Fruit Varieties Journal 51(1):13-27 1997

Description of 80 Cultivars and 36 Clonal Selections of Chestnut (*Castanea sativa* Mill.) from Northwestern Spain

S. PEREIRA-LORENZO[1] AND J. FERNANDEZ-LOPEZ[2]

Abstract

Chestnut (*Castanea sativa* Mill.) is an important species in Galicia, Northwestern Spain, and cultivars for nut and timber production have been reported since Middle Ages. Nut and timber production are mainly based on old grafted cultivars which were supposedly introduced by the Romans. For five years these old cultivars of chestnut were studied by agronomic traits: tree, fruit, burr, leaves, male catkin and phenology. These cultivars were also characterized based on five isoenzyme systems: isocitrate dehydrogenase (IDH; EC 1.1.1.42), phosphoglucoisomerase (PGI; EC 5.3.1.9), phosphoglucomutase (PGM; EC 2.7.5.1), malate dehydrogenase (MDH; EC 1.1.1.37), and shikimate dehydrogenase (SKDH; EC 1.1.1.25). This paper presents the most important characteristics of 80 cultivars and 36 clonal selections. This information will be useful for growers choosing cultivars for new orchards and researchers looking for specific agronomic characters. Clonal selections have been made by choosing superior trees within heterogenous cultivars and permitting a clear distinction among cultivars. The most important characteristics of these cultivars are non-divided nuts, sweetness, easy peeling and late harvesting (26 October to 11 November). Some cultivars have very large nuts. The most interesting cultivars are 'Famosa,' 'Garrida,' 'Inxerta,' 'Ventura,' 'Peluda,' 'Praga d'Afora,' 'Redondo' and 'Soutogrande' whose nuts can be used fresh, peeled, or in *marron glacé*. There is a great deal of genetic variability in Galician chestnuts and it is recommended that these cultivars be preserved in the Germplasm Bank of the Centro de Investigaciones Forestales de Lourizán.

After five years of studying Galician chestnut cultivars (*Castanea sativa* Mill.), we presented the results on the morphological and isoenzymic variability (11, 12, 13). A large amount of intra- and inter-cultivar variability was found, and selection within heterogeneous cultivars is recommended. Here, we describe 80 cultivars and 36 clonal selections, and discuss how we can improve production using this material. We consider 15 cultivars to be the most important according to their distribution area (7). The characteristics described here are interesting for researchers and growers who need information about cultivars can be useful in new research programs or for establishing new orchards. We also discuss the importance of certification in chestnut because of important intra-cultivar variability.

Material and Methods

Plant material

From 1989 to 1991, 373 trees were sampled (12) of which 353 belonged to 81 cultivars which are described in this paper. These grafted cultivars were named by local farmers and were previously classified using morphological traits (12). Most of the chestnut growing areas in Galicia, Northwestern Spain, were sampled (6). The trees were growing at 140 to 1060 m above sea level. Scions were collected in February from each cultivar present at each sampled location and grafted on to the hybrid rootstock CHR-151 (*C. crenata* x *C. sativa*, F2, previously

This research was funded in part by the INIA and the Conselleria de Agricultura, Xunta de Galicia.

[1]Associate Professor. Departamento de Ingenieria Agroforestal y Produccion Vegetal, Universidad de Santiago de Compostela, Campus de Lugo, 27002 Lugo, Spain.

[2]Plant Breeding Researcher. Centro de Investigaciones Forestales de Lourizán, Apartado 127, 36080 Pontevedra, Spain. Address where interchanges of scions can be required.

known as 'HS') in a collection at the Centro de Investigaciones Forestales de Lourizan. These trees were inspected previously during harvesting time in October. More than one tree was gathered for each of 50 cultivars. For the remaining cultivars, only one tree was found (6).

Clonal selection was carried out by choosing a single tree of the most frequent genotype within each cultivar at each site, after studying the sampled trees by morphological traits and isoenzymes and defining the intra- and intercultivar variability (12, 13), sometimes removing some trees with unsatisfactory characteristics. More than one clone was selected when more than one tree showed characteristics interesting for nut or timber production. Differences among trees within a cultivar, observed as differences in isoenzyme pattern or morphological characteristics, may have arisen as mistakes by the grower during propagation, misnaming or resulted from occasional sexual propagation, since mutation has not been referenced previously (12).

Morphological and agronomic traits

Of the 135 characters studied, the 32 agronomic and morphological traits considered most useful for describing cultivars and clonal selections are presented in this work (11): 1) number of trees (NOT), 2) the range altitudes at which that cultivar and selection were found (ALT), 3) the production for most of the cultivars estimated as average in 1978 and 1979 in Galicia (PRO) (6), 4) type of male catkins (A = astaminate, B = brachystaminate, M = mesostaminate, L = longistaminate) (for more details, see reference 2), 5) length of male catkins (LMC), 6) leaf blade length (LLL), 7) leaf blade width (LLW), 8) leaf length/width ratio (LWR), 9) type of burr according to the length: E1, short, E2, medium, E3, long (TBL) (14), 10) percentage of normal nuts per burr (NNB), 11) caliber (nuts per kg, CAL), 12 to 16) percentage of nuts with diameter less than 24 mm, between 24 and 28 mm, between 29 and 32 mm, between 33 and 36 mm, and between 37 and 40 mm, respectively (P24, P28, P32, P36 and P40), 17 and 18) shape index of central and lateral nuts (width/length x 100), respectively (SCN and SLN), 19 and 20) weight of central and lateral nuts, respectively (WCN and WLN), 21) nut color (6 classes as defined previously in 11 and 14), NUC); 22) facility of peeling (FAP); 23) taste (TAS); 24) percentage of divided nuts (DNP); 25) percentage of nuts with penetrations of the inner coat in the cotyledons (PNP); 26) percentage with the pericarp split (SNP); 27) percentage of nuts attacked by *Balaninus (Curculio) elephas* Gyll (BAL); 28) percentage of nuts attacked by *Laspeyresia splendana* Hubner (LAS); 29) percentage of nuts attacked by *Sclerotinia pseudotuberosa* Rehm (SCL); 30) percentage of nuts attacked by *Phoma endogena* Speg. (PHO); 31) percentage of nuts attacked by *Penicillium sp* (PEN); 32) harvesting time (HAT). For obtaining the means of quantitative traits, 15 male catkins, leaves and burrs (traits 5 to 10), 10 fruits (traits 17 to 20) and 40 fruits for estimating the percentages (traits 11 to 16 and 24 to 32) were sampled per each tree at the origin location. Data were collected for three years for most fruit traits, one year on burrs, leaves and male flowers (samples conserved in the herbarium at Centro de Investigaciones Forestales de Lourizán).

By choosing the most frequent phenotype within cultivars which nor show intracultivar variability neither for four traits (CAL, SCN, LMC and BSL) nor for isoenzymes, most of the cultivars could be classified in eight groups defined previously (12, 13).

Electrophoresis and isoenzyme staining

The following five isoenzyme systems were studied in the scions collected at the Centro de Investigaciones

Table 1. Characteristics of the most important Galician chestnut cultivars and their clonal selections (Pereira et al., 1996a).

