GERMINATION OF THE LAUREL FOREST SPECIES. II. GARAJONAY NATIONAL PARK. CANARY ISLANDS.

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With 11 figures & 1 table

ABSTRACT. The germination behavior towether with the description of seeds and seedlings of 7 singular species of the laurisilva is presented. The taxa studied constitute 4 canarian endemics [*Aeonium castello-paivae* BOLLE (1859), *Cryptotaenia elegans* WEBB ex BOLLE (1861), *Gesnouinia arborea* (L. fil.) GAUD. (1830) and *Pericallis appendiculata* (L. fil.) B. NORD. (1978)] and 3 macaronesian endemics [*Cedronella canariensis* (L.) WEBB & BERTH. (1845), *Hypericum inodorum* MILL. (1768) and Phyllis nobla L. (1753)] that are widely distributed within the Garajonay National Park.

KEY WORDS: Laurisilva, germination, Canary Islands.

MATERIAL AND METHODS

As in the initial contribution to the study of the propagation of the laurel forest species (BAÑARES, 1992), on this ocassion, the seeds of the above mentioned species were obtained from plants growing at natural sites within the Garajonay National Park, concretely in the surroundings of Meriga (850 m a.s.l.), in July 1992. After initially drying the fruits, the seeds were extracted and weighed, and at the same time, described and illustrated. In certain cases (*C. canariensis, C. elegans, G. arborea, P. nobla* and *P. appendiculata*) where the seeds were embedded within the fruits (CORNER, 1976), the latter were regarded as the seminal units and are described as such. Posteriorly, supposedly fertile seeds were selected visually by means of the "water test". However, this method proved not to be very efficient for *A. castello-paivae* and *H. inodorum* due to the minute size and reduced weight of the seeds. With these species, the seeds were examined under a binocular microscope and only those that were similar in colour and aspect to seeds known to have a latent embrion (by examination of transversel sections) were selected. When descripting and illustrating the

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seedlings, we have followed MÜLLER (1978) who defines this growth stage as the period when the first two leaves are visible on the cotyledons.

The paucity of information concerning the germination behaviour of canarian plant species has meant that it has been difficult to adopt the recommendations presented in germination test manuals; however in some cases we have used as a basis the guidelines offered by ELLIS et al. (1985).

Greenhouse Trials

The selected seeds were split up into 2 lots of 100 units. One group was submitted to hormonal treatment (24 hr. immersion in an aqueous solution of GA_3 (Gibberelic Acid) (15 mg/100 ml) while the other group received no treatment whatsoever and thus acted as a "control".

The seedbeds were installed inside a conventional greenhouse situated at 600 m. a.s.l. in an area with a natural environment similar to that of the potential habitat of the species (Thermocanarian Bioclimatic Zone). The atmospheric conditions pervailing at the site throughout the time period of the trials were registered by using a thermohygrograph located inside the greenhouse. (Fig. 8).

The seeds were sown in polyethylene trays containing a mixture of fertilized peat and homogenized pyroclast in equal proportions. This substrate was kept permanently damp and every 15 days, received an application of a mixture of fungicides in which Benomil (30%) and Captan (85%) were the active components at a dosage of 1 gr/l of water.

By systematically counting the nascences throughout a trial period of 60 days (30 Oct.-28 Dec. 1992), the results of their germination behaviour are presented in Tab. 1, and the corresponding graphs (Figs. 9-11) in terms of the following parameters: "%G" Germination percentage or capacity; "VG" Germination Value, that includes both the germination rate as well as the percentage (CZBATOR, 1962). Finally $\chi 2$ tests, with 95% confidence limits, were applied to determine statistical differences between the results obtained for the hormone and control treatments.

Trials in the germination chamber

The preselected seeds were divided up into 8 different groups, each comprising 50 units, for their introduction into germination chambers, installed at the laboratories of El Centro Nacional de Mejora Genética Forestal (El Serranillo, Guadalajara).

Sowing was carried out on sterilized Petri dishes using either filter paper or calibrated sand as the substrate. The reason for employing two alternative substrates resides in the fact that although the latter is more hostile to fungal infections, the reduced seed dimensions of some of the taxa (*A. castello-paivae, G. arborea, H. inodorum, P. appendiculata*) conditioned the use of filter paper in order to be able to detect their germination.

The substrates were moistened with an antifungal solution of 0,5% neutral oxyquinoline sulphate in distilled water, registering no cryptogamic infection throughout the course of the germination process.

With the aim of carrying out tests under different conditions of temperature and photoperiod, two chambers were used. In one, 4 dishes were maintained at 19° C with constant fluorescent light while in the other, 4 dishes were kept at 16° C receiving 12 hours of natural light.

Germination was monitored by carrying out multiple observations throughout the trial period (limited to 60 days), during which, the germinated seeds were counted and removed. The corresponding results and calculations of germination behaviour -referring to the most successful test- are presented in Tab. 1 and the respective graphs (Figs. 9-11) for each of the taxa studied.

Finally, once the trials had terminated, an incision was made into those seeds that had failed to germinate in order to elucidate the cause of their germination incapacity. The corresponding results are expressed in Tab. 1 as percentages of the following 3 types: "vain seeds" that lack the necessary structures in order to germinate, possessing only the seedcoat; "hard seeds" that despite having a latent embrion, remain unaltered throughout the trials due to their incapacity to absorb water (HARTMANN & KESTER, 1987); and finally "dead seeds" that despite being free from fungal attack did not germinate although they were neither vain nor hard. For certain species, seed types of the hard category were registered in significant proportions, thereby demonstrating the need to be subjected to pretreatment in order to increase their germination success.

