Hybridization of seedless grapes

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Summary:

1. Complete seedlessness was not achieved in any seedless x seedless families produced. This clearly shows the seedless trait is not controlled by a single recessive gene.

2. The percentage of seedlessness obtained was not the same for all families. This indicates the importance of parental combinations and the need for progeny testing to increase the efficiency of producing seedless offspring.

3. All seedless genotypes used except Thompson Seedless have a seeded female parent, indicating heterogenity for seeds/aborted seeds. It will be interesting now to use seedlings from the seedless x seedless families to see if 100 % seedless offspring can be obtained.

4. Three seedless x seedless families compared to their complementary families from seeded x seedless were significantly different for percent seedless. *In ovulo* embryo rescue of seedless x seedless hybrids is also advantageous as it allows direct hybridization without seeded genotypes. This eliminates the introduction of genes from seeded genotypes and one generation – a savings of 5 years. The ability to achieve complimentary crosses between seedless genotypes directly can be achieved.

Key words: table grape, berry, seedlessness, stenospermocarpy, crossing, genetics, tissue culture.

Introduction

Consumer demands for stenospermocarpic seedless grapes have increased as they become familiar with this type of grape in the market. Grape breeders have tried to meet this demand by hybridizing seeded by seedless genotypes to create new seedless cultivars. The production of seedless genotypes by this method is quite low, ranging from 10 to 30 % (Loomis and Weinberger 1975). Table grape breeders have dreamed of hybridizing seedless genotypes directly to increase the percentage of seedless offspring obtained and increase the efficiency of the breeding program.

The development of *in ovulo* embryo rescue techniques for grapes (Emershad and Ramming 1984; Spiegel-Roy *et al.* 1985) has now made direct hybridization of seedless genotypes possible. The improvement of culture procedures (Emershad *et al.* 1989) and production of plants (Ramming 1989) has been reported elsewhere. The results obtained from 9 families produced in 1983 or 1984 are reported.

Materials and methods

Seedless genotypes with aborted seeds ranging from 0 to 25 mg fresh weight (FW) were hybridized by emasculation and controlled pollination (Table 1). P79-101 has only female flowers and was not emasculated but covered with paper bags before blooming and after pollination. All families had 24 or more fruiting seedlings and the percentage of seedlings bearing fruit ranged from 64 to 93 %. The average FW of the seed/aborted seed was determined by taking the largest seed from each berry of the 10 largest berries in a cluster. This allows us to determine the maximum expression of seed size for each seedling. Statistical differences between populations for the seedless character were determined with Chi square analysis.

Results and discussion

The distribution of seedlings with varying size of seeds/aborted seeds is shown in the figure. The histograms indicate that there are two groups of seedlings based on the bimodal distribution of seed FW. After comparing the seedling distribution in the histograms and observing the morphological traits of the seeds/aborted seeds, 25 mg FW was selected as the best division

Table 1: The seedless x seedless crosses made in 1983-84, the average weight of the seeds for each parent and the percent seedless offspring

Female	seed[1] (mg FW)	Male	seed[1] (mg FW)	Mid-parent Mean	% Sdlss[2] (<25mg)	% Sdlss[2] (<10mg)
C85-82	10.6	C20-149	6.6	8.6	78	58
P60-58	13.8	Thompson Seedless	3.2	8.5	70	60
B46-112	5.7	C18-36	5.9	5.8	67	67
A71-185	19.9	C32-68	14.2	17.1	56	33
P79-101	25.0	C32-68	14.2	19.6	83	67
P79-101	25.0	C33-199	0.0	12.5	76	56
P79-101	25.0	Flame Seedless	5.9	15.5	73	52
P79-101	25.0	B31-164	13.8	14.4	54	29
P79-101	25.0	C35-33	14.0	14.5	44	24