Cultivar	NOT	ALT m	PRO t	TMC	LMC cm	LLL cm	LLW cm	LWR	TBL	NNB %	CAL nuts/kg	P24 %	P28 %	P32 %	P36 %	P40 %	SCN	SLN	WCN g	WLN g	GROUP
Amarelante	25	460-950	134	M,A,L	18,12	14,33	4,46	3,28	E2,E3,E1	66	111	18	43	32	5	2	114	111	10	12	VIII
Amarelante1[z]	4	550-950	-	M	21,54	14,87	4,52	3,35	E2	66	82	0	35	55	7	3	115	111	11	13	VIII
Amarelante2[z]	3	680-770	-	M	19,20	14,66	3,91	3,79	E3	66	73	0	25	60	11	5	117	112	13	15	
Blanca	17	240-1000	68	A,L,M,B	16,32	13,43	4,41	3,10	E2	73	131	37	55	8	0	0	117	116	9	9	II
Blanca1[z]	3	320-550	-	A	10,42	13,73	4,38	3,22	E2	82	113	33	62	5	0	0	129	126	10	11	II
Blanca2[z]	2	320-550	-	A	10,42	13,56	4,42	3,19	E2	77	113	31	65	5	0	0	132	127	10	11	II
Famosa	16	720-950	784	B,L,M	20,47	13,40	4,50	3,00	E3,E2	66	93	8	55	30	4	3	121	113	12	13	IV
Famosa[z]	5	860-950	-	B	22,55	12,51	4,16	3,04	E3	59	86	5	59	31	1	3	128	118	13	13	IV
Garrida	7	510-650	-	B,M	18,24	15,48	5,23	3,06	E2	64	85	6	51	38	4	2	122	116	13	14	V
Garrida[z]	4	600	-	B	19,01	14,74	5,33	2,82	E2	60	74	0	41	50	5	3	123	116	14	15	V
Inxerta	10	570-920	73	M	20,08	15,36	4,38	3,56	E2	70	74	0	15	48	17	20	111	107	13	14	I
Inxerta1[z]	3	640-920	-	M	20,12	15,78	4,47	3,63	E2	60	81	0	19	50	17	14	111	106	12	13	I
Inxerta2[z]	1	770	-	M	19,90	17,86	4,17	4,27	E2	100	89	4	74	22	0	0	123	118	11	11	I
Inxerta3[z]	1	760	-	M	18,94	12,86	3,95	3,32	E2	73	58	0	6	45	17	33	123	119	16	16	I
Longal	9	570-890	298	B,M	18,15	14,37	4,71	3,09	E3,E2	42	124	27	53	16	1	1	94	94	9	9	III
Longal1[z]	5	720-890	-	B	17,95	14,14	4,67	3,07	E3	50	118	23	55	18	2	2	90	89	9	10	III
Loura1	12	460-650	-	M,B	15,70	14,33	4,33	3,36	E2,E3,E1	59	90	12	60	26	2	0	125	121	12	13	VIII
Loura[z]	3	550-650	-	M	13,37	14,91	4,32	3,48	E2	59	86	11	67	21	1	0	127	125	14	14	VIII
Luguesa	11	240-900	-	M,L	16,83	14,65	4,57	3,22	E2,E1	71	92	7	76	18	0	0	120	118	11	12	VIII
Luguesa1[z]	3	550-600	-	M	16,82	14,61	4,66	3,14	E2	79	83	7	76	17	0	0	117	117	11	14	VIII
Luguesa2[z]	2	550-600	-	M	17,26	14,50	4,57	3,17	E2	76	83	8	77	15	0	0	120	120	11	13	VIII
Negral	13	520-820	690	L,A,M	19,47	14,76	4,51	3,34	E2	64	115	25	50	23	2	0	116	115	9	10	VI
Negral1[z]	4	500-630	-	L	24,93	17,04	4,54	3,80	E2	55	118	21	46	31	2	0	114	112	9	10	VI
Negral2[z]	1	500	-	L	28,09	18,43	5,10	3,73	E2	65	62	0	9	67	21	4	113	115	15	17	VI
Parede	16	450-750	-	M	15,95	14,39	4,39	3,30	E2,E1	65	135	35	61	4	0	0	108	104	8	9	VIII
Parede[z]	6	600-750	-	M	16,12	13,89	4,19	3,34	E2	69	135	32	65	3	0	0	109	102	8	9	VIII
Presa	9	600-820	-	M,L	17,09	15,57	5,36	3,02	E2,E3,E1	67	103	9	75	15	0	0	123	123	10	11	VIII
Presa[z]	3	760-820	-	M	17,41	14,83	5,27	2,90	E2	62	96	4	83	14	0	0	126	117	10	13	VIII
Raigona	16	350-800	842	B,M,A	19,71	15,09	4,60	3,35	E2	77	130	25	60	10	2	1	117	114	8	9	IV
Raigona1[z]	5	500-800	-	B	19,82	14,79	4,45	3,37	E2	83	128	21	68	5	0	0	119	116	8	9	IV
Raigona2[z]	2	500-800	-	B	17,47	14,78	4,41	3,40	E2	90	124	24	59	1	0	0	122	120	9	10	IV
Rapada	18	530-950	519	M	18,74	13,94	4,38	3,26	E1	60	106	21	64	14	1	0	118	114	10	11	VII
Rapada[z]	6	530-950	-	M	18,80	13,26	4,32	3,13	E1	57	99	15	74	11	0	0	121	117	10	11	VII
Ventura	8	810-1060	480	M	20,21	13,07	4,08	3,25	E2,E3	64	89	5	40	47	6	3	106	105	12	12	VIII
Ventura[z]	5	810-1060	-	M	20,41	13,47	4,24	3,20	E2	60	87	6	33	54	6	2	106	104	12	13	VIII
Verde	16	450-970	70	A,M	14,76	13,62	4,41	3,15	E2	68	118	26	63	10	1	0	121	115	9	10	II
Verde[z]	3	780-800	-	A	9,35	13,70	4,49	3,10	E2	73	105	22	76	2	0	0	138	123	9	9	II

NOT = Number of trees; ALT = altitude; PRO = production in Galicia; USE = recommended use; TMC = type of male catkin (A = astaminate, B = brachystaminate, M = mesostaminate, L = longistaminate); LMC = length of male catkin; LLL = leaf blade length; LLW = leaf blade width; LWR = length/width ratio; BSL = burr spine length (E1, short; E2, medium; E3, long); TBL = type of burr according to the length; NNB = percentage of normal nuts per burr; CAL = caliber; P24, P28, P32, P36, P40 = Percentage of nuts with diameter less than 24, between 24 and 28 mm, between 29 and 32, between 33 and 36, and between 37 and 40 mm, respectively; SCN, SLN = shape index of central and lateral nuts; WCN = weight of central nut; WLN = weight of lateral nut.
[z]Clonal selection.

Table 2. Characteristics of the most important Galician chestnut cultivars and their clonal selections (Pereira et al., 1996a).

Cultivar	NUC	FAP	TAS	DNP %	PNP %	SNP %	BAL %	LAS %	SCL %	PHO %	PEN %	HAT	USE
Amarelante	4	Regular	Sweet	2	32	3	14	15	6	9	1	26OCT - >11NOV	Fresh, marmalade, purée
Amarelante1[z]	4	Regular	Sweet	1	25	1	21	23	4	8	1	26OCT ->11NOV	Fresh, marmalade, purée
Amarelante2[z]	4	Bad	Sweet	2	30	1	13	15	1	3	1	26OCT - 11NOV	Fresh, marmalade, purée
Blanca	4	Good	Sweet	4	37	12	14	9	4	10	1	26OCT ->11NOV	Fresh, marmalade, purée
Blanca1[z]	4	Regular	Variable	0	34	9	15	8	6	12	0	26OCT - 11NOV	"
Blanca2[z]	4	Regular	Sweet	0	25	7	14	8	9	15	0	26OCT - 11NOV	"
Famosa	4,3,2	Good	Sweet	0	20	7	10	14	6	9	0	>11NOV	Every
Famosa[z]	4	Good	Sweet	0	24	11	5	9	9	7	0	>11NOV	Every
Garrida	4	Variable	Sweet	2	36	2	36	31	4	4	0	>11NOV	Fresh, marmalade, purée, timber
Garrida[z]	4	Good	Sweet	2	34	1	43	41	2	3	0	>11NOV	Every, timber
Inxerta	3	Good	Sweet	1	41	2	13	11	17	11	1	26OCT - >11NOV	Every
Inxerta1[z]	3	Good	Sweet	1	40	2	14	12	18	8	0	26OCT - >11NOV	Every
Inxerta2[z]	-	Bad	Sweet	0	0	5	48	33	3	23	0	26OCT - >11NOV	Fresh, marmalade, purée
Inxerta3[z]	2	Regular	Sweet	2	65	4	6	0	16	16	0	26OCT - >11NOV	Fresh, marmalade, purée
Longal	4	Good	Sweet	0	13	6	10	12	9	3	0	26OCT - 11NOV	Every with biggest nuts
Longal1[z]	4	Good	Sweet	0	12	4	14	11	4	3	0	26OCT - >11NOV	Every with biggest nuts
Loura	4	Bad	Variable	3	36	3	33	27	4	5	0	26OCT - >11NOV	Fresh, marmalade, purée, timber
Loura[z]	4	Bad	Variable	1	39	7	35	32	8	6	0	26OCT - >11NOV	Fresh, marmalade, purée, timber
Luguesa	4	Regular	Sweet	4	23	13	14	27	9	11	0	>11NOV	Fresh, marmalade, purée
Luguesa1[z]	6,7	Regular	Variable	1	57	28	14	25	11	6	0	>11NOV	Marmalade, purée
Luguesa2[z]	6,7	Regular	Sweet	1	40	29	19	33	14	8	0	>11NOV	Fresh, marmalade, purée
Negral	4	Good	Sweet	2	36	6	10	19	6	9	0	10OCT - 11NOV	Fresh, marmalade, purée, pollinizer
Negral1[z]	4	Good	Sweet	1	42	1	11	19	4	8	1	10OCT - 11NOV	Fresh, marmalade, purée, pollinizer
Negral2[z]	4	Variable	Sweet	3	37	0	26	31	15	21	0	26OCT - 11NOV	Fresh, marmalade, purée, pollinizer
Parede	2	Variable	Sweet	1	18	4	12	16	17	5	1	26OCT - 11NOV	Marmalade, purée, timber
Parede[z]	2	Good	Sweet	0	19	3	13	16	11	3	2	26OCT - 11NOV	Marmalade, purée, timber
Presa	7,3	Regular	Insipid	1	48	7	16	22	9	10	0	26OCT - 11NOV	Fresh, marmalade, purée, timber
Presa[z]	3,6,7	Regular	Insipid	2	71	4	14	21	3	7	0	26OCT - 11NOV	Fresh, marmalade, purée, timber
Raigona	4,2	Good	Sweet	8	29	1	10	17	9	5	0	26OCT - 11NOV	Marmalade, purée
Raigona1[z]	4,2	Good	Sweet	14	49	2	16	22	10	5	1	26OCT - 11NOV	Marmalade, purée
Raigona2[z]	4,2	Good	Sweet	5	70	2	4	11	11	7	1	26OCT - 11NOV	Marmalade, purée
Rapada	2,7	Good	Sweet	2	16	46	4	12	14	11	0	26OCT - 11NOV	Marmalade, purée
Rapada[z]	7	Good	Sweet	4	40	3	10	22	6	11	0	26OCT - 11NOV	Marmalade, purée
Ventura	4	Good	Sweet	1	30	5	23	41	0	2	0	26OCT - 11NOV	Every
Ventura[z]	2,3	Good	Sweet	0	27	7	19	38	0	2	0	26OCT - 11NOV	Every
Verde	3	Variable	Sweet	2	41	6	11	12	8	9	0	26OCT - 11NOV	Marmalade, purée
Verde[z]	3	Good	Sweet	3	52	12	10	7	1	3	0	>11NOV	Marmalade, purée

NUC = nut color (1 to 6); FAP = facility of peeling; TAS = taste; DNP = percentage of divided nuts; PNP = percentage of nuts with penetrations of the inner coat in the cotyledons; SNP = percentage with the pericarp split; BAL, LAS, SCL, PHO, PEN = Percentage of nuts attacked by *Balaninus elephas* Gyll, *Laspeyresia splendana* Hubner, *Sclerotinia pseudotuberosa* Rehm, *Phoma endogena* Speg. and *Penicillium sp*, respectively; HAT = harvesting time.
[z]Clonal selection.

Table 3. Characteristics of the minor Galician chestnut cultivars and their clonal selections (Pereira et al., 1996a).