Nascence Coefficient (Cn)

The strict control of the atmospheric conditions and the sterility of the substrate that one can obtain when working under laboratory conditions, in most cases, gives rise to higher germination rates and percentages than those obtained in the greenhouse. Consequently, we have applied the "nascence coefficient" (DIEHL & MATEO BOX, 1978) for quantifying the yield obtained in the nursery using the formula $Cn = (100 \times n)/Fg$, where "n" is the germination percentage in the greenhouse and "Fg" the corresponding value obtained in the chamber.

TAXA STUDIED

Aeonium castello-paivae BOLLE (1859)

SEEDS Elongated ovate to subpyriform, minute, measuring 0.5 x 0.2 mm. Seedcoat dark brown with longitudinal ridges. Weigh approximately 0.08 mg. (Fig. 1).

SEEDLING Hypocotyl light green, 2-3 mm in length, pubescent. Cotyledons obovate, sessile, light green and pubescent, 2-4 x 2-3 mm, fleshy. Epicotyl absent or virtually absent. Leaves arranged in a rosette, subspatulate, acute, fleshy with ciliated margins, glaucous with reddish hues on the upper surface. (Fig. 1).

GERMINATION BEHAVIOUR The results from the chamber revealed a low germination capacity that was slightly higher under the low temperature (16° C) treatment (33%). The high proportion of hard seeds (63%) that did not germinate under these conditions tends to indicate the need for an initial pretreatment.

In the greenhouse, the use of GA_3 gave better results, significantly different to that of the control treatment. Likewise, the superior VG obtained with hormones indicates the use of these products in order to obtain a high germination yield.

According to ELLIS *et al.* (1985), light constitutes an important factor that stimulates germination in the genus *Sedum* (L, 1753); bearing in mind the fact that the seed morphology of *Aeonium* (WEBB & BERTH., 1840) is very similar to that of the former genus, it is highly probable that the latter responds to the same germination pattern. On the other hand, submitting the seeds to scarification at high temperatures could similarly improve germination success.

The Cn value of 91% obtained in the greenhouse indicates a high yield, though the VG is lower than that registered in the chamber. (Tab. 1; Fig. 9).

Cedronella canariensis (L.) WEBB & BERTH. (1845)

FRUIT A tetra-nutlet; nutlets triangular in section, 2 x 1 mm, blackish-brown, finely rugose with a whitish lateral protuberance and a weak ventral rib. Weigh approximately 1.7 mg. Previously described by LA SERNA (1976). (Fig. 2).

SEEDLING Hypocotyl smooth, light green, 4-5 mm in length. Cotyledons green, petiolate, obovate, 5-6 X 3-4 mm. Epicotyl absent or practically absent. Leaves trifoliolate, 10-15 x 6-8 mm; leaflets lanceolate with serrated margins, glabrous above and pubescent below. (Fig. 2).

GERMINATION BEHAVIOUR The results from the chamber showed a poor germination capacity, slightly higher under low temperature conditions (16° C) (13%). The large proportion (81%) of hard seeds that failed to germinate infers the need for pretreatment.

Likewise a low germination percentage was recorded in the greenhouse. Treatment with GA_3 gave lower results, significantly different to those of the control and they also gave an inferior VG.

Consequently, this species demonstrates a poor germination yield under the test conditions employed and thus, coincides with the results offfered by ELLIS *et al.* (1985) with respect to the family Labiatae, the seeds of which usually exhibit latency. (Tab. 1; Fig. 9).

Cryptotaenia elegans WEBB ex BOLLE (1861)

FRUIT Subglobose schizocarp, glabrous, black; mericarps more or less ellipsoid, 2 x 1 mm, ribbed on their commissural face and slightly appendiculated at the apex. Weigh approximately 0.8 mg. (Fig. 3).

SEEDLING Hypocotyl 9-10 mm, brown, smooth. Cotyledons sessile, linear, green, 8-10 x 1-2 mm. Epicotyl hardly noticeable. Leaves pinnatisect, 10-12 x 8-15 mm; lobules lanceolated, lustrous green and weakly pubescent. (Fig. 3).

GERMINATION BEHAVIOUR The tests in the germination chamber gave a 100% germination capacity under high temperature conditions (20° C).

In the greenhouse, the use of GA_3 gave lower results, significantly different to that registered in the control treatment and they also gave an inferior VG. The Cn value indicates the yield in the greenhouse as 58%, and a substantially inferior VG was obtained in comparison with that from the chamber. (Tab. 1; Fig. 9).

Gesnouinia arborea (L. fil.) GAUD. (1830)

FRUIT Slightly flattened obovate achene, embedded in the calyx, 1 x 0.5 mm, brown, hirsute and longitudinally ribbed. Weigh approximately 1.5 mg. (Fig. 4).

SEEDLING Hypocotyl 3-4 mm, glabrous, white hyaline to reddish. Cotyledons weakly petiolate, ovate, 2-3 x 1-2 mm, glabrous, green above and whitish below. Epicotyl 2-4 mm, whitish to reddish. Leaves entire, acuminate, trinervate, pubescent. (Fig. 4).

GERMINATION BEHAVIOUR The trials in the germination chamber produced a 62% germination capacity under high temperature conditions (20° C). The seeds that failed to germinate were entirely either vain or dead.

The use of GA_3 in the greenhouse gave lower results, but not significantly different to that of the control treatment. However, an inferior VG were obtained using hormones.

The resultant Cn gives a 58% yield in the greenhouse and a substantially lower VG is obtained in comparison to that from the chamber. (Tab. 1; Fig. 10).

Hypericum inodorum MILL. (1768)

SEEDS Ovate, minute, 0.8 x 0.5 mm., brown, finely rugose with a lateral rib. Weigh approximately 0.09 mgs. (Fig. 5).

SEEDLING Hypocotyl 3-4 mm, hyaline white, glabrous. Cotyledons sessile, obovate, 1-1.5 x 0.5-1 mm, glabrous, bright green above and pale green below. Epicotyl 1-2 mm. Leaves petiolate, ovate and obtuse, 3-5 x 1.5-2 mm, glabrous, green above and greenish white below. (Fig. 5).

