Cucurbit Genetics Cooperative

Report No. 6

July 1983

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Cucurbit Genetics Cooperative Report 6:ii-iv (Introduction) 1983

Introduction

Resolution and Notes of Organization Meeting

Resolution and notes of organization meeting, October 28, 1976, Denver Hilton, Denver, Colorado, U.S.A. The following resolution was adopted by research workers interested in organizing a Cucurbit Genetics Cooperative: The Cucurbit Genetics Cooperative is organized to develop and advance the genetics of economically important cucurbits.

Membership to this Cooperative is voluntary and open to workers who have an interest in Cucurbit Genetics (an invitation to participate is extended to all Horticulturalists, Entomologists, Plant Pathologists, Geneticists, and others with an interest in Cucurbits.

Reports of the Cooperative will be issued on an annual basis. The reports will include articles submitted by members and for the use of the members of the Cucurbit Genetics Cooperative. None of the information in the annual report may be used in publications without the consent of the respective authors for a period of five years. After five years the information may be used in publications without the consent of the authors.

Dues for the Cucurbit Genetics Cooperative

Further, dues for the Cucurbit Genetics Cooperative dues for the Cucurbit Genetics Cooperative (CGC) will be $2.50* per year and will be used to defray cost of preparation and mailing of the annual report. Members from outside the U.S.A. are encouraged to pay dues in at least two-year increments because of bank charges incurred for clearing checks. Only postal money orders or checks drawn on U.S. banks are acceptable. The annual report will include four sections: Research Notes, Stocks and Germplasm desired or for Exchange, Membership Directory, and Financial Statement. Other sections will be added in future reports as desired, i.e. gene lists, linkage groups, etc.

In accordance with the above resolution, we requested that an invitation to join the CGC be published in the following:

- Agronomy News
- Euphytica
- HortScience
- Journal of Economic Entomology
- Journal of Heredity
- Phytopath News

We are most pleased to acknowledge the assistance of the editors of these publications.

*Dues structure and biennial membership, effective 1982 and 1983.

Subscriber	Dues (biennial membership)	Back issue fee
U.S.	$ 6.00	$ 3.50
Libraries	10.00	6.00
Foreign	10.00	6.00

Report of Sixth Annual Meeting

J. D. McCreight

The sixth annual meeting of the Cucurbit Genetics Cooperative was held in conjunction with the American Society for

Horticultural Science on August 11, 1982 in Ames, Iowa. There were 25 in attendance. The meeting was chaired by R. L. Lower. He reported on publication of CGC No. 5 and the financial status of CGC. The cost of publication and mailing for CGC Report No. 5 was $441.07, which left a balance of $1,168.14. The membership was 159. A motion was made by Larry Baker (second McCreight) with no discussion that a crop advisory committee be formed for cucurbits. The motion passed unanimously and the chair accepted the responsibility for contacting the USDA. Discussion followed on the the advisability of including a listing of cucurbit-oriented publications in the CGC report. There was no further new or old business and the meeting was adjourned.

The **1983 Annual Meeting** of CGC will be held in McAllen, Texas, U.S.A., during the American Society for Horticultural Science meetings on August 19, 1983. Consult local program for exact time and place.

Comments From The Coordinating Committee

The call for papers for the 1984 report will go out in November, 1983, and they should be submitted to the Coordinating Committee by January 31, 1984. Hopefully, the seventh report will be published by June, 1984.

We are eager to hear from the membership regarding the future direction of the CGC. It is a pleasure to acknowledge the assistance of Patricia Coan who was responsible for the typing, proofing, and duplicating of this report. We express our sincere appreciation.

Coordinating Committee

- W. R. Henderson (watermelon)
- J. A. Juvik (*Cucurbita* spp.)
- J. D. McCreight (muskmelon)
- R. W. Robinson (other genera)
- T. C. Wehner (cucumber)
- R. L. Lower, Chairman

The coordinating Committee acknowledges the service of the Nominating Committee chaired by James McCreight.* The Committee nominated Dr. J.A. Juvik as the replacement for W.P. Bemis on the Coordinating Committee. The chairman thanks all of the Coordinating Committee for their assistance and especially Dr. Bemis who rotated off the committee effective November 1, 1982.

* Nominating committee includes: James McCreight, Greg Tolla and Todd Wehner.

Erratum

CGC Report No. 5:9. The correct table is as follows:

Table 1. Analysis of variance for seed traits.