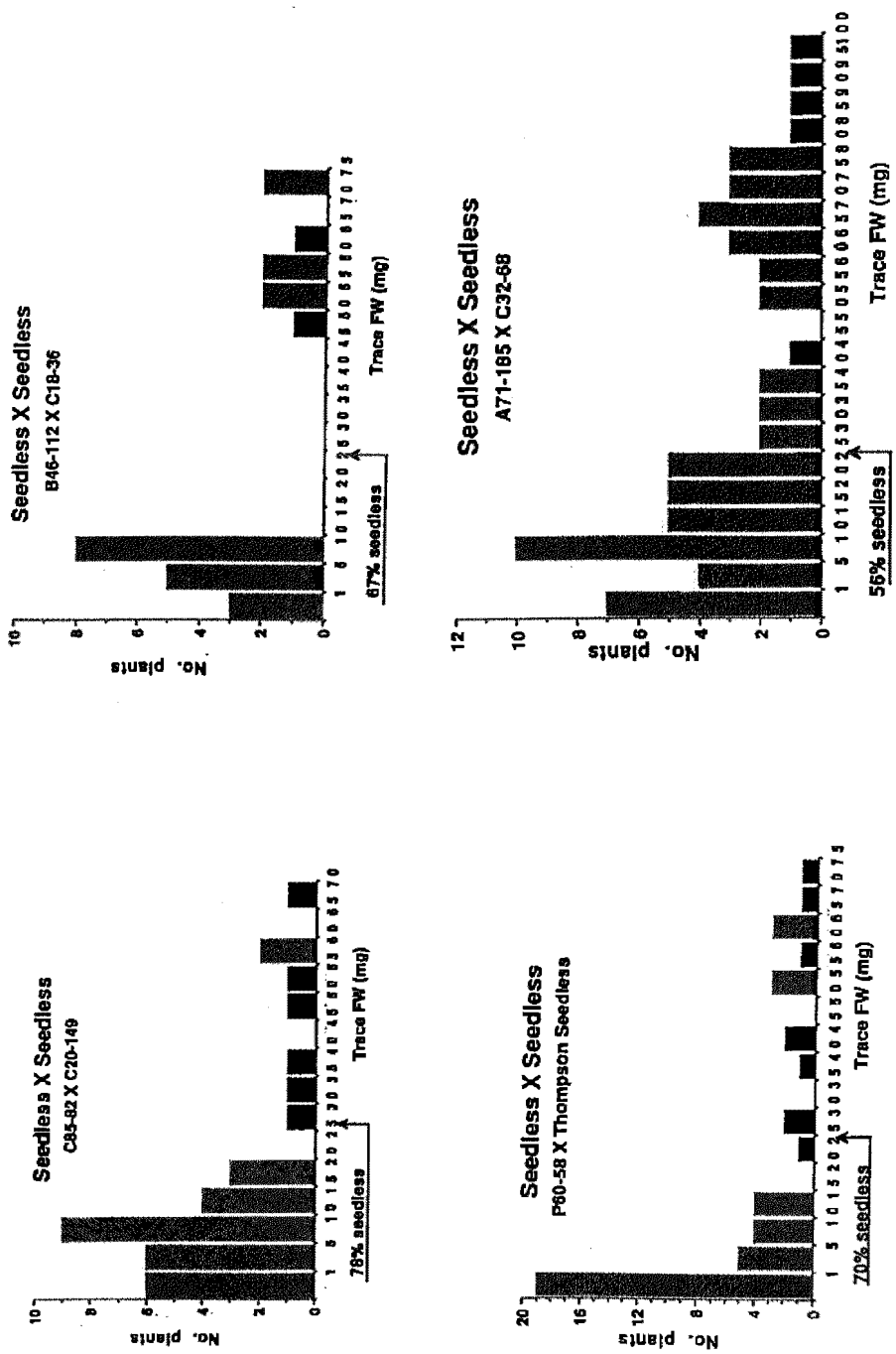
[1]Seed weight determined by weighting the largest seed from the 10 largest berries per cluster.
[2]Division between seeded and seedless = 25 or 10mg FW as indicated.

Table 2: The percent seedless offspring from seedless x seedless families with the same maternal parent, P79-101

Seedless Pollen Parent	% sdlss[1]	n
C32-68	83	24
C33-199	76	34
Flame Seedless	73	111
B31-164	54	24
C35-33	44	78
Significance[2]	***	

[1]Seedless = aborted seeds less than 25 mg.
[2]*** significant at the 0.5% level.

between seeded and seedless genotypes from an anatomical point of view. The maximum seed size for consumer acceptance as seedless is probably nearer 10 mg FW, but is influenced by flesh texture.