Cultivar	NOT	ALT m	PRO t	TMC	LMC cm	LLL cm	LLW cm	LWR	TBL	NNB %	CAL nuts/kg	P24 %	P28 %	P32 %	P36 %	P40 %	SCN	SLN	WCN g	WLN g	GROUP
Abadá[Y]	3	460-550	-	M	17,09	15,67	4,63	3,42	E1,E2	58	79	0	60	38	1	1	117	117	12	12	
Abarcá	1	420	-	M	17,75	17,46	5,32	3,27	E2	76	108	11	53	37	0	0	111	107	8	8	VIII
Amadengue	1	650	-	-	-	-	-	-	-	60	122	52	43	5	1	0	136	132	10	10	
Anaxa	1	860	-	M	15,50	15,50	2,99	2,99	E3	62	93	0	54	44	1	1	108	108	11	13	
Das Anchas	1	550	24,5	M	19,18	12,73	3,88	3,33	E2	89	101	1	86	14	0	0	108	108	11	11	VIII
Areal	2	580-600	-	L	20,25	13,70	3,87	3,55	E2	59	81	0	36	60	3	1	111	107	10	10	VI
Berciana	-	-	-	-	-	-	-	-	-	-	115	36	61	3	0	0	132	118	11	10	
Bermella[Y]	5	500-810	7	M	21,34	15,99	5,37	3,01	E2,E1	68	120	25	56	17	2	1	108	107	9	11	
Bolesas	1	520	-	M	12,10	9,17	3,52	2,63	E1	60	102	4	75	20	2	0	112	112	11	13	
Bravo de Leirado	5	600-800	-	L	21,49	13,48	4,16	3,26	E1,E2	77	102	16	63	21	0	0	128	120	9	10	VI
Bravo de Leirado[Z]	1	680	-	L	19,79	13,24	4,19	3,19	E2	93	107	21	59	19	0	0	121	119	10	13	VI
Burgaceira	2	580-820	-	A	9,93	10,20	3,32	3,10	E2	53	90	13	76	12	0	0	125	116	9	11	II
Cabezuda	3	550-650	-	M	21,49	15,97	4,40	3,77	E2	56	80	4	60	28	5	4	125	121	14	14	VIII
Calva	4	620-840	85,9	M	18,12	13,68	4,02	3,46	E2,E1,E3	80	83	8	46	37	5	5	119	117	12	13	VIII
Calva[Z]	1	780	-	M	19,29	14,21	4,51	3,18	E2	100	68	0	28	52	10	11	119	116	14	12	VIII
Campilla	3	460-620	155,9	M	13,82	14,06	3,66	3,92	E2	55	188	51	44	5	0	0	114	114	5	6	VIII
Carrelao	1	860	-	M	20,32	16,23	5,44	3,03	E2	58	87	0	26	71	3	0	107	113	12	14	VIII
Castelás	1	240	-	M	17,94	18,22	5,34	3,41	-	-	-	-	-	-	-	-	-	-	-	-	
Caurelal	1	800	-	B	14,28	16,02	4,04	4,02	E2	47	129	44	54	2	1	0	115	116	9	10	
De Cedo	2	500	-	M	19,45	14,77	3,79	3,94	E2	90	85	3	71	26	0	0	122	122	12	14	VIII
Cerreda	2	570	4,35	M,L	12,69	15,59	4,61	3,40	E2	53	89	7	85	8	0	0	127	116	11	11	VI
Courelá	7	420-820	10,0	L,M	17,92	17,20	5,20	3,41	E2	71	116	22	61	16	1	1	120	113	9	10	VI
Courelá[Z]	4	460-600	-	L	19,88	15,97	4,98	3,23	E2	71	130	31	60	9	0	0	115	113	8	9	VI
Culona[Y]	4	550-820	-	M	16,15	12,45	3,42	3,68	E2,E1	68	90	2	68	29	1	0	119	112	11	11	
Curuxa	1	640	-	M	14,79	10,85	4,11	2,67	E2	73	191	94	6	0	0	0	122	114	7	6	
Desgrañadiza[Y]	2	750-810	53,0	B,M	17,48	13,85	3,85	3,77	E2,E1	50	111	13	74	12	0	0	114	114	8	9	
Galega	2	510-640	-	M	14,60	12,60	4,67	2,71	E1	73	102	21	71	8	0	0	117	117	10	11	
Garriga	1	820	-	B	14,36	12,59	4,90	2,58	E2	50	139	53	43	4	0	0	120	122	7	7	
Horrón	2	600-740	-	M	18,20	13,42	4,10	3,34	E2	64	104	18	77	5	0	0	119	115	11	12	VIII
Da Lebre[Y]	3	720-820	-	B	12,68	9,14	2,91	3,24	E1	72	94	8	82	11	0	0	112	118	10	13	
De Lemos[Y]	4	300-600	-	M,B	19,78	15,47	4,57	3,42	E1,E2	72	94	6	69	23	1	1	113	116	10	12	
Maceirá	1	570	-	M	19,18	18,59	5,94	3,13	E1	50	109	8	73	19	0	0	115	114	9	8	VII
De San Miguel	1	470	-	M	17,35	14,70	4,63	3,20	E2	67	73	0	36	65	0	0	117	116	15	14	VIII
Monfortina	1	650	-	L	19,24	12,41	3,48	3,58	E1	67	129	29	70	1	0	0	126	117	8	10	VI
Ouriza[Y]	3	500-670	6,5	B,L	14,11	13,61	4,10	3,36	E1,E2	76	170	73	27	0	0	0	113	120	5	7	
Outeira[Y]	2	500-530	-	B,L	14,35	13,55	5,80	2,36	E1,E2	60	184	90	10	0	0	0	121	115	6	7	
Do Pais[Y]	2	520	-	M	12,37	11,28	3,44	3,30	E1,E2	93	156	41	50	9	0	0	108	109	6	7	
Pallaregas	1	650	-	M	17,34	13,77	4,22	3,30	E2	70	123	31	65	4	0	0	121	123	10	13	VIII
Paradesa	1	270	-	M	18,65	12,19	3,44	3,58	E2	82	98	6	54	37	3	0	115	106	9	11	VIII
Patacuda	1	520	9,5	M	23,77	13,25	3,62	3,71	-	60	74	0	19	31	15	35	120	112	11	14	

NOT = Number of trees; ALT = altitude; PRO = production; USE = recommended use; TMC = type of male catkin; LMC = length of male catkin (A = astaminate, B = brachystaminate, M = mesostaminate, L = longistaminate); LLL = leaf blade length; LLW = leaf blade width; LWR = length/width ratio; BSL = burr spine length (E1, short; E2, medium; E3, long); TBL = type of burr according to the length; NNB = percentage of normal nuts per burr in percentage; CAL = caliber; P24, P28, P32, P36, P40 = percentage of nuts with diameter less than 24, between 24 and 28 mm, between 29 and 32, between 33 and 36, and between 37 and 40 mm, respectively; SCN, SLN = shape index of central and lateral nuts; WCN = weight of central nut; WLN = weight of lateral nut.
[Z]Clonal selection; [Y]The intracultivar variability does not permit define perfectly the cultivar.

Table 3 (Continuation). Characteristics of the minor Galician chestnut cultivars and their clonal selections (Pereira et al., 1996a).

Cultivar	NOT	ALT m	PRO t	TMC	LMC cm	LLL cm	LLW cm	LWR	TBL	NNB %	CAL nuts/kg	P24 %	P28 %	P32 %	P36 %	P40 %	SCN	SLN	WCN g	WLN g	GROUP
Pelada	4	500-920	-	M	18,05	15,03	4,87	3,12	E1,E2,E3	59	87	8	60	30	1	1	122	121	11	13	VIII
Pelada[z]	2	510	-	M	17,11	14,23	4,53	3,16	E2	60	91	10	64	24	2	1	123	121	10	13	VIII
Peluda	1	940	-	M	23,77	14,87	4,93	3,01	E2	60	83	2	40	39	16	3	106	102	11	11	
Picona[y]	2	650-700	-	M,L	21,08	14,06	4,95	2,91	E2	68	119	29	61	10	0	0	122	120	9	9	
Porteliña	2	760	-	M	17,65	19,26	6,36	3,03	E2	33	83	7	29	29	11	24	102	102	13	14	I
Portuguesa	2	600-700	-	A	10,34	15,00	4,84	3,08	E1	100	174	62	38	0	0	0	110	110	5	7	II
Pozoredondo	4	480-920	20	M,L	20,05	12,89	4,23	3,11	E2	85	119	23	72	5	0	0	110	109	8	9	VIII
Pozoredondo[z]	3	480-920	-	M	21,24	13,14	4,54	2,91	E2	79	121	31	65	4	0	0	111	107	8	9	VIII
Praga d'Afora	4	480-820	79	B,M,L	15,02	14,47	4,22	3,52	E2	65	105	12	79	9	0	0	116	112	10	10	V
Praga d'Afora[z]	2	480-820	-	B	13,25	14,91	3,97	3,82	E2	74	98	6	79	15	0	0	118	116	11	11	V
Praga do Bolo	5	470-820	99,5	B	15,68	12,72	3,84	3,36	E2,E1	59	86	8	61	28	2	0	112	111	10	12	
Praga do Bolo1[z]	2	470-570	-	B	16,24	12,77	4,10	3,14	E2	52	88	11	57	29	2	0	111	112	9	12	
Praga do Bolo2[z]	2	750-820	-	B	15,11	12,67	3,58	3,57	E1	67	89	8	67	22	3	0	117	111	11	13	
Puga	1	670	-	M	19,82	15,19	3,95	3,87	E2	50	189	51	49	1	0	0	111	104	4	4	VIII
Puga do Receiro	1	480	-	B	13,75	11,97	4,13	2,92	E2	82	127	33	65	2	0	0	116	117	9	9	V
Rañuda	1	460	-	B	13,76	13,71	2,75	4,99	-	-	-	-	-	-	-	-	-	-	-	-	
Redondo	1	920	-	M	15,73	13,71	4,27	3,25	E2	67	81	5	78	17	0	0	125	120	12	11	VIII
Riá	2	590	131	L	26,31	17,47	4,73	3,70	E2	67	112	26	52	19	3	0	118	112	9	10	VI
Ribeirá	1	570	-	M	17,55	13,25	4,51	2,98	E2	67	91	5	53	32	7	4	106	102	11	11	VIII
Rosenda	1	820	-	L	19,59	12,80	3,65	3,52	-	-	-	-	-	-	-	-	-	-	-	-	
Rozada	1	820	-	M	23,85	16,51	4,65	3,55	E2	38	104	4	85	11	0	0	111	112	10	10	VIII
Salnesa	5	460-820	10	L,A,B	16,52	13,88	4,17	3,36	E2	83	123	33	63	3	1	0	122	116	7	8	VI
Salnesa[z]	3	460-820	-	L	19,18	14,33	4,26	3,43	E2	78	117	24	71	5	1	0	122	116	7	9	VI
Sergude	2	300-350	-	B,L	21,07	15,46	5,67	2,84	E2	68	90	8	50	42	0	0	109	105	12	12	VI
Sergude[z]	1	300	-	L	23,01	15,03	4,55	3,33	E2	68	90	8	50	42	0	0	109	105	12	12	VI
Serodia	6	420-820	16,3	L,M	20,64	13,09	4,06	3,24	E2,E1	72	116	32	53	15	1	0	122	118	9	10	VI
Serodia[z]	2	650	-	L	19,57	10,18	3,10	3,31	E2	57	100	23	67	10	0	0	130	129	10	10	VI
Soutogrande	1	720	20	M	17,19	11,10	3,59	3,14	E2	100	80	0	35	46	13	6	92	98	13	15	VIII
Tarabelao	1	660	-	M	21,90	13,82	4,20	3,31	E2	67	94	9	80	12	0	0	112	116	11	13	VIII
Temperá	9	400-800	-	M,B,L	21,20	15,68	4,53	3,49	E2	54	84	6	52	31	4	7	118	111	13	13	VIII
Temperá[z]	3	520-570	-	M	20,92	15,98	4,75	3,38	E2	63	85	2	56	39	3	1	126	116	13	13	VIII
Torbeana[y]	2	660-800	-	B,M	18,99	13,32	4,23	3,21	E2,E3	46	162	49	26	23	3	1	109	107	7	8	
Toubesa	1	300	-	B	24,50	13,01	4,12	3,17	E3	59	66	0	41	50	5	4	126	122	17	16	IV
Veiguiña	1	800	-	M	15,15	20,10	6,30	3,19	E2	60	104	13	80	7	0	0	124	116	11	11	VIII
Vileta	2	720	6	L	23,96	15,86	4,49	3,55	E2	93	96	11	72	20	0	0	109	115	12	13	VI
Villarenga	1	650	-	M	16,77	11,58	4,25	2,78	E1	77	107	20	72	8	0	0	130	130	8	9	
Xabrega	7	320-1000	9	L,B	19,03	14,87	4,49	3,33	E2	58	120	30	59	11	0	0	115	111	9	9	VI
Xabrega1[z]	2	320-500	-	L	23,06	16,69	4,84	3,48	E2	65	139	44	55	1	0	0	112	106	8	8	VI
Xabrega2[z]	2	670-1000	-	B	15,09	13,23	4,38	3,05	E2	53	120	33	55	13	0	0	116	113	9	9	VI
Xilimendra	1	820	-	M	23,47	13,90	4,93	2,88	E2	60	91	8	67	25	0	0	126	119	11	12	VIII