		Mean square		
Source	df	Emergence percentage	Seed weight	Percent normal seeds
Block	3	3850 **	0.003 NS	144 NS
Cross	37	3286 NS	0.30 NS	886 NS
Maternal parent (Cross)	38	4506 **	0.25 **	1464 **
Error	225	556	0.005	150

** Significant at 1% level.

Cucurbit Genetics Cooperative Report 6:3-4 (article 1) 1983

Effect of Within Row Spacing on Mature Fruit Yield of Three *Cucumis sativus* var. *hardwickii* Derivatives and a Gynoecious Inbred of *Cucumis sativus*

D. E. Delaney, R. L. Lower and M. D. Edwards

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Cucumis sativus var. *hardwickii* has great potential as a source of germplasm for improving yield of pickling cucumbers. It is unique in that it sets large numbers of seeded fruit, and seems to lack apical dominance, producing more and longer laterals than lines of *C. sativus*. Under North Carolina conditions it averaged 80 fruit and 11.4 laterals per plant on a 0.6 m within row spacing (1). Previous studies have evaluated several morphological characteristics of *C. sativus* var. *hardwickii* at different within row spacings (2). Decreasing within row spacing had no effect on either main stem length or number of nodes on the main stem, but it did significantly decrease number of lateral branches. The objectives of this study were to compare the effect of within row spacing on fruit number per plant at maturity and to evaluate the potential usefulness of *C. sativus* var. *hardwickii* germplasm in commercial settings.

All plots were seeded in July of 1982 at the Hancock, WI Experiment Station in a completely random design with five replications. Within row spacings were 8 cm, 15 cm, 20 cm, 61 cm and 1.5 m. There were 1.5 m between rows. Plant material consisted of three open-pollinated *C. sativus* var. *hardwickii* derivatives and Gy 14, a gynoecious inbred of *C. sativus*. The *hardwickii* derivatives were from a random mating block of *hardwickii* material that was started in 1978. This germplasm had about 20% selection pressure for mature fruit yield and has been increased in each subsequent year. The derivatives were very heterogeneous and thus were not true breeding in terms of harvest date or numerous other characters. For this reason, a mature fruit harvest was chosen as the best index of fruit yield. Mature fruit count per plot was taken in September when the plants had stopped growing.

The *C. sativus* var. *hardwickii* derivatives consistently outyielded Gy 14 at all within row spacings (Table 1). Significant differences in fruit number per plant were not only found between the *hardwickii* derivatives and Gy 14, but also between the individual derivatives. At the two highest plant densities, *hardwickii* derivative #1 was significantly higher yielding than derivatives #2 and #3. Mean fruit number per plant for the *hardwickii* derivatives decreased greatly as plant density increased from 4,300 to 43,000 plants per hectare, while on Gy 14 the decrease was more gradual (Fig. 1). The same is true for fruit number per hectare. On the *hardwickii* derivatives, mean fruit number per hectare increased greatly as plant density increased to 43,000 plants per hectare, but then leveled off. On Gy 14, however, fruit number per hectare increased linearly as plant density increased.

Although fruit numbers on *C. sativus* var. *hardwickii* derivatives decline rapidly as plant population increases, they are so much higher than standard *C. sativus* cultivars that the potential for increasing yield is still great. Also, as is indicated by the highly significant interaction between lines and within row spacings (Table 2), lines perform differently at varying plant densities. In fact, *hardwickii* derivative #2 did not show the same leveling off of fruit number per hectare as plant density increased, but was continuing to increase steadily up to 86,000 plants per hectare. Thus, it may be possible to extract lines that are not as sensitive to high plant populations, yet are still higher yielding than the standard *C. sativus* cultivars currently available.

Table 1. Mean mature fruit numbers per plant for three *C. sativus* var. *hardwickii* derivatives and Gy 14 at five different within row spacings.

	Within-Row Spacing				
Line	**8 cm**	**15 cm**	**30 cm**	**61 cm**	**1.5 m**
C. s. var. *hardwickii* #1	8.19c	17.02c	17.25b	27.56b	39.32b

