of cell number and cell size in the fleshy part of the fruit and, in other crops, stress reduces both these parameters [40], it is possible that in cultivation fruit size will increase, whether this will be negatively correlated with fruit number, because of source-sink relationships, remains to be seen.

7.3.8. Harvesting

Since the fruit are able to remain ripe on the bush for several months, and several harvests every 7–10 days, similar to the harvest interval for highbush blueberries may be practical. Fruit can be harvested by hand and eventually may be harvested mechanically. Harvesting and handling conditions would be similar to those for highbush blueberries [38]. Since the fruits have a very strong skin, they can be bulk harvested and then sorted and cleaned, to remove unripe and small fruits, and debris.

8. Conclusion

C. album is a white berried perennial which is adapted to sandy soils in the Iberian Peninsula which has been consumed by humans for many centuries. It has the possibility to become a new niche berry crop, because it has a distinct colour and provides high nutritional value. Also, the very strong skin of the fruit makes it possible to mechanically harvest and handle the fruit in bulk with a long shelf-life.

Its initial production area would be the Iberian Peninsula with the potential to spread throughout southern Europe and the Mediterranean basin.

While some of its physiology has been already enunciated, *C. album* may well react completely differently in cultivation. This is because the summer drought stress will alleviated when the plants are fertilized and irrigated. The flowering and fruiting phenology may change as could the fruit characteristics and yield potential.

So that plantations can be established, initial research needs to identify suitable clones that can be used as seed parents for the initial commercial plantations, to investigate seed germination to produce a reliable protocol, and to determine how to propagate plants vegetatively. From our observations, the two characteristics which need immediate attention are the relatively large seeds, and the translucency which can develop in the fruit after they have been harvested. Both can be eliminated or reduced by clonal selection. Thereafter, the initial production system needs to be developed and refined.

A marketing strategy is needed which will determine the value chain, characteristics of the end product, and pricing strategies. A focus group analysis, including blind taste tests, needs to be done, as does a competitive analysis. Also, the strategy must identify where the fruit can be sold, the names of the main potential buyers, and how the growers are going to consolidate and market their crop.

The most common English name for *C. album* is ‘white crowberry’. Unfortunately, the name carries negative connotations with birds of a similar name, crows. For example, the American colloquial idiom ‘eating crow’ means ‘to be humiliated by admitting wrongness or having been proved wrong after taking a strong position’ [4]. Consequently, we suggest that a marketing name with more positive connotations be used, and one that recognizes the natural habitats of the species – the beachberry.

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