NOT = Number of trees; ALT = altitude; PRO = production; USE = recommended use; TMC = type of male catkin; LMC = length of male catkin (A = astaminate, B = brachystaminate, M = mesostaminate, L = longistaminate); LLL = leaf blade length; LLW = leaf blade width; LWR = length/width ratio; BSL = burr spine length (E1, short; E2, medium; E3, long); TBL = type of burr according to the length; NNB = percentage of normal nuts per burr in percentage; CAL = caliber; P24, P28, P32, P36, P40 = percentage of nuts with diameter less than 24, between 24 and 28 mm, between 29 and 32, between 33 and 36, and between 37 and 40 mm, respectively; SCN, SLN = shape index of central and lateral nuts; WCN = weight of central nut; WLN = weight of lateral nut.
[z]Clonal selection; [y]The intracultivar variability does not permit define perfectly the cultivar.

Table 4. Characteristics of the minor Galician chestnut cultivars and their clonal selections (Pereira et al., 1996a).

Cultivar	NUC	FAP	TAS	DNP %	PNP %	SNP %	BAL %	LAS %	SCL %	PHO %	PEN %	HAT	USE
Abadá	4	Bad	Insipid	1	31	8	21	24	0	5	0	26OCT - >11NOV	Marmalade, purée
Abarcá	4	Variable	Sweet	0	35	0	19	24	6	13	0	26OCT - >11NOV	Fresh, marmalade, purée
Amadengue	3	Good	Sweet	8	49	11	13	14	3	5	0	26OCT - >11NOV	Marmalade, purée
Anaxa	4	Regular	Sweet	0	48	6	26	36	10	5	0	26OCT - 11NOV	Fresh, marmalade, purée
Das Anchas	2	Good	Sweet	0	28	1	18	1	27	5	1	>11NOV	Fresh, marmalade, purée
Areal	2	Good	Sweet	2	37	7	44	44	14	8	0	>11NOV	Every, pollinizer
Berciana	-	Good	Sweet	3	34	11	3	11	6	0	0	-	Marmalade, purée
Bermella	4,2	Good	Sweet	6	21	0	23	21	6	16	0	26OCT - 11NOV	Fresh, marmalade, purée
Bolesas	2	Regular	Sweet	0	65	31	5	12	17	26	0	26OCT - >11NOV	Marmalade, purée, pollinizer
Bravo de Leirado	6	Good	Insipid	1	27	19	9	19	15	10	0	>11NOV	Marmalade, purée, pollinizer
Bravo de Leirado[z]	4	Regular	Insipid	0	44	33	4	10	1	14	1	>11NOV	Natural marron, fresh, marmalade, purée, pollinizer
Burgaceira	7	Good	Sweet	3	26	6	15	19	28	12	0	26OCT - 11NOV	Natural marron, fresh, marmalade, mashed
Cabezuda	6	Regular	Insipid	1	40	11	26	14	1	11	0	26OCT - 11NOV	Marmalade, purée
Calva	4	Regular-Good	Insipid	2	42	4	24	15	13	9	0	>11NOV	Marmalade, purée
Calva[z]	4	Regular	Insipid	2	42	0	24	16	5	23	0	>11NOV	Marmalade, purée
Campilla	3	Good	Sweet	0	39	1	10	15	2	0	0	11OCT - 11NOV	Marmalade, purée
Carrelaos	-	Good	Sweet	3	3	0	63	58	28	0	0	11OCT - 25OCT	Natural marron, fresh, marmalade, purée
Castelás	-	-	-	-	-	-	-	-	-	-	-	-	-
Caurelal	1	Good	Sweet	9	19	11	14	4	11	0	0	>11NOV	Marmalade, purée
De Cedo	4	Good	Insipid	0	35	0	0	11	0	0	0	11OCT - 25OCT	Natural marron, marmalade, purée
Cerreda	4,2	Bad	Sweet	0	42	3	8	4	9	3	0	-	Fresh, marmalade, purée
Courelá	4	Good	Sweet	2	48	3	9	10	9	10	0	11OCT - 11NOV	Marmalade, purée
Courelá[z]	4	Good	Sweet	1	38	3	7	11	10	11	0	11OCT - 11NOV	Marmalade, purée, pollinizer
Culona	6	Regular	Sweet	3	27	3	9	23	9	15	0	26OCT - >11NOV	Fresh, marmalade, purée
Curuxa	2	Good	Sweet	1	26	6	8	10	4	34	0	26OCT - >11NOV	Marmalade, purée
Desgrañadiza	4,2	Regular	Sweet	0	23	1	28	25	21	16	0	26OCT - >11NOV	Marmalade, purée
Galega	2	Good	Sweet	6	26	12	11	9	6	15	1	26OCT - >11NOV	Fresh, marmalade, purée
Garriga	2	Regular	Sweet	0	35	4	14	16	6	16	0	>11NOV	Marmalade, purée
Horrón	4	Regular	Sweet	3	41	2	16	22	7	3	6	26OCT - >11NOV	Fresh, marmalade, purée
Da Lebre	4	Good	Sweet	0	43	13	14	11	12	21	2	>11NOV	Natural marron, fresh, marmalade, purée
De Lemos	2,3,4	Good	Sweet	8	26	9	36	33	10	10	2	>11NOV	Natural marron, fresh, marmalade, purée
Maceirá	4	Good	Sweet	1	43	3	1	19	1	0	0	26OCT - >11NOV	Fresh, marmalade, purée
De San Miguel	4	Bad	Sweet	0	75	13	0	100	0	13	0	26OCT - >11NOV	Fresh, marmalade, purée
Monfortina	7	Bad	Sweet	0	37	18	20	23	8	21	0	26OCT - >11NOV	Marmalade, purée, pollinizer
Ouriza	2,3,6	Good	Insipid	0	26	1	8	11	11	12	0	26OCT - >11NOV	Marmalade, purée
Outeira	4	Good	Sweet	0	38	1	27	14	11	9	1	26OCT - >11NOV	Marmalade, purée, timber
Do Pai	2	Good	Sweet	0	53	9	9	11	8	12	0	26OCT - >11NOV	Marmalade, purée
Pallaregas	2	Regular	Sweet	0	51	6	19	8	11	20	0	26OCT - 11NOV	Marmalade, purée
Paradesa	4	Good	Insipid	0	3	0	4	31	0	0	0	26OCT - 11NOV	Marmalade, purée
Patacuda	4	Variable	Insipid	2	30	6	27	30	1	10	0	26OCT - >11NOV	Marmalade, purée

NUC = nut color (1 to 6); FAP = facility of peeling; TAS = taste; DNP = percentage of divided nuts; PNP = percentage of nuts with penetrations of the inner coat in the cotyledons; SNP = percentage with the pericarp split; BAL, LAS, SCL, PHO, PEN = Percentage of nuts attacked by *Balaninus elephas* Gyll, *Laspeyresia splendana* Hubner, *Sclerotinia pseudotuberosa* Rehm, *Phoma endogena* Speg. and *Penicillium sp*, respectively; HAT = harvesting time.
[z]Clonal selection.

