Biochemical and Molecular Diversity in the Chilean Strawberry and its Implications for Plant Breeding

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The Chilean wild strawberry (*Fragaria chiloensis* L. Duch.) is distributed in a wide range of agroecological systems, and as a result, has evolved considerable diversity in morphological and molecular traits. The native and ancient land races of *F. chiloensis* could be used as parents in a breeding program to improve the species or as a gene pool to improve the cultivated strawberry *F.* ×*ananassa.* At the national Research Institute of Agriculture (INIA), Experimental Center in Cauquenes, a collection of wild strawberry germplasm sampled throughout the country (Cameron et al., 1993) is maintained. Over the last ten years, the morphological and molecular patterns of variability in these collections have been examined (Becerra et al., 2001, 2002; Maureira et al., 1996). Here we describe the patterns in genetic diversity of selected Chilean strawberry accessions using isozymes and amplified fragment lenght polymorphism (AFLP).

Materials and Methods

Leaf sample preparation for isozyme analysis were similar to those described by Arulsekar et al., 1981. DNA was extracted from 61 genotypes representing the geographic and climatic range of strawberries in Chile (Table 1). DNA was extracted as previously described (Becerra and Gepts, 1994) and was amplified using the procedure of Becerra et al., 2001. The following primer pairs were utilized: *Eco*RI-AGC/*Mse*I-CTG; *Eco*RI-ACA/*Mse*I-CAG; *Eco*RI-ACC/*MseI*-CAA; *Eco*RI-ACC/*Mse*I-CAT; *Eco*RI-ACT/*Mse*I-CAC y *Eco*RI-AGG/*Mse*I-CTT. The gels were run according to Vos *et al*., 1995, with a nonradioactive modification. Band fragments were scored as present (1) or absent (0) and analysed using UPGMA clustering of Jaccard's coefficient (NTSYS) version 2.1, Rohlf, 2000.

Results and Discussion

The isozyme work showed a very low level of diversity in three isozyme systems, glucose phosphate isomerase (GPI), leucine aminopeptidase (LAP) and phosphoglucomutase (PGM). Only a few accessions showed any polymorphism. However, a great deal of diversity was previously found among genotypes for morphological traits. For example, growth habit type varied from postrate to erect, leaf width range between 2.42 and 4.32 cm, and runner first node length varied between 19.0

Table 1. Chilean accessions analyzed with biochemical and molecular markers.