GERMINATION BEHAVIOUR The tests carried out in the chamber revealed an optimum germination capacity (82%) under high temperature conditions (20° C). The seeds that failed to germinate were exclusively either vain or dead.

The use of GA_3 in the greenhouse gave lower results, significantly different to that registered in the control treatment and they also gave an inferior VG.

The Cn value of 87% demonstrates a high yield in the greenhouse and the corresponding VG is slightly inferior to that obtained in the chamber. (Tab. 1; Fig. 10).

Pericallis appendiculata (L. fil.) B. NORD. (1978)

FRUIT Ellipsoidal to subcylindrical achenes, 1.5-1.9 x 0.5 mm, black, finely rugose, longitudinally ribbed and possessing an apical ring covered with a notorius pappus. Weigh approximately 0.5 mg. (Fig. 6).

SEEDLING Hypocotyl 4-5 mm, glabrous, reddish. Cotyledons obovate, 3-4 x 2-3 mm, bright green on upper surface. Epicotyl hardly visible. Leaves ovate to subcordiform, 6-10 x 4-5 mm, margin weakly lobed and serrated, upper surface bright green and glabrous while underside is white, lanuginose. (Fig. 6).

GERMINATION BEHAVIOUR The tests in the germination chamber produced an optimal germination capacity (94%) at high temperatures (20° C). The seeds that failed to germinate were exclusively either vain or dead.

The use of GA_3 in the greenhouse gave lower results but not significantly different to that of the control treatment. However, an inferior VG were obtained using hormones.

The Cn value of 79% indicates a high yield in the greenhouse, though the resultant VG is lower to that obtained in the chamber. (Tab. 1; Fig. 10).

Phyllis nobla L. (1753)

FRUIT Greyish to black schizocarp; mericarps concave in section, 3 x 1 mm, rugose, slightly ribbed on abaxial face, shiny and hairy on the adaxial face. Weigh approximately 1.10 mg. (Fig. 7).

SEEDLING Hypocotyl 2-3 mm, glabrous, white hyaline. Cotyledons petiolate, oval, 3-4 x 1.5-2 mm, slightly pubescent on the upperside. Epicotyl practically imperceptible. Leaves lanceolate to suboval, entire, 8-15 x 5-6 mm, glabrous, bright green on the upperside. (Fig. 7).

GERMINATION BEHAVIOUR The results from the chamber trials produced an optimum germination capacity (95%) under high temperature conditions (20° C). The seeds that failed to germinate were all dead.

The use of GA_3 in the greenhouse gave lower results, significantly different to that registered in the control treatment and they also gave an inferior VG.

The Cn value of 99% indicates a very high yield in the greenhouse though the resultant VG is lower to that obtained in the chamber. (Tab. 1; Fig. 11).

ACKNOWLEDGEMENTS

Part of the work has been carried out thanks to the collaboration offered by El Centro Nacional de Mejora Genética Forestal through D. JUAN PEÑUELAS who placed at our disposition the personnel and materials of the mentioned Centre. We would also like to thank D. ANGEL FERNANDEZ for his assistance with the fieldwork and supplying chorological data and finally, DÑA. LUZ MARINA RODRIGUEZ for preparing the iconography.

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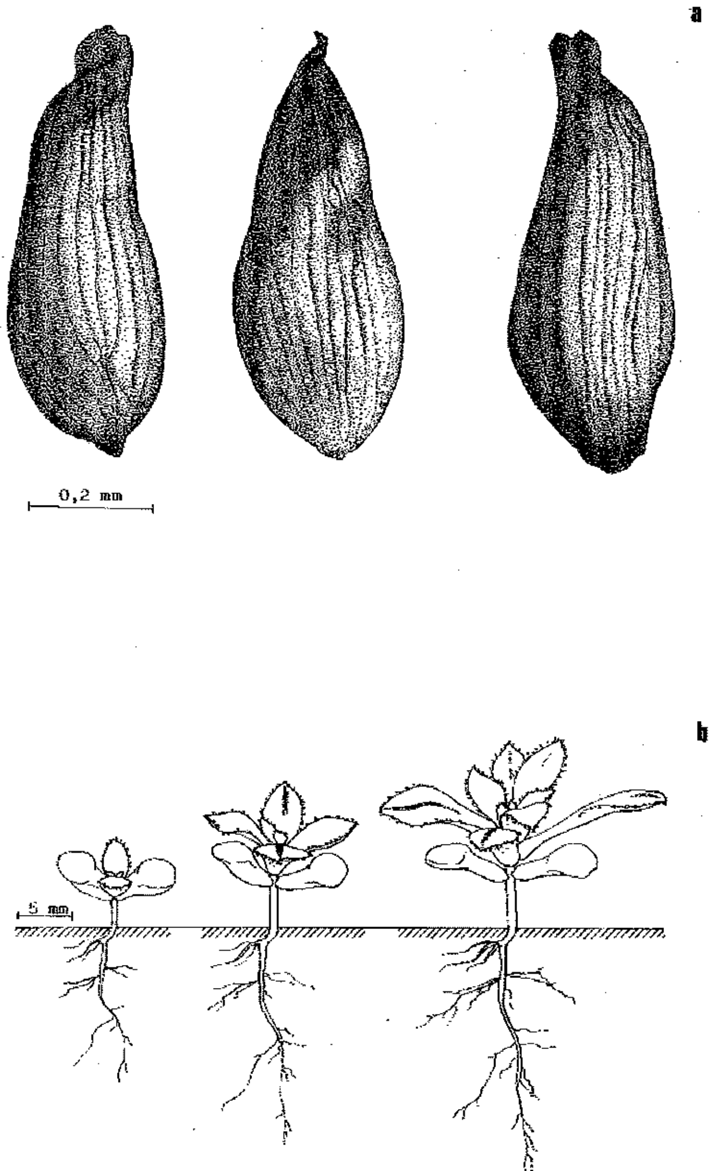

Figure 1 - *Aeonium castello-paivae*. (a) seeds. (b) development of seedlings.