Table 4 (Continuation). Characteristics of the minor Galician chestnut cultivars and their clonal selections (Pereira et al., 1996a).

Cultivar	NUC	FAP	TAS	DNP %	PNP %	SNP %	BAL %	LAS %	SCL %	PHO %	PEN %	HAT	USE
Pelada	2,4	Regular	Variable	3	32	8	34	37	1	14	0	26OCT - 11NOV	Marmalade, purée
Pelada[z]	2	Regular	Insipid	1	38	5	33	40	2	12	0	26OCT - >11NOV	Marmalade, purée
Peluda	4	Good	Sweet	0	30	6	14	27	10	18	0	26OCT - >11NOV	Every
Picona	4	Good	Insipid	14	38	9	22	21	5	7	0	>11NOV	Marmalade, purée
Porteliña	4	Good	Insipid	4	32	8	16	6	23	15	0	>11NOV	Natural marron, marmalade, purée
Portuguesa	4	Good	Sweet	14	49	4	9	14	1	6	3	26OCT - >11NOV	Marmalade, purée
Pozoredondo	4,3,2	Good	Sweet	3	35	4	6	9	5	15	1	26OCT - >11NOV	Marmalade, purée
Pozoredondo[z]	4,3,2	Good	Sweet	2	33	4	5	9	3	18	1	26OCT ->11NOV	Marmalade, purée
Praga d'Afora	2,3,4	Good	Sweet	1	43	8	11	9	15	7	0	>11NOV	Fresh, marmalade, purée
Praga d'Afora[z]	2,4	Good	Sweet	1	46	12	14	15	8	11	0	>11NOV	Every
Puga do Bolo	4	Bad	Sweet	0	26	1	15	18	3	20	0	>11NOV	Fresh, marmalade, purée
Puga do Bolo1[z]	4	Regular	Sweet	0	21	1	20	17	4	20	0	26OCT - >11NOV	Fresh, marmalade, purée
Puga do Bolo2[z]	4	Regular	Insipid	0	40	1	13	27	0	11	0	>11NOV	Marmalade, purée
Puga	2	Good	Insipid	1	19	3	4	6	5	0	0	26OCT - >11 NOV	Marmalade, purée
Puga do Receiro	4	Good	Sweet	1	53	4	7	17	9	10	4	26OCT - >11NOV	Marmalade, purée
Rañuda	-	-	-	-	-	-	-	-	-	-	-	26OCT - >11NOV	-
Redondo	4	Good	Sweet	2	24	5	2	11	5	8	0	26OCT - >11NOV	Every
Riá	4,6	Bad	Sweet	3	48	0	3	13	9	20	0	26OCT - >11NOV	Fresh, marmalade, purée, pollinizer
Ribeirá	2	Bad	Insipid	1	48	10	23	20	3	4	1	>11NOV	Marmalade, purée
Rosenda	-	-	-	-	-	-	-	-	-	-	-	-	Pollinizer
Rozada	6	Regular	Sweet	0	17	7	28	13	10	28	0	>11NOV	Fresh, marmalade, purée
Salnesa	4	Good	Sweet	1	46	6	5	9	7	4	0	26OCT -11NOV	Marmalade, purée
Salnesa[z]	4	Good	Sweet	1	47	0	8	10	4	4	0	26OCT - 11NOV	Marmalade, purée, pollinizer
Sergude	4	Regular	Sweet	3	3	0	70	63	15	30	0	26OCT - >11NOV	Fresh, marmalade, purée
Sergude[z]	4	Regular	Sweet	3	3	0	70	63	15	30	0	26OCT - >11NOV	Fresh, marmalade, purée, pollinizer
Serodia	4,3	Good	Sweet	1	41	6	26	26	6	8	0	26OCT - 11NOV	Marmalade, purée
Serodia[z]	3,6	Good	Sweet	1	48	10	12	7	9	14	0	26OCT - >11NOV	Fresh, marmalade, purée, pollinizer
Soutogrande	3	Good	Sweet	0	44	8	9	10	13	15	0	26OCT - >11NOV	Every
Tarabelao	4	Bad	Sweet	0	44	16	5	24	5	3	0	26OCT - 11NOV	Fresh, marmalade, purée
Temperá	4	Variable	Sweet	1	18	5	25	21	6	7	0	26OCT - 11NOV	Fresh, marmalade, purée, timber
Temperá[z]	4	Bad	Sweet	3	15	2	34	25	16	6	0	26OCT - 11NOV	Fresh, marmalade, purée, timber
Torbeana	2,4	Regular	Sweet	0	35	10	5	16	14	10	0	>11NOV	Marmalade, purée
Toubesa	4	Bad	Insipid	0	65	2	30	51	3	5	0	26OCT - >11NOV	Fresh, marmalade, purée
Veiguiña	6	Good	Sweet	0	64	5	26	21	2	8	0	26OCT - >11NOV	Fresh, marmalade, purée
Vileta	4	Variable	Insipid	7	43	1	2	7	0	0	1	26OCT - >11NOV	Marmalade, purée, pollinizer
Villarenga	7	Good	Sweet	3	23	8	16	18	23	37	0	26OCT - >11NOV	Fresh, marmalade, purée
Xabrega	2,4	Good	Sweet	1	40	4	12	18	3	12	0	26OCT - 11NOV	Marmalade, purée
Xabrega1[z]	4	Bad	Sweet	1	68	0	3	27	1	1	0	26OCT - 11NOV	Marmalade, purée, pollinizer
Xabrega2[z]	3	Good	Sweet	0	19	5	6	5	3	15	0	26OCT - >11NOV	Marmalade, purée, pollinizer
Xilimendra	4	Bad	Sweet	3	15	0	0	13	0	0	0	26OCT - 11NOV	Fresh, marmalade, purée

NUC = nut color (1 to 6); FAP = facility of peeling; TAS = taste; DNP = percentage of divided nuts; PNP = percentage of nuts with penetrations of the inner coat in the cotyledons; SNP = percentage with the pericarp split; BAL, LAS, SCL, PHO, PEN = Percentage of nuts attacked by *Balaninus elephas* Gyll, *Laspeyresia splendana* Hubner, *Sclerotinia pseudotuberosa* Rehm, *Phoma endogena* Speg. and *Penicillium sp*, respectively; HAT = harvesting time.
[z]Clonal selection.

Forestales de Lourizan: isocitrate dehydrogenase (IDH; EC 1.1.1.42), phosphoglucoisomerase (PGI; EC 5.3.1.9), phosphoglucomutase (PGM; EC 2.7.-5.1.), malate dehydrogenase (MDH; EC 1.1.1.37), and shikimate dehydrogenase (SKDH; EC 1.1.1.25). Previous work resolved seven loci for these isoenzymes (5, 7). The separation was carried out by electrophoresis in starch using leaf extracts. The extraction buffer was described by Aletà et al. (1). The gel and electrode buffers were defined those used by Shields et al. (16) for MDH, PGI and PGM and by Kephart (9) for SKDH and IDH. The staining procedures were from Vallejos (17).

Possible uses of the cultivars

Cultivars were placed in five groups by use (USE) according to the following characteristics: 1) marron glacé, <80 nuts/kg and good peeling; 2) natural marron, 80-90 nuts/kg and good peeling; 3) fresh, < 100 nuts/kg, sweet, bright and clear color, and early harvest date which increases the price; 4) marmalade and puree, > 100 nuts/kg; and 5) pollinizers, longistaminate male catkins. Suitability for timber was also recorded if the wood quality of a cultivar was reputed to be good or when the tree performance was very good with the aim of identifying dual-purpose cultivars.

Results

Morphological and agronomic traits

A great deal of intercultivar variability was observed; but intracultivar variability was also present (12). The cultivars 'Abadá,' 'Bermella,' 'Culona,' 'Desgrañadiza,' 'Da Lebre,' 'De Lemos,' 'Ouriza,' 'Outeira,' 'Do Pais,' 'Picona' y 'Torbeana' could not be classified using these diagnostic traits because of the large amount of variability within these cultivars (Table 4). Clonal selections were made within 27 cultivars (12, 13), but two clones were selected in seven cultivars and three in 'Inxerta' because more than one clone was considered interesting. 'Amarelante2' presents very good characteristics for nut production, but the length of the burr (type 3) classified it in a different group than 'Amarelante1.' 'Blanca2' peels bette than 'Blanca1.' 'Inxerta2' and 'Inxerta3' produce very good nuts but the isoenzyme profile are different from 'Inxerta1.' 'Luguesa2' can be recommended for fresh market owing to the sweet nuts. 'Negral2' has bigger nuts but worse peeling than 'Negral1.' 'Raigona2' presents lower percentage of divided nuts than 'Raigona1.' 'Praga do Bolo1' produces sweeter nuts than 'Praga do Bolo2' but the classification is different according to the shorter spine burr, and 'Xabrega2' from Puebla de Trives has brachystaminate catkins while 'Xabrega1' from Barco de Valdeorras has longistaminate catkins like 'Negral.'

Fifteen cultivars are grown over a wide geographic are, but some of the minor cultivars were more important in the past if we consider nut production data (6): 'Bermella,' 'Calva,' 'Campilla,' 'Cerreda,' 'Desgrañadiza,' 'Ouriza,' 'Patacuda,' 'Pozoredondo,' 'Praga d'Afora,' 'Praga do Bolo,' 'Serodia' and 'Soutogrande' (Table 4). Cultivars like 'Praga d'Afora,' 'Serodia' and 'Soutogrande' appear to merit continued interest. 'Das Anchas' is a synonym of 'Amarelante' (13), and 'Courelá,' 'Riá,' 'Salnesa,' 'Vileta' and 'Xabrega' are synonymous of 'Negral.' 'Negral' appears to be the most important cv. in León (Pereira y Fernández, unpublished data). Though 'Raigona' produces more chestnuts than 'Negral,' at present growers are regrafting with this variety since it is earlier, has very good nut size and its cotyledons are not divided.