Location	Province	Accession	South latitude	West longitude	Altitude (MASL)
Ambato	Ecuador	96 AMB1A	01.01	NI[z]	2500
Iloca	Curicó	92ILO1A	34.55	72.11	NI
Vilches	Talca	3VIL1A	35.34.13	70.37.34	535
Huelón	Talca	3HUE1A	35.05.75	72.03.55	50
Carrizal	Talca	3RRI1A	35.16.45	72.14.20	245
Curanipe	Cauquenes	3CUR1A	35.51.55	72.37.00	165
Cobquecura	Ñuble	3COB1A	36.12.20	72.47.42	155
Río los Sauces	Ñuble	90SAU1A	36.25	71.08	NI
Termas de Chillán	Ñuble	3TCH5A	36.54.27	71.24.54	1500
Los Lleuques	Ñuble	3LLE1A	36.52.06	71.35.87	1000
Laguna Laja	Biobío	3LAJ2A	37.23.74	71.24.52	1020
Purén	Angol	97PUR1A	37.57	73.10	NI
Cayucupil	Arauco	3CAY5A	37.48.18	73.09.34	660
Ramadilla	Arauco	3RAM1A	37.20.21	73.13.58	240
Quilapo	Arauco	3APO1A	37.24.47	73.33.74	180
Trongol	Arauco	3TRO1A	37.33.59	73.21.17	130
Cañete	Arauco	3CAÑ1A	37.37.49	73.25.02	160
Cayucupil	Arauco	94CAY1A	37.44.40	73.35.50	NI
Elicura	Arauco	3ELI1A	37.48.19	73.09.34	325
Agua fría	Malleco	3FRI1A	37.46.02	72.48.12	775
El Manzano	Malleco	3MAN1A	37.47.45	72.51.34	560
Nahuelbuta	Malleco	3NAH7A	37.47.20	72.59.59	1290
Laguna Icalma	Cautín	3ICA4A	38.49.53	71.23.40	1285
Laguna Icalma	Cautín	3ICA8A	38.41.23	71.20.10	1155
Captren	Cautín	3MEL9A	38.38.34	71.47.19	1210
Lonquimay	Cautín	3LON6A	38.21.02	71.16.44	840
Galletué	Cautín	3GAL2A	38.35.33	71.26.12	1140
Pino Hachado	Cautín	3PIN2A	38.38.75	70.57.07	1620
Puerto Saavedra	Cautín	3SAA2A	38.46.48	73.16.13	NI
Nueva Imperial	Cautín	3NIM1A	38.45.81	72.54.99	90
Nitrito	Cautín	3NIT1A	38.07.54	71.20.08	805
Sierra Nevada	Cautín	3SIE1A	38.26.93	71.22.80	1050
Conguillío	Cautín	3GUI2A	38.38.85	71.38.15	1120
Llaima	Cautín	3LLA1A	38.41.24	71.49.48	1200
Lago Icalma	Cautín	3ICA7A	38.43.22	71.12.53	1120
Conguillío	Cautín	3MEL5A	38.45.94	71.37.93	750
Lago Budi	Cautín	3BUD1A	38.48.17	73.23.43	80
Cunco	Cautín	3CUN1A	38.51.06	71.40.51	410
Lago T. Los Santos	Osorno	2LTS1A	41.14	72.45	229
Paso Card. Samoré	Osorno	3PUY1A	40.44.81	72.05.59	1060
Petrohué	Osorno	93PET1A	41.08	72.16	NI
Puyehue	Osorno	3PUY5A	40.42.90	71.56.66	1290
Niebla	Valdivia	3NIE1A	39.47.59	73.23.24	30
Tres Chiflones	Valdivia	3FLO2A	40.02.80	73.10.49	360
Lago Maihue	Valdivia	3MAI1A	40.12.44	72.08.29	NI
Chanquín	Valdivia	3HAN1A	39.16.39	73.10.98	50
Nigue	Valdivia	3NIG1A	39.19.12	73.11.53	50
Corral	Valdivia	3COR1A	39.56.21	73.13.28	NI
Tres Chiflones	Valdivia	3FLO1A	40.02.80	73.10.49	360
Futrono	Valdivia	3ONO1A	40.09.59	72.35.16	NI
Riñinahue	Valdivia	3RIÑ1A	40.17.74	72.10.86	80
Río El Salto	Chiloé	2PAL2A	43.30	71.55	183
Palena	Chiloé	2PAL3A	43.35	71.45	NI
Futaleufú	Chiloé	2FUT4A	43.08	71.40	NI
Río Camahueto	Chiloé	2CAM1A	42.50	72.53	2
Mar Brava	Chiloé	2BRA1A	41.50	73.55	2
Balmaceda	Aisén	2BAL1B	45.52	71.51	530
La Tapera	Aisén	2TAP3A	44.40	71.45	NI
La Tapera	Aisén	2TAP4A	44.38	71.39	NI
Puerto M.Balmaceda	Aisén	2MAR1A	43.47	72.57	0
Mallín Grande	Gral. Carrera	2MAL2A	46.08	72.06	351

[z]NI = no information.

[y]Accesion analyzed by molecular markers. (I DO NOT SEE ANY FOOTNOTE???)

[x]MASL = meters above sea level.

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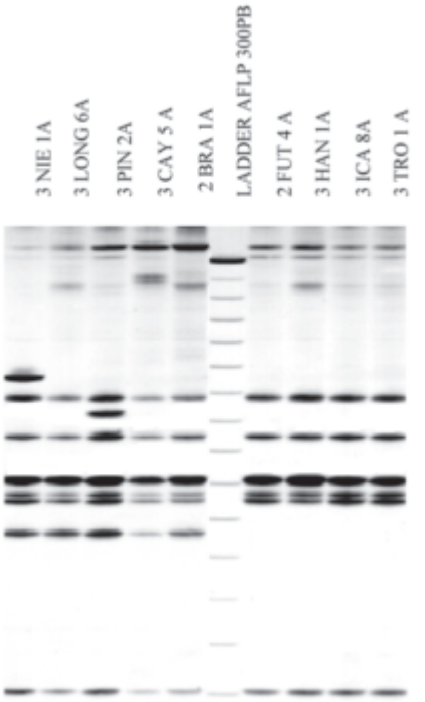

Fig. 1. AFLP banding pattern of *Fragaria chiloensis* accessions for *Eco* RI-ACT/ *Mse*I-CAC primer combination.

and 38.5 cm (Becerra et al., 2001; Maureira et al., 1996).