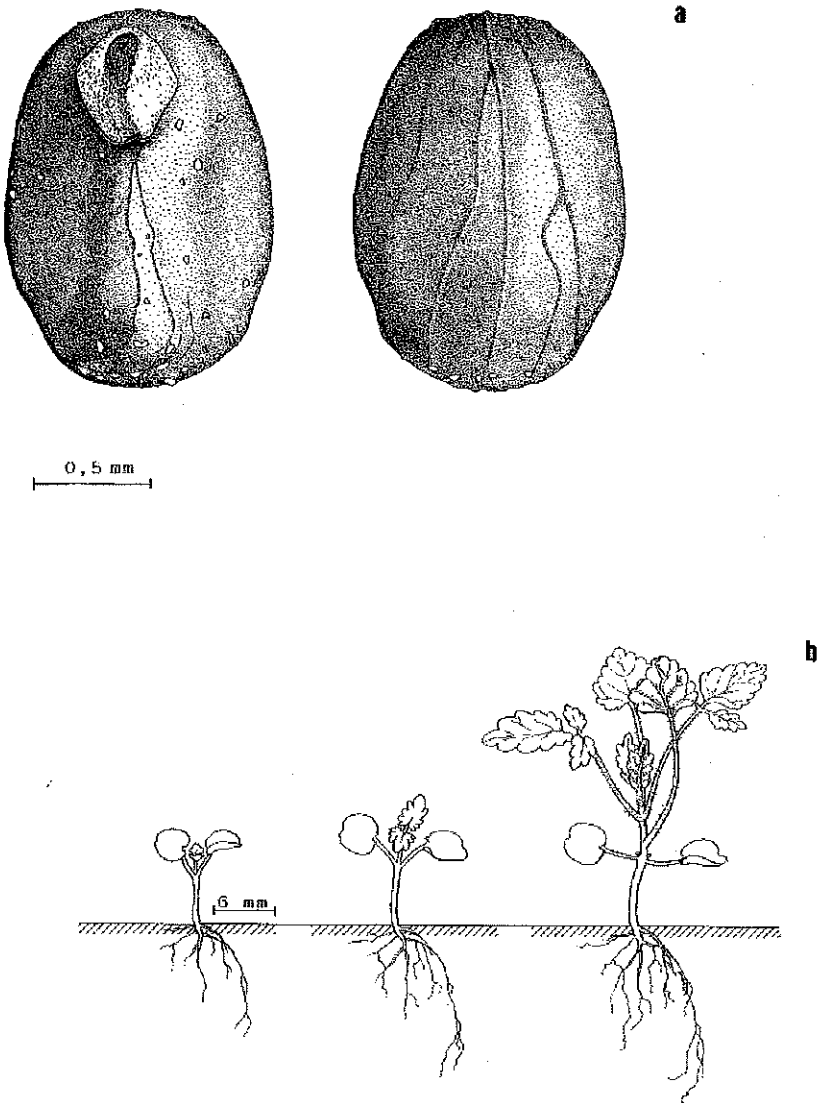

Figure 2 - *Cedronella canariensis*. (a) fruits. (b) development of seedlings.

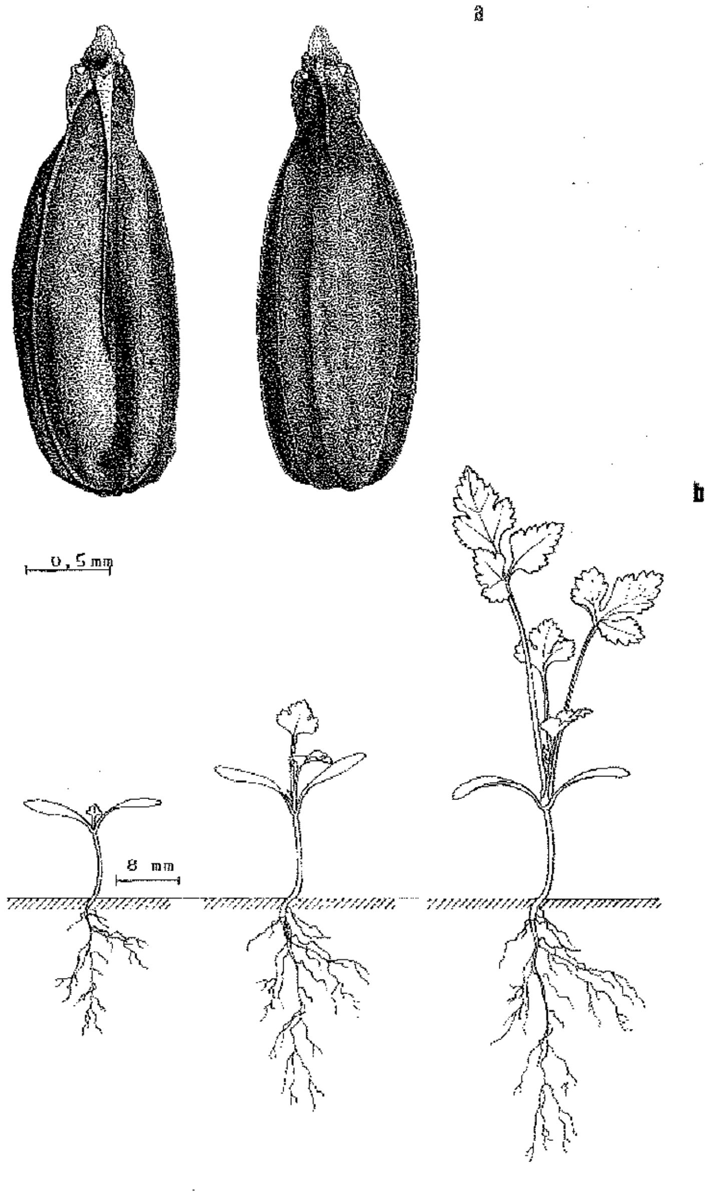

Figure 3 - *Cryptotaenia elegans*. (a) fruits. (b) development of seedlings.