More than 50% of the cultivars show mesostaminate catkins, with the astaminate type being less frequent and the shortest in length. 'Verde' has the shortest catkins (9,35 cm) being astaminate type, while 'Negral' catkins are the longest (28 cm). We can find the biggest leaves in 'Porteliña' and 'Veiguiña,'

Table 5. Isoenzyme frequencies in the most important Galician chestnut cultivars and clonal selections (Pereira et al., 1996b).

No. Trees	Cultivar	Mdh-1	Mdh-2a	Mdh-2b	Mdh-3a	Mdh-3b	Idh-2a	Idh-2b	Skdh-a	Skdh-b	Skdh-c	Pgi-2a	Pgi-2b	Pgi-2c	Pgm-2a	Pgm-2b
21	Amarelante	1.00	0.71	0.29	0.40	0.60	0.90	0.10	0.38	0.12	0.50	0.40	0.00	0.60	0.50	0.50
4	Amarelante1[z]	1.00	0.50	0.50	0.50	0.50	1.00	0.00	0.50	0.00	0.50	0.00	0.00	1.00	0.50	0.50
3	Amarelante2[z]	1.00	0.50	0.50	0.50	0.50	1.00	0.00	0.50	0.00	0.50	0.00	0.00	1.00	0.50	0.50
13	Blanca	1.00	0.65	0.35	0.08	0.92	0.65	0.35	0.62	0.04	0.35	0.46	0.04	0.50	0.54	0.46
3	Blanca1[z]	1.00	0.50	0.50	0.00	1.00	0.50	0.50	1.00	0.00	0.00	0.50	0.00	0.50	0.50	0.50
2	Blanca2[z]	1.00	0.50	0.50	0.00	1.00	0.50	0.50	1.00	0.00	0.00	0.50	0.00	0.50	0.50	0.50
13	Famosa	1.00	0.92	0.08	0.12	0.88	0.69	0.31	0.42	0.12	0.46	0.08	0.04	0.88	0.50	0.50
5	Famosa[z]	1.00	1.00	0.00	0.00	1.00	0.50	0.50	0.50	0.00	0.50	0.00	0.00	1.00	0.50	0.50
7	Garrida	1.00	0.50	0.50	0.00	1.00	0.93	0.07	0.71	0.07	0.21	0.93	0.00	0.07	0.50	0.50
3	Garrida1[z]	1.00	0.50	0.50	0.00	1.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	0.50	0.50
9	Inxerta	1.00	1.00	0.00	0.44	0.56	0.89	0.11	0.00	0.33	0.67	0.17	0.00	0.83	0.50	0.50
3	Inxerta1[z]	1.00	1.00	0.00	0.50	0.50	1.00	0.00	0.00	0.50	0.50	0.00	0.00	1.00	0.50	0.50
1	Inxerta2[z]	1.00	1.00	0.00	0.50	0.50	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.50	0.50
1	Inxerta3[z]	1.00	1.00	0.00	0.00	1.00	0.50	0.50	0.00	0.00	1.00	0.50	0.00	0.50	0.50	0.50
7	Longal	1.00	0.93	0.07	0.00	1.00	0.93	0.07	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.50
5	Longal1[z]	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.50
10	Loura	1.00	0.90	0.10	0.40	0.60	0.95	0.05	0.10	0.40	0.50	0.20	0.40	0.40	0.50	0.50
3	Loura[z]	1.00	1.00	0.00	0.50	0.50	1.00	0.00	0.00	0.50	0.50	0.00	0.50	0.50	0.50	0.50
7	Luguesa	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.43	0.07	0.50	0.07	0.00	0.93	0.93	0.07
3	Luguesa1[z]	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.50	0.00	0.50	0.00	0.00	1.00	1.00	0.00
2	Luguesa2[z]	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.50	0.00	0.50	0.00	0.00	1.00	1.00	0.00
10	Negral	1.00	0.60	0.40	0.35	0.65	0.90	0.10	0.80	0.00	0.20	0.40	0.05	0.55	0.50	0.50
4	Negral1[z]	1.00	0.50	0.50	0.50	0.50	1.00	0.00	1.00	0.00	0.00	0.50	0.00	0.50	0.50	0.50
1	Negral2[z]	1.00	0.50	0.50	0.50	0.50	1.00	0.00	1.00	0.00	0.00	0.50	0.00	0.50	0.50	0.50
12	Parede	1.00	1.00	0.00	0.00	1.00	0.96	0.04	0.54	0.00	0.46	0.88	0.04	0.08	0.50	0.50
6	Parede[z]	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.50	0.00	0.50	1.00	0.00	0.00	0.50	0.50
10	Presa	1.00	1.00	0.00	0.00	1.00	0.94	0.06	0.11	0.00	0.89	0.61	0.00	0.39	0.50	0.50
3	Presa[z]	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	1.00	0.50	0.00	0.50	0.50	0.50
13	Raigona	1.00	0.58	0.42	0.46	0.54	1.00	0.00	0.62	0.00	0.38	0.50	0.00	0.50	0.50	0.50
5	Raigona[z]	1.00	0.50	0.50	0.50	0.50	1.00	0.00	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.50
2	Raigona[z]	1.00	0.50	0.50	0.50	0.50	1.00	0.00	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.50
15	Rapada	1.00	0.83	0.17	0.13	0.87	0.70	0.30	0.47	0.07	0.47	0.67	0.00	0.33	0.50	0.50
6	Rapada1[z]	1.00	1.00	0.00	0.00	1.00	0.50	0.50	0.50	0.00	0.50	1.00	0.00	0.00	0.50	0.50
7	Ventura	1.00	1.00	0.00	0.50	0.50	0.50	0.50	0.00	0.07	0.93	1.00	0.00	0.00	0.50	0.50
5	Ventura1[z]	1.00	1.00	0.00	0.50	0.50	0.50	0.50	0.00	0.00	1.00	1.00	0.00	0.00	0.50	0.50
17	Verde	1.00	0.94	0.06	0.26	0.74	0.85	0.15	0.59	0.00	0.41	0.56	0.03	0.41	0.50	0.50
3	Verde1[z]	1.00	1.00	0.00	0.50	0.50	1.00	0.00	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.50

[z]Clonal selection.

while the leaves of 'Bolesas' and 'Da Lebre' are the smallest. 'Famosa2' shows the lower length/width ratio while 'Rañuda' has the highest. The predominant burr spine length is E2 in 68% of the trees studied (14), though we can also find E1 and E3. Type E1 defines group VII in the classification of Galician cultivars like 'Rapada' and 'Maceirá' (13) and type E3 defines groups III and IV with cultivars like 'Longal,' 'Famosa' and 'Toubesa.'

Fertility is indicated by the number of developed nuts per burr: all nuts of 'Inxerta2,' 'Calva,' 'Portuguesa' and 'Tarabelao' were normal while 'Portelia' and 'Rozada' showed a low fertility (< 40%). High fertility does not appear to reduce nut size, since 'Inxerta2' and 'Calva' produce big nuts and average three big nuts per burr (11). The average caliber of Galician cultivars is 100 nuts per kg (14), but we can see in Tables 1 and 3 that the caliber varied from 58 nuts per kg in 'Inxerta3' to nearly 190 nuts per kg in 'Campilla' and 'Puga.' Very large nuts (over 32 mm diameter) are characteristics of 'Inxerta,' 'Patacuda' and 'Porteliña' and its clonal selections (Tables 1 and 3). 'Inxerta,' 'Inxerta1' and 'Porteliña' produce eliptical-triangular nuts while 'Longal' produces triangular nuts as was defined by Pereira et al. (12). The average weight varies between four g in 'Puga' to 17 g in 'Negral2' and 'Toubesa' though the maximum value was 26 g.

The predominant color is reddish (number 4), though dark brown is present in 'Luguesa,' 'Presa,' 'Rapada,' 'Bravo de Leirado,' 'Burgaceira,' 'Cabezuda,' 'Culona,' 'Monfortina,' 'Ouriza,' 'Riá,' 'Serodia,' 'Veiguiña' and 'Villarenga' (numbers 6 and 7). The bright reddish color (number 2) found in 'Parede' is also present in 'Famosa,' 'Das Anchas,' 'Areal,' 'Bolesas,' 'Curuxa,' 'Galega,' 'Garriga,' 'Do Pais,' 'Pallaregas,' 'Pelada,' 'Puga' and 'Ribeira.' Color number 3 was present in 'Inxerta,' 'Verde,' 'Amadengue,' 'Campilla,' and 'Soutogrande.' Only 'Caurelal' showed a yellowish color (number 1), and the brown color (number 5) was not assigned to any of this material.

With respect to facility of peeling, 56% of the cultivars have good peeling, 20% average, 14% bad, and 10% variable. 78% of the cultivars produce sweet chestnuts, 15% insipid and the 2% variable, respectively. Nearly all Galician cvs. showed a lack of divided nuts. Since the percentage is below 12%, these cvs. are considered 'marron' (2). Only 'Picona' and 'Portuguesa' had more than 12% divided nuts. Clonal selection 'Raigonal' also has a high percentage of divided nuts; 'Raigona2' is recommended since it has fewer divided nuts. Penetration of the inner coat of the cotyledons is very frequent, 10% to 75% of the nuts, which makes them difficult to peel. The split pericarp, which is a problem in storing the nuts, is frequent (> 20%) in some cultivars like 'Luguesa1,' 'Luguesa2,' 'Rapada,' 'Bolesas' and 'Bravo de Leirado.' The average amount of split nuts in the cultivars was 6% (11); incidence of wormy nuts was high (*L. splendana*, 17%; *B. elephas*, 14%) and disease incidence was intermediate (*S. pseudotuberosa*, 8%; *P. endogena*, 9%; *Penicillium sp.* had very low incidence with 0.3%). Differences among cultivars were significant only for *L. splendana* (11). Therefore, we must recommend the removing of leaves, burr and chestnuts from the ground yearly for decreasing the *inoculum*.

Nuts of most (71%) of the Galician cultivars are harvested after 26 October, while 24% of the cultivars are harvested after 11 November. Only the early-maturing cultivars 'Carrelaos' and 'De Cedo' produce chestnuts between 11 and 25 October. 'Negral' nuts also begin to mature at this time but most of the crop is harvested in November because it is grown at higher elevations. Although every cultivar is useful for marmalade and pureé, only 51% of cultivars and 61% of clonal

Table 6. Isoenzyme frequencies in minor Galician chestnut cultivars and clonal selections (Pereira et al., 1996b).