In the AFLP analysis, 37 polymorphic fragments were generated (Fig. 1), and most of the genotypes clustered around 90% of similarity, with no apparent regional clusters (Fig. 2). This limited amount of clustering contrasted greatly with the well differentiated phenograms generated using morphological and RAPD data (Becerra et al., 2002; Maureira et al., 1996).

Conclusions

The wild and cultivated Chilean populations of *F. chiloensis* are highly diverse, based on morphological and molecular markers. Isozymes were not so variable, which agrees with other reports concerning strawberry (Arulsekar et al., 1981). The high level of diversity found in most *F. chiloensis* traits indicates that there is a storehouse of genetic variability available to plant breeders. Because this diversity appears to be widely distributed geographically, the primary considerations in selecting superior parents would appear to be their horticultural characteristics and their environmental adaptations.

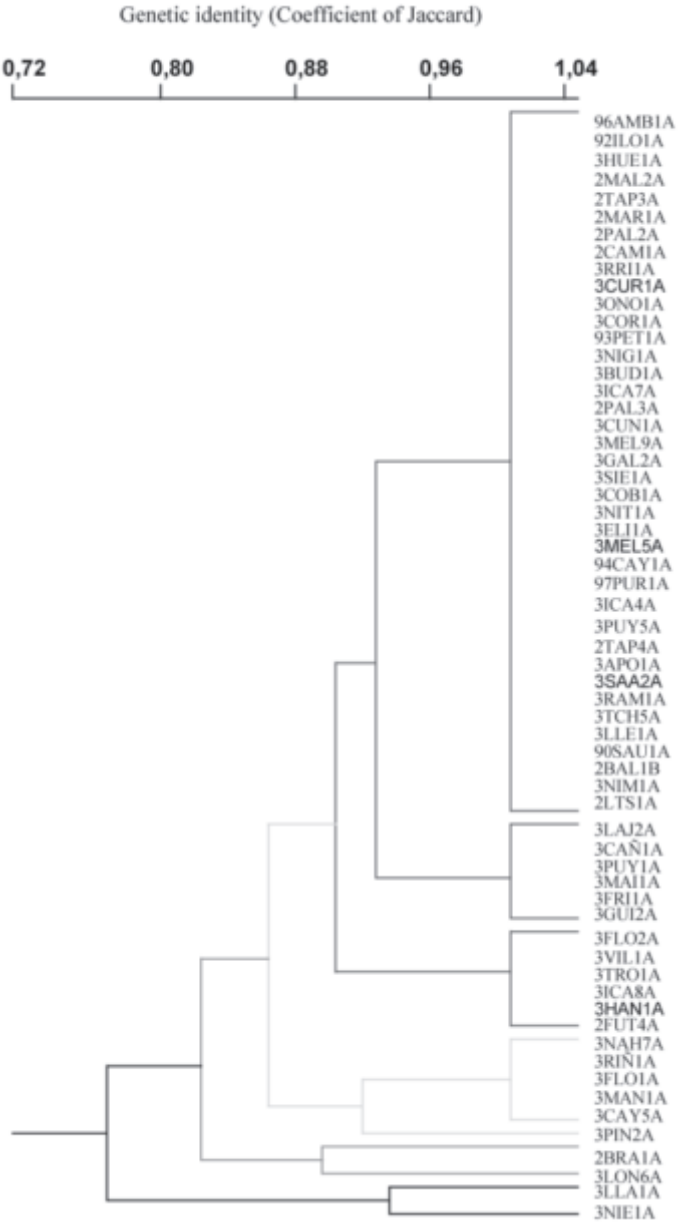

Fig. 2. Genetic relationship among 61 accessions of *Fragaria chiloensis*, detected by 6 primer combinations of AFLP.

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