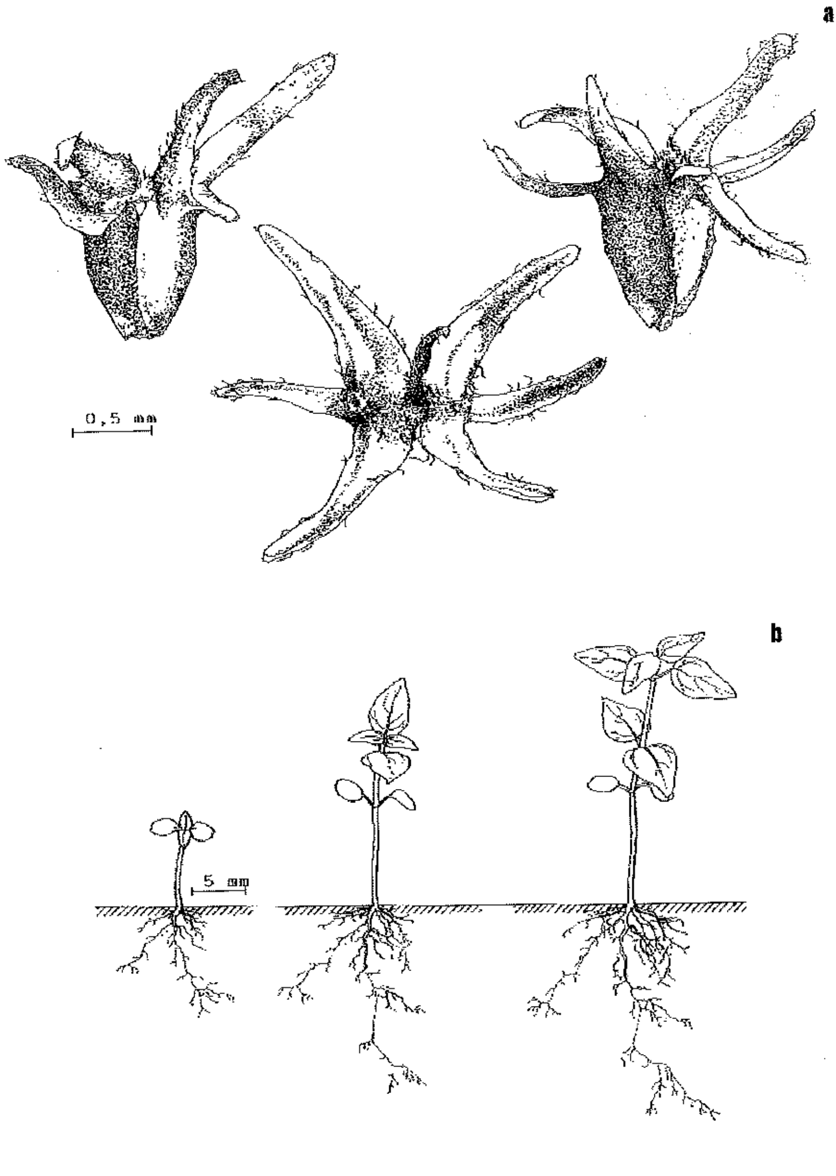

Figure 4 - *Gesnouinia arborea*. (a) fruits. (b) development of seedlings.