No. Trees	Cultivar	Mdh-1	Mdh-2a	Mdh-2b	Mdh-3a	Mdh-3b	Idh-2a	Idh-2b	Skdh-a	Skdh-b	Skdh-c	Pgi-2a	Pgi-2b	Pgi-2c	Pgm-2a	Pgm-2b
3	Abadá	1.00	0.83	0.17	0.00	1.00	1.00	0.00	0.33	0.00	0.67	0.33	0.00	0.67	0.83	0.17
1	Abarcá	1.00	0.50	0.50	0.50	0.50	1.00	0.00	0.50	0.00	0.50	0.00	0.00	1.00	0.50	0.50
1	Anaxa	1.00	0.50	0.50	0.50	0.50	1.00	0.00	0.50	0.00	0.50	0.00	0.50	0.50	0.50	0.50
1	Anchas	1.00	0.50	0.50	0.50	0.50	1.00	0.00	0.50	0.00	0.50	0.00	0.00	1.00	0.50	0.50
2	Areal	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.50	0.50
4	Bermella	1.00	0.63	0.38	0.13	0.88	0.75	0.25	0.63	0.00	0.38	0.38	0.00	0.63	0.50	0.50
4	Bravoleirado	1.00	0.83	0.17	0.00	1.00	0.67	0.33	0.50	0.00	0.50	1.00	0.00	0.00	0.50	0.50
1	Bravoleirado[z]	1.00	1.00	0.00	0.00	1.00	0.50	0.50	0.50	0.00	0.50	1.00	0.00	0.00	0.50	0.50
1	Burgaceira	1.00	1.00	0.00	0.50	0.50	0.50	0.50	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.50
2	Cabezuda	1.00	0.50	0.50	0.00	1.00	1.00	0.00	0.00	0.50	0.50	1.00	0.00	0.00	0.50	0.50
4	Calva	1.00	0.88	0.13	0.25	0.75	0.50	0.50	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.50
1	Calva[z]	1.00	1.00	0.00	0.50	0.50	0.50	0.50	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.50
1	Campilla	1.00	1.00	0.00	0.00	1.00	0.50	0.50	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.50
1	Carrelao	1.00	0.50	0.50	0.50	0.50	1.00	0.00	0.00	0.50	0.50	0.50	0.00	0.50	0.50	0.50
1	Castelás	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.50	0.50
2	De Cedo	1.00	0.50	0.50	0.00	1.00	1.00	0.00	0.00	0.50	0.50	1.00	0.00	0.00	0.50	0.50
1	Cerreda	1.00	1.00	0.00	0.50	0.50	1.00	0.00	1.00	0.00	0.00	0.50	0.00	0.50	0.50	0.50
4	Courelá	1.00	0.71	0.29	0.29	0.71	1.00	0.00	0.57	0.21	0.21	0.50	0.00	0.50	0.50	0.50
1	Courelá[z]	1.00	0.50	0.50	0.50	0.50	1.00	0.00	1.00	0.00	0.00	0.50	0.00	0.50	0.50	0.50
3	Culona	1.00	1.00	0.00	0.17	0.83	0.67	0.33	0.50	0.00	0.50	0.67	0.00	0.33	0.50	0.50
2	Desgrañadiza	1.00	0.50	0.50	0.25	0.75	0.75	0.25	0.25	0.00	0.75	0.25	0.00	0.75	0.50	0.50
1	Hórrea	1.00	1.00	0.00	0.00	1.00	0.50	0.50	0.50	0.00	0.50	1.00	0.00	0.00	0.50	0.50
1	Lebre	1.00	0.50	0.50	0.00	1.00	0.50	0.50	0.00	0.00	1.00	0.50	0.00	0.50	0.50	0.50
3	Lemos	1.00	0.83	0.17	0.00	1.00	0.67	0.33	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.50
1	Maziño	1.00	0.50	0.50	0.00	1.00	1.00	0.00	0.00	0.50	0.50	1.00	0.00	0.00	0.50	0.50
1	San Miguel	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.50	0.00	0.50	0.00	0.00	1.00	1.00	0.00
1	Monfortina	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.50	0.50
2	Ouriza	1.00	0.50	0.50	0.25	0.75	0.75	0.25	0.25	0.00	0.75	0.25	0.00	0.75	0.50	0.50
1	Outeira	1.00	1.00	0.00	0.50	0.50	1.00	0.00	1.00	0.00	0.00	0.50	0.00	0.50	0.50	0.50
2	Pais	1.00	1.00	0.00	0.00	1.00	0.50	0.50	0.50	0.00	0.50	1.00	0.00	0.00	0.50	0.50
1	Pallaregas	1.00	1.00	0.00	0.50	0.50	1.00	0.00	0.00	0.50	0.50	0.00	0.50	0.50	0.50	0.50
1	Paradesa	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.50	0.00	0.50	1.00	0.00	0.00	0.50	0.50
1	Patacuda	1.00	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.50
4	Pelada	1.00	0.88	0.13	0.38	0.63	1.00	0.00	0.00	0.50	0.50	1.00	0.00	0.00	0.50	0.50
2	Pelada[z]	1.00	1.00	0.00	0.50	0.50	1.00	0.00	0.00	0.50	0.50	1.00	0.00	0.00	0.50	0.50
1	Peluda	1.00	0.50	0.50	0.50	0.50	1.00	0.00	0.50	0.00	0.50	0.00	0.00	1.00	0.50	0.50
2	Picona	1.00	1.00	0.00	0.00	1.00	0.50	0.50	0.50	0.00	0.50	1.00	0.00	0.00	0.50	0.50

[z]Clonal selection.

Table 6 (Continuation). Isoenzyme frequencies in minor Galician chestnut cultivars and clonal selections (Pereira et al., 1996b).

No. Trees	Cultivar	Mdh-1	Mdh-2a	Mdh-2b	Mdh-3a	Mdh-3b	Idh-2a	Idh-2b	Skdh-a	Skdh-b	Skdh-c	Pgi-2a	Pgi-2b	Pgi-2c	Pgm-2a	Pgm-2b
1	Porteliña	1.00	1.00	0.00	0.50	0.50	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.50	0.50
2	Portugués	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.00	0.50	0.50	1.00	0.00	0.00	0.50	0.50
2	Pozoredondo	1.00	0.75	0.25	0.25	0.75	0.75	0.25	0.75	0.00	0.25	0.75	0.00	0.25	0.50	0.50
1	Pozoredondo[z]	1.00	1.00	0.00	0.00	1.00	0.50	0.50	0.50	0.00	0.50	1.00	0.00	0.00	0.50	0.50
4	Praga d'Afora	1.00	0.88	0.13	0.13	0.88	0.63	0.38	0.50	0.00	0.50	0.88	0.00	0.13	0.50	0.50
2	Praga d'Afora[z]	1.00	1.00	0.00	0.00	1.00	0.50	0.50	0.50	0.00	0.50	1.00	0.00	0.00	0.50	0.50
3	Praga do Bolo	1.00	0.67	0.33	0.33	0.67	0.83	0.17	0.67	0.00	0.33	0.50	0.00	0.50	0.50	0.50
1	Praga do Bolo1[z]	1.00	1.00	0.00	0.00	1.00	0.50	0.50	1.00	0.00	0.00	0.50	0.00	0.50	0.50	0.50
2	Praga do Bolo2[z]	1.00	0.50	0.50	0.50	0.50	1.00	0.00	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.50
1	Puga	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.50
1	Puga do Receiro	1.00	0.50	0.50	0.00	1.00	0.50	0.50	1.00	0.00	0.00	0.50	0.00	0.50	0.50	0.50
1	Rañuda	1.00	0.50	0.50	0.00	1.00	1.00	0.00	0.00	0.50	0.50	0.50	0.00	0.50	0.50	0.50
1	Redondo	1.00	1.00	0.00	0.50	0.50	0.50	0.50	0.50	0.00	0.50	1.00	0.00	0.00	0.50	0.50
2	Riá	1.00	0.50	0.50	0.50	0.50	1.00	0.00	1.00	0.00	0.00	0.50	0.00	0.50	0.50	0.50
1	Ribeirá	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.50	0.50
1	Rosenda	1.00	0.50	0.50	0.50	0.50	1.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.50	0.50
1	Rozada	1.00	1.00	0.00	0.50	0.50	1.00	0.00	0.00	0.50	0.50	0.00	0.00	1.00	0.50	0.50
2	Salnesa	1.00	1.00	0.00	0.25	0.75	0.75	0.25	0.75	0.00	0.25	0.50	0.00	0.50	0.50	0.50
1	Salnesa[z]	1.00	1.00	0.00	0.50	0.50	1.00	0.00	1.00	0.00	0.00	0.50	0.00	0.50	0.50	0.50
1	Sergude	1.00	0.50	0.50	0.50	0.50	1.00	0.00	0.50	0.00	0.50	0.00	0.00	1.00	0.50	0.50
1	Sergude[z]	1.00	0.50	0.50	0.50	0.50	1.00	0.00	0.50	0.00	0.50	0.00	0.00	1.00	0.50	0.50
5	Serodia	1.00	1.00	0.00	0.00	1.00	0.70	0.30	0.50	0.10	0.40	0.80	0.00	0.20	0.50	0.50
2	Serodia[z]	1.00	1.00	0.00	0.00	1.00	0.50	0.50	0.50	0.00	0.50	1.00	0.00	0.00	0.50	0.50
1	Soutogrande	1.00	1.00	0.00	0.50	0.50	1.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.50	0.50
1	Tarabelao	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.50	0.00	0.50	0.00	0.00	1.00	1.00	0.00
6	Temperá	1.00	0.58	0.42	0.08	0.92	0.92	0.08	0.25	0.33	0.42	0.67	0.00	0.33	0.50	0.50
3	Temperá[z]	1.00	0.50	0.50	0.00	1.00	1.00	0.00	0.00	0.50	0.50	1.00	0.00	0.00	0.50	0.50
1	Torbeana	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.50
1	Toubesa	1.00	0.50	0.50	0.00	1.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	0.50	0.50
1	Veiguiña	1.00	1.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00	1.00	0.50	0.00	0.50	0.50	0.50
2	Vileta	1.00	0.50	0.50	0.50	0.50	0.50	0.50	1.00	0.00	0.00	0.50	0.00	0.50	0.50	0.50
1	Villarenga	1.00	1.00	0.00	0.00	1.00	0.50	0.50	1.00	0.00	0.00	0.50	0.00	0.50	0.50	0.50
7	Xabrega	1.00	0.64	0.36	0.43	0.57	0.79	0.21	0.86	0.00	0.14	0.64	0.00	0.36	0.50	0.50
2	Xabrega1[z]	1.00	0.50	0.50	0.50	0.50	1.00	0.00	1.00	0.00	0.00	0.50	0.00	0.50	0.50	0.50
2	Xabrega2[z]	1.00	0.50	0.50	0.50	0.50	0.50	0.50	1.00	0.00	0.00	0.50	0.00	0.50	0.50	0.50
1	Xilimendra	1.00	0.50	0.50	0.00	1.00	1.00	0.00	0.50	0.00	0.50	0.50	0.00	0.50	0.50	0.50