Distribution of seedlings containing various sizes of seed/aborted seed. (Continued overleaf.)

Every seedless x seedless family examined contained seedlings with seeds. This shows that seedlessness is not controlled by a single recessive gene as postulated in some reports (Constantinescu *et al.* 1975; Dudnik and Moliver 1976).

The percentage of seedless offspring for the families ranged from 83 to 44 % (Table 1). The correlation coefficient between percent seedless offspring and mid-parent values for the 9 families

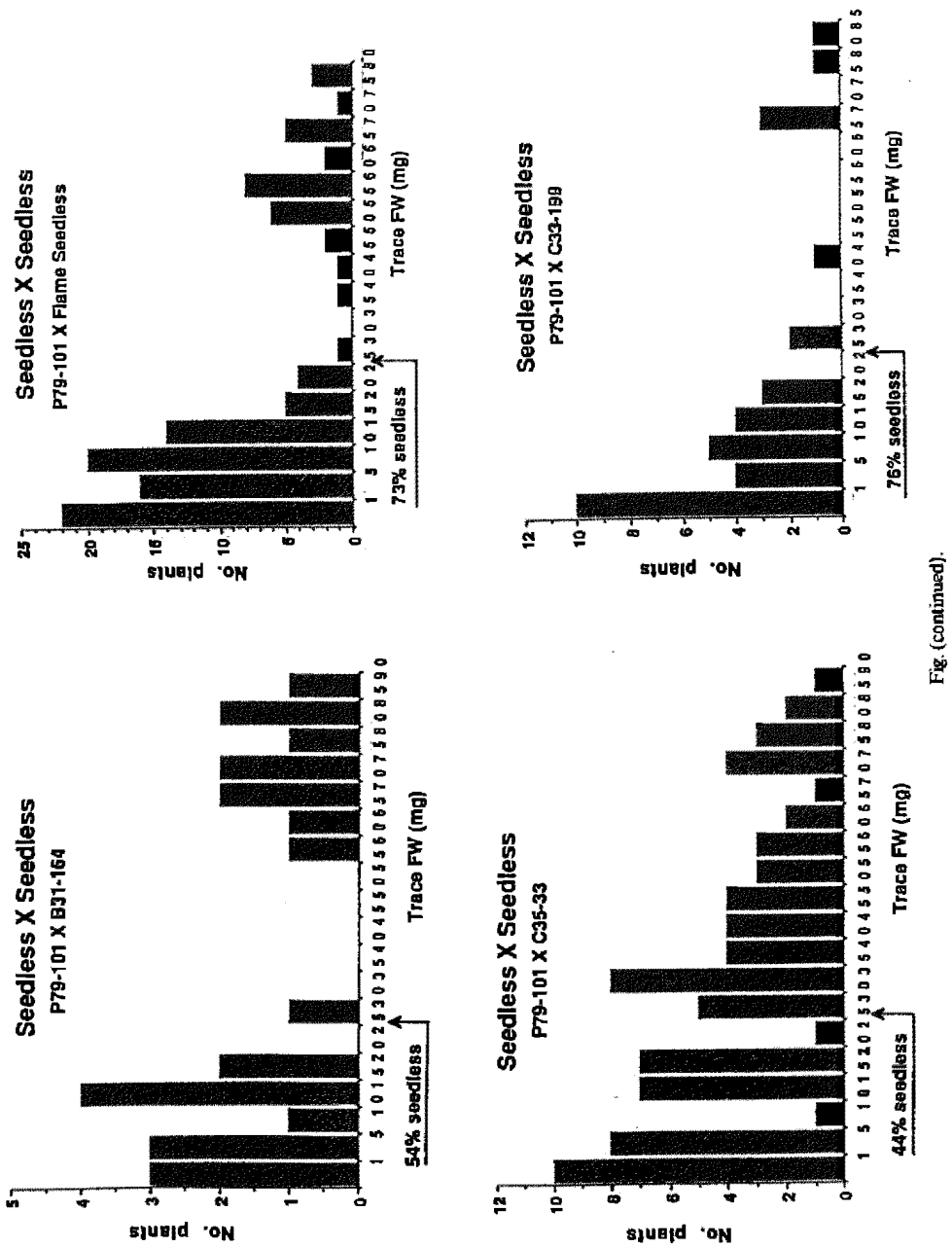


Fig. (continued).