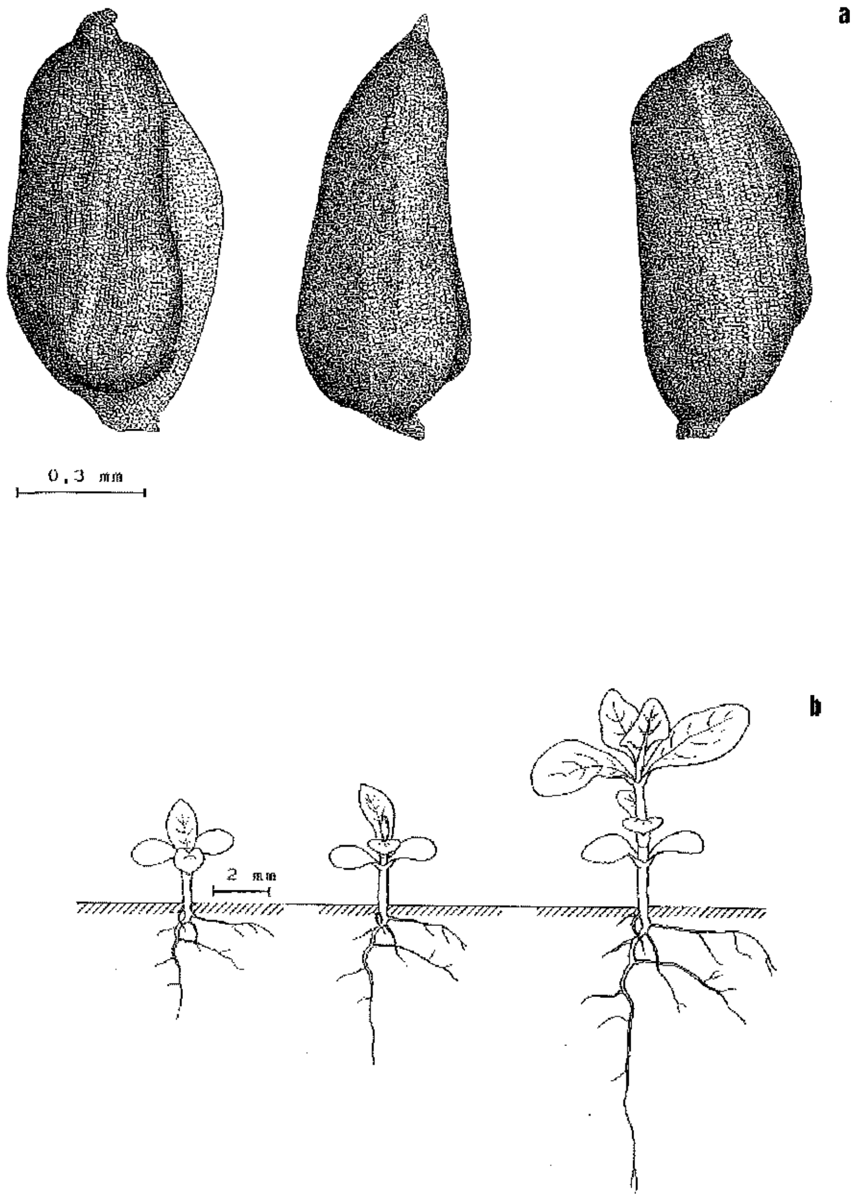

Figure 5 - *Hypericum inodorum*. (a) seeds. (b) development of seedlings.

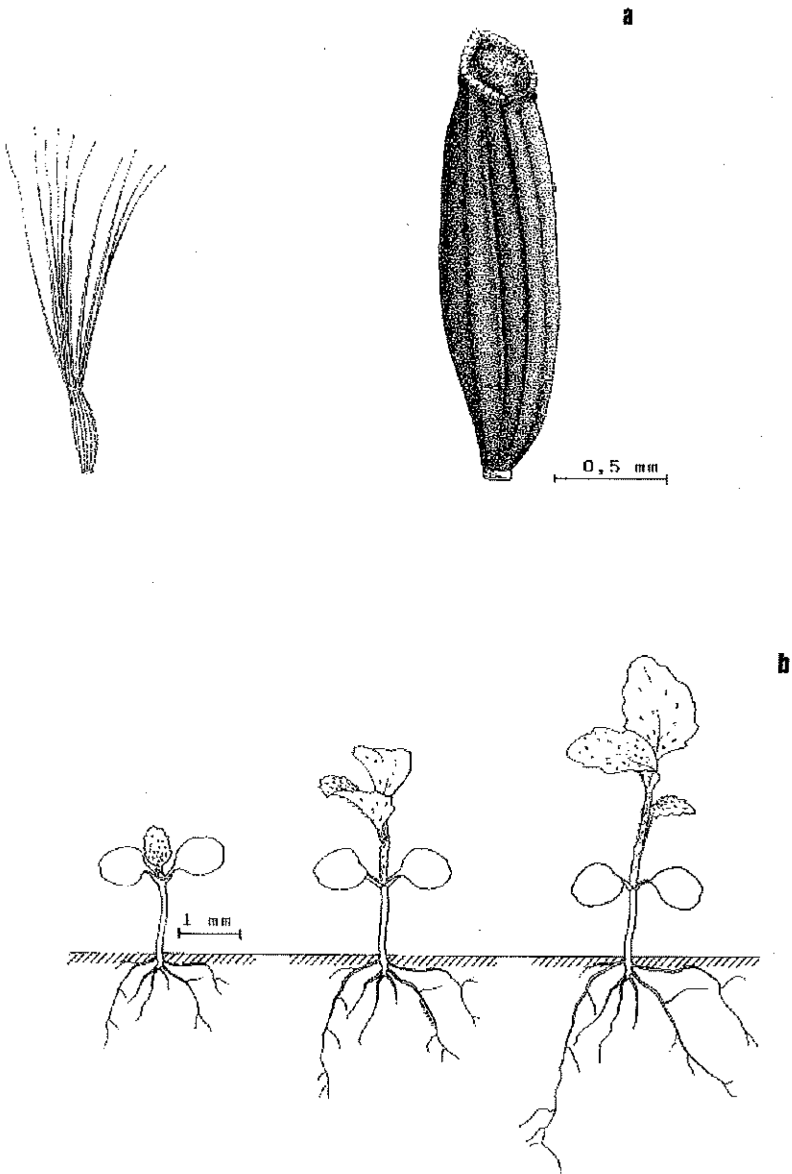

Figure 6 - *Pericallis appendiculata*. (a) fruits. (b) development of seedlings.