[z]Clonal selection.

selections can be used for fresh market, 13% and 6% for natural marron, 10% and 14% for *marron glacé*, and 6% and 11% for timber. Though the pollen compatibility assays have not yet been done, 10% of the cultivars and 26% of the clonal selections have longistaminate catkins and thus may be useful as pollinizers.

If we take into account all of these characters, the most interesting cultivars for nut production are 'Famosa,' 'Garrida,' 'Inxerta,' 'Ventura,' 'Peluda,' 'Praga d'Afora,' 'Redondo' and 'Soutogrande' because the nuts can be used for every use: fresh, peeling and *marron glacé*. Of these cultivars, only 'Famosa' was previously recognized as interesting for the peeling industry.

Isoenzymes

Isoenzymes (Tables 5 and 6) show intracultivar variability as was the case with agronomic characters. Although allelic frequencies differ among cultivars, clonal selections are more easily distinguished (13). Furthermore, the isoenzymes indicate that the following cultivars are synonymous (12, 13): i) 'Negral,' 'Courela^{z},' 'Xabrega1^{z}' and 'Vileta'; ii) 'Areal' and 'Monfortina'; 'Amarelante1,' 'Amarelante2,' 'Abarcá' and 'Das Anchas'; iii) 'Loura^{z}' and 'Pallaregas'; iv) 'Luguesa1,' 'Luguesa2' and 'Tarabelao'; v) 'Parede^{z}' and 'Paradesa'; vi) 'Presa^{z}' and 'Veiguiña'; vii) 'Temperá^{z},' 'Cabezuda' and 'De Cedo.'

Comparison with foreign cultivars

If we compare Galician and French production regions (2, 3) we see that French cultivars are recommended for altitudes below 600 m while the most important area for nut production in Galicia is between 600 and 800 m (6), though the climates may be similar. Of the cultivars recommended by Bergougnoux et al. (2) and Breisch (3) nuts of 'Belle Epine,' 'Marron Dauphine,' 'Marron de Goujounac' and 'Marron d'Olargues' mature between 10 and 25 October, while nuts of 'Belle Epine,' 'Verdale' and 'Comballe' mature late (between 26 October and 11 November). Galician cultivars appear to be harvested later since most of them are harvested after 25 October. Every recommended French cultivar has less than 12% divided nuts, with 'Comballe' being the only exception.

The main Portuguese cultivar, 'Longal' is highly appreciated in industry for its ease of peeling (15, 8). Our results are in agreement. 'Martainha' nuts mature earlier than 'Longal' and many of the nuts are divided. 'Verdeal' is harvested between September and October, clearly earlier than 'Verde' in Spain and thus does not appear to be synonymous. 'Lada' produces more than 50% divided nuts. Percentages can reach 80% in 'Martainha' and 14% in 'Judia.' These high values of double seeds are not suitable for industry.

Nuts of 'Marrone Fiorentino' or 'Casentinese,' also known as 'Marrone Toscano,' the most appreciated Italian 'marron' (4), mature between 10 and 20 October and have very large fruits (14-20 g) in comparison to Galician cultivars. 'Verdone' is an Italian cultivar (10) with a name similar to Spanish 'Verde' and Portuguese 'Verdal,' and 'Nzerte' also named 'Inserta,' very near in shape to Spanish 'Inxerta.'

Conclusion

This highly diverse group of cultivars is now being preserved in a Germplasm Bank at the Centro de Investigaciones Forestales de Lourizán. The knowledge of the allelic composition will permit maintenance of trueness-to-name in the propagation of the selected clones. The most interesting material has been established in a nuclear orchard from which scions can be distributed to nurseries and growers with a guarantee of distinctness. A study of chestnut cultivars in other parts of the Iberian Peninsula is being completed by the authors (Data not published). There are genetic differences in the cultivars grown in different regions (13), and the planting of ap-

propriate material is very important. The use of clonal selections preserves the qualities of the original cultivars while allowing them to be easily distinguished.

Bibliography

1. Aletà, N., Olarte, C., Truco, M. J., and P. Arus. 1990. Identification of walnut cultivars by isozyme analysis. Acta Horticulturae 284:91-96.
2. Bergougnoux, F., A. Verlhac, H. Breisch, J. Chapa. 1978. Le châtaignier. INVUFLEC, Paris, 192 pp.
3. Breisch, H. 1993. Le verger de châtaignier, mise en place et entretien. CTIFL, Rapports, 62 pp.
4. Breviglieri, N. 1955. Indagini ed osservazioni sulle migliori varietà italiane di Castagno. Centro di Studio Sul Castagno, Pubblicazione No. 2, Supplemento a la Ricerca Scientifica, pp. 27-164.
5. Fernández, J. 1992. Variability in *Castanea sativa, Castanea crenata* and interspecific hybrids for GOT, ACO, APS, PGM, PGI, IDH, MDH, SDH isozymes. In: Abstracts *International Symposium on population genetics and gene conservation of forest trees.* INRA/IUFOR, Carcans Maubuisson 24-28 August 1992.
6. Fernández, J. and S. Pereira. 1993. Inventario y distribución de los cultivares tradicionales de castaño (*Castanea sativa* Mill.) en Galicia. MAPA, MONOGRAFIAS I.N.I.A., 87, 271 pp. I.S.B.N.: 84-7498-424-6.
7. Fernández, J., S. Pereira, and E. Miranda. 1993. Selección, identificación y esquema de producción de clones hibridos de *Castanea sativa* Mill. *y C.crenata* Sieb. et Zucc. o *C. mollissima* Blume para producción de madera o fruto. Congreso Forestal Español, Lourizán, Spain.
8. Gomes, J., C. Pinto, and T. Valdiviesso. 1993. Chestnut selection in Portugal. Evaluation of some characteristics. International Congress on Chestnut, Spoleto, Italia.
9. Kephart, S. R. 1990. Starch gel electrophoresis of plant isozymes: a comparative analysis of techniques. Amer. J. Bot. 77:69-712.
10. Paglietta, R. and G. Bounous. 1979. Il castango da frutto. Edagricole, p. 189.
11. Pereira, S. 1994. Caracterización y selección de cultivares tradicionales de castaño (*Castanea sativa* Mill.) en Galicia. PhD, Polithecnic University of Madrid, 434 pp.
12. Pereira-Lorenzo, S., J. Fernández-López and J. Moreno-González. 1996a. Variability and grouping of Northwestern Spanish chestnut cultivars. I. Morphological traits. J. Amer. Soc. Hort. Sci. 121:183-189.
13. Pereira-Lorenzo, S., J. Fernández-López and J. Moreno-González. 1996b. Variability and grouping of Northwestern Spanish chestnut cultivars. II. Isozyme traits. J. Amer. Soc. Hort. Sci. 121:190-197.
14. Pereira-Lorenzo, S.; Ferńndez-López, J.; Moreno-González, J. 1996c. Variabilidad morfológica en cultivares de castaño (*Castanea sativa* Mill.) en Galicia: valores descriptivos. I.N.I.A. (Accepted for publishing).
15. Pinto, C.; Gomes, J.; Valdivieso, T. (1990). Caracterizacao de variedades de castanheiro portuguesas. I° CONGRESSO IBERICO DE CIENCIAS HORTICOLAS, Lisboa.
16. Shields, C. R., T. J. Orton, and C. W. Stuber. 1983. An outline of general resource needs and procedures for the electrophoretic separation of active enzymes from plant tissues, pp. 443-468. In: S. D. Tanksley and T. J. Orton (eds.). Isozymes in plant genetics and breeding, Part A. Elsevier, Amsterdam.
17. Vallejos, C.E. 1983. Enzyme activity staining pp. 469-516. In: S. D. Tanksley and T. J. Orton (eds.). Isozymes in plant genetics and breeding, Part A. Elsevier, Amsterdam.

Yield Components of Day-Neutral and Short Day Strawberries

Eight day-neutral and 7 short day strawberry varieties were evaluated in B.C. Among the day-neutral varieties in 1990 total variation in marketable yield originated in fruit count (26%), total yield (18%), average leaf size (22%), and runner count (19%) per plant. In 1991, total variation in yield originated in fruit count (38%), runner count (23%), crown count (13%), and total yield (16%) per plant. 'Selva' was one of the most productive day-neutral varieties and had the heaviest fruit and fewest culls during both years. The short day varieties had uniformly low-yields during the establishment year. Variation in yield originated in runner count (34%), total yield (18%), and fruit count (16%). Of the short day varieties in 1991, 'Shuswap' had the highest yield and along with 'Pajaro' and 'Sequoia' had the fewest culls. 'Shuswap was a prolific producer of runners, while 'Sumas' and 'Redcrest' yielded well without prolific runner production. From Baumann et at. 1993. *HortScience* 28(9):891.894.