Table 3: Comparison of families from seeded x seedless with seedless x seedless for percent seedless offspring

	Seedless pollen parents					
	Flame Seedless		C32-68		C35-33	
Females	% sdlss[1]	n	% sdlss[1]	n	% sdlss[1]	n
Seeded[2]						
P45-98	36	(281)	44	(249)	31	(35)
C15-133	32	(208)	39	(64)	25	(83)
Kishmiski	14	(20)	26	(99)	23	(103)
Seedless[3]						
P79-101	73	(111)	83	(24)	44	(78)
Significance[4]	***		***		NS	

[1] Seedless = aborted seeds less than 25mg FW.

[2] Seed/aborted seed weight based on average FW of all seeds in 10 average berries.

[3] Seed/aborted seed weight based on largest seed in 10 largest berries.

[4] NS,*** = Nonsignificant or significant at the 0.5% level respectively.

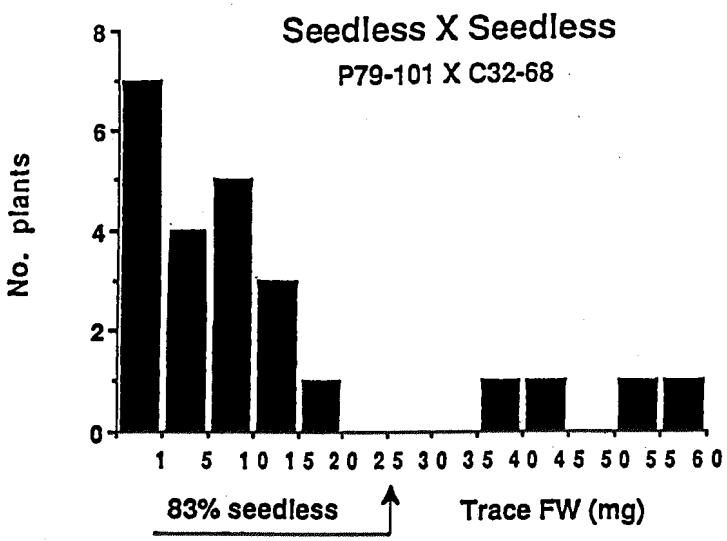


Fig. (continued).

was -0.4. This shows a low negative correlation between the aborted seed size of the parents and the percent seedless offspring, suggesting a low relation between phenotype and genotype for seedlessness. However, when individual families are compared it is seen that phenotype of the parents does not always correlate to the percent seedlessness in the family. For example, A71-185 x C32-68 and P79-101 x C32-68 representing parents with large aborted seeds had low (56 %) and high (83 %) seedless offspring, respectively, showing parental combination is important. The 5 families with P79-101 as the common female were compared (Table 2) and significant differences between percent seedlessness in the families were found. Even though C32-68 has a large aborted seed, in this case the family had the highest percent seedless offspring. This again points out the importance of parental combination and the need for progeny testing to achieve maximum efficiency in breeding for seedless genotypes.

The families from 3 seedless selections used as pollen parents and hybridized with the seedless selection P79-101 were compared to families from the same 3 seedless pollen parents hybridized with 3 seeded selections (Table 3). The families from the seeded females were studied earlier and their seed/aborted seed FW is based on the a v e r a g e seed weight from 10 largest berries. This measurement actually increases the percent seedless found compared to the method used for determining the FW of the seedless x seedless crosses. The seedless x seedless families were significantly different from the seeded families in 2 of the 3 cases. If the average FW for all traces instead of the largest trace is used for the seedless x seedless family, P79-101 x C35-33, 3 more seedlings are now classified as seedless instead of seeded. This increases the percent seedless to 47 % which is significantly different from the seeded x seedless families.

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