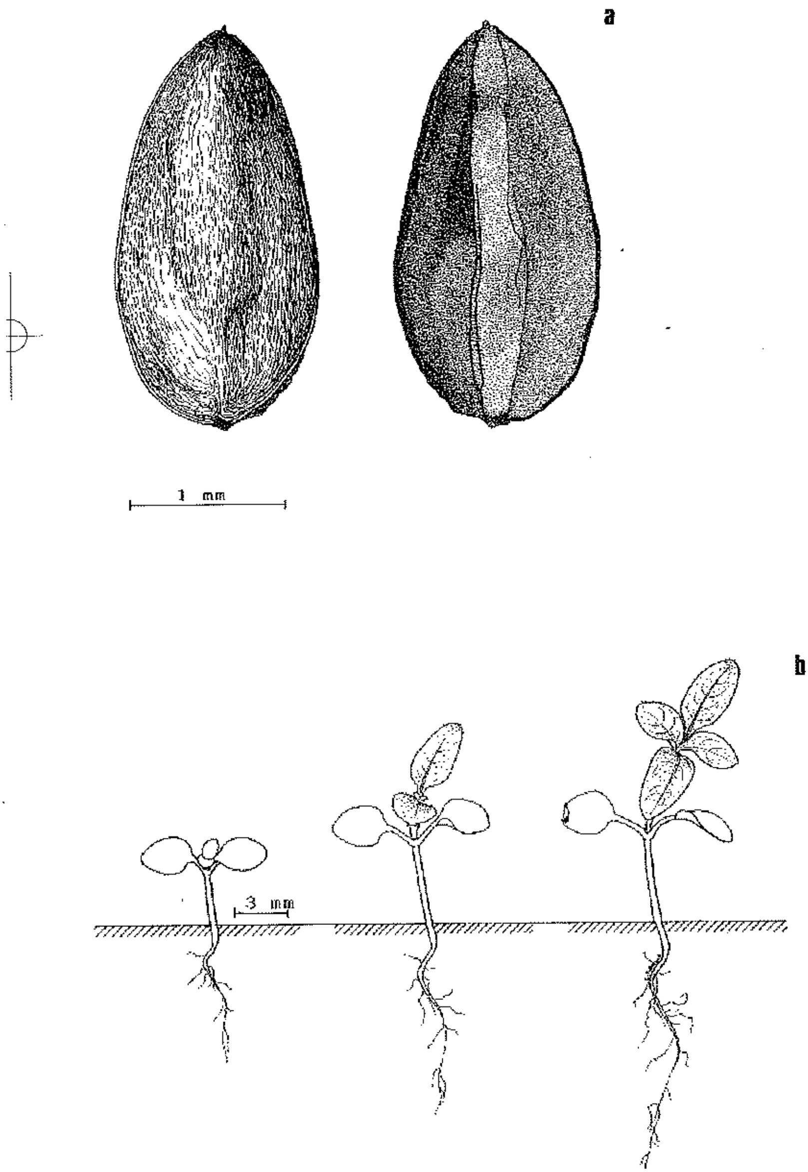

Figure 7 - *Phyllis nobla*. (a) fruits. (b) development of seedlings.

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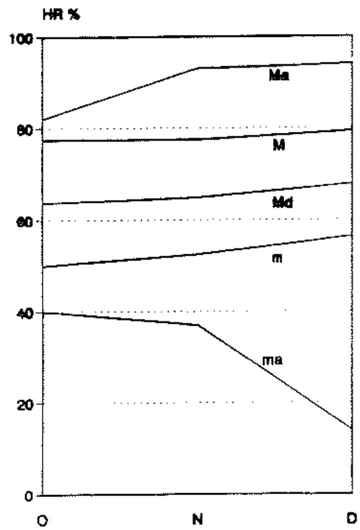

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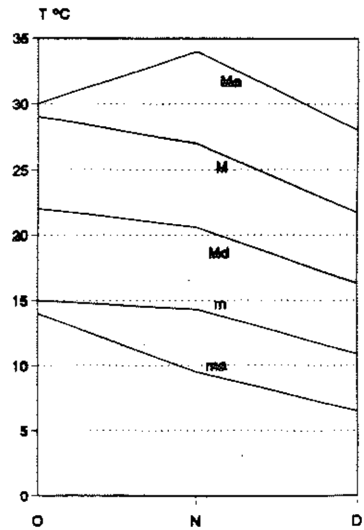

Figure 8 - Relative Humidity (RH %) and Temperature (T °C) in the Greenhouse at E.U.I.T.A. (600 m a.s.l.). Period from Oct. to Dic. 1992. Ma, absolute maximum. M, maximum average. Md, absolute average. m, minimum average. ma, absolute minimum.

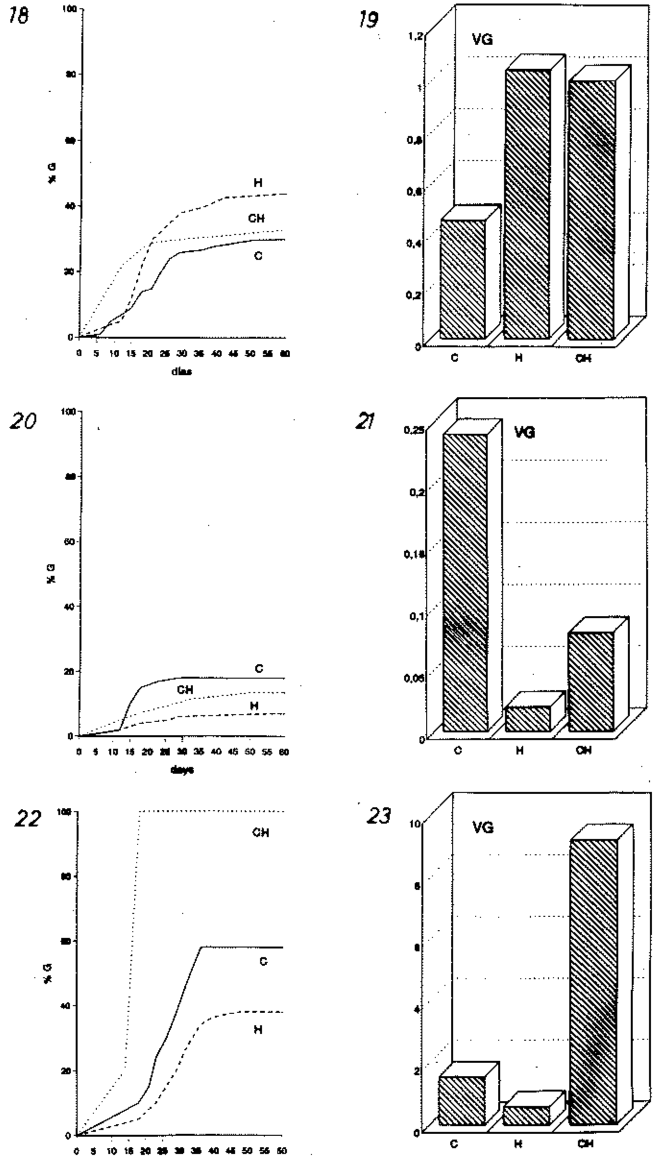

Figure 9 - Germination Capacity (%G) and Germination Value (VG). (a) *Aeonium castello-paivae.* (b) *Cedronella canariensis.* (c) *Cryptotaenia elegans.* C, Control treatment. H, Hormones treatment. CH, Chamber.

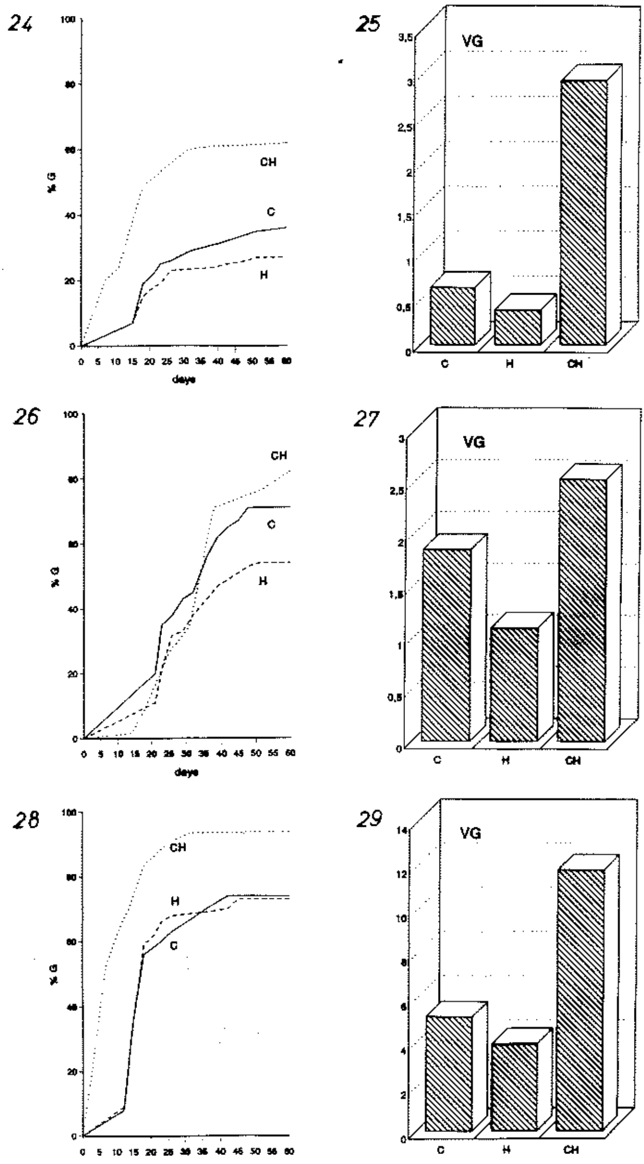

Figure 10 - Germination Capacity (%G) and Germination Value (VG). (a) *Gesnouinia arborea.* (b) *Hypericum inodorum.* (c) *Pericallis appendiculata.* C, Control treatment. H, Hormones treatment. CH, Chamber.

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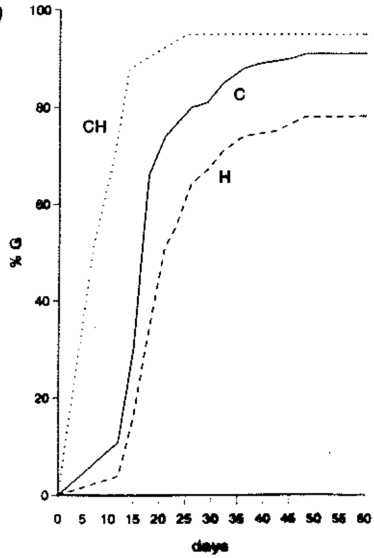

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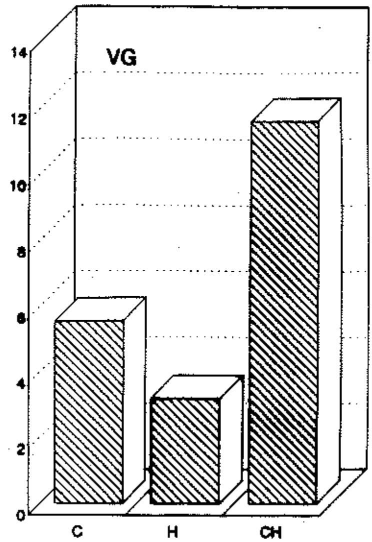

Figure 11 - Germination capacity (%G) and Germination Value (VG). *Phyllis nobla*. C, Control treatment. H, Hormones treatment. CH, Chamber.

TABLE 1 - Germination behavior in the Greenhouse and Chamber of the species studied. G: Germination Capacity (%). VG: Germination Value. C, H: Control and Hormone treatment. V, D, H: Vain, Dead and Hard seeds (%), respectively. Cn: Nascence Coefficient.

	GREENHOUSE					GERMINATION CHAMBER					Cn
	G			VG		G	VG	V	D	H	
	C	H	χ^2	C	H						
Aeonium castello-paivae	30	44	4,20	0,46	1,04	33	1,00	0	2	63	91
Cedronella canariensis	18	7	5,53	0,24	0,02	13	0,08	1	3,5	81	138
Cryptotaenia elegans	58	38	8,01	1,55	0,59	100	9,24	0	0	0	58
Gesnouinia arborea	36	27	1,87	0,64	0,39	62	2,94	32,5	5,5	0	58
Hypericum inodorum	71	54	16,39	1,86	1,10	82	2,54	6,5	7,5	0	87
Pericallis appendiculata	74	73	0,02	5,20	3,97	94	11,85	4	2	0	79
Phyllis nobla	91	78	6,45	5,55	3,19	95	11,60	0	5	0	96