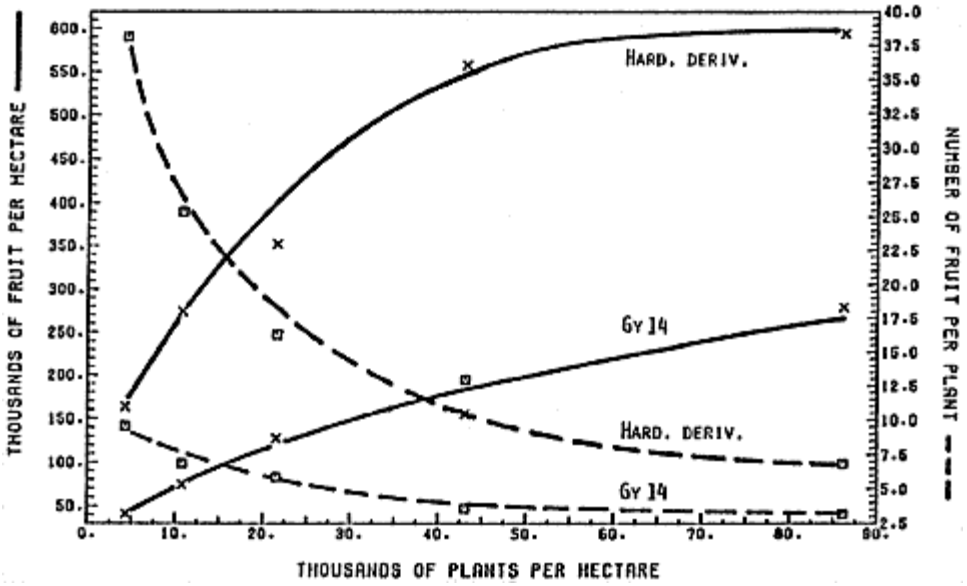
C. s. var. *hardwickii* #2	6.14b	9.24b	14.61b	22.45b	37.96b
C. s. var. *hardwickii* #3	6.37bc	12.54b	17.16b	26.32b	37.04b
Gy 14	3.24a	3.61a	5.94a	6.92a	9.63a
LSD (.05)	1.85	4.22	3.55	5.89	9.31

Table 2. Analysis of variance for mature fruit number per plant between GY14 and three *C. sativus* var. *hardwickii* derivatives.

Source	**df**	**Mean Squares for Mature Fruit No./Plant**
Line	3	1298.2**
Within row spacing	4	1907.4**
Line x within row spacing	12	123.8**
Error	80	17.9

**Significant at the 0.01 level.

Fig. 1 EFFECT OF PLANT DENSITY ON YIELD (MATURE FRUIT)



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2. Horst, E. K. and R. L. Lower. 1978. *Cucumis hardwickii*: a source of germplasm for the cucumber breeder. Cucurbit Genetics Coop. Rpt. 1:5.

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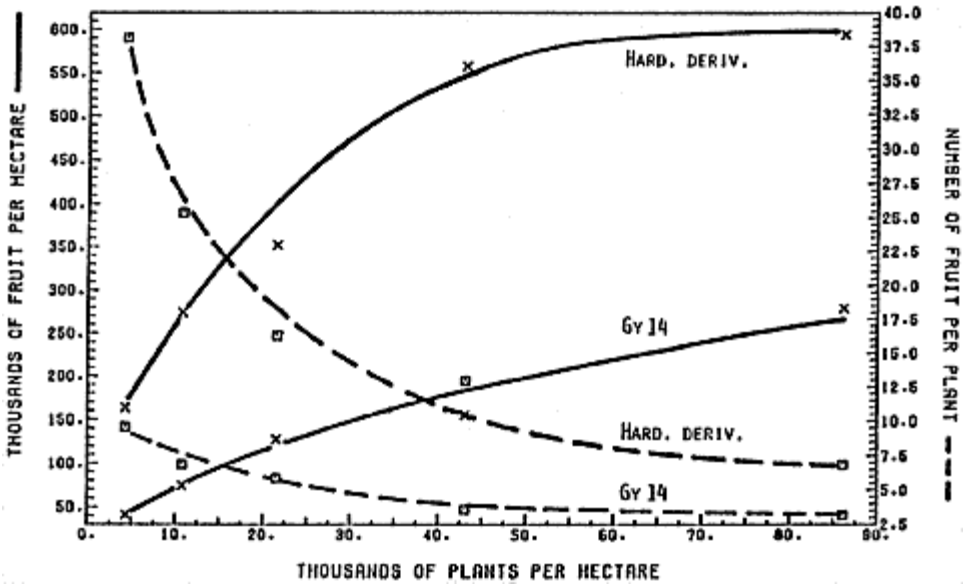

Cucurbit Genetics Cooperative Report 6:5-7 (article 2) 1983

Effect of Inbreeding on Seed Traits of Compact Cucumber

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Previous reports have described seed quality problems associated with the compact plant type (*cp cp*) in cucumbers (1). Variability exists in compact populations for emergence potential of seeds as well as for associated traits (2). Emergence percentage in a reference compact population has been shown to exhibit a moderate level of heritability and to be under the control of the genotype of the seed parent, i.e. maternally controlled (3).

Inbred compact lines have been obtained by recurrent backcrossing of a compact donor into each of five commercial pickling inbreds. Under most conditions, the quality of seeds produced on these inbred compact plants has been poorer than that of a reference compact population. The reason for this particularly poor seed quality is unknown.

Cucumbers have been reported to exhibit measurable inbreeding depression for some traits (4, 5, 6). The magnitude of inbreeding depression observed has usually not been great. Consequently, the crop is not generally considered to suffer from inbreeding depression. This study was conducted to determine if the extremely low seed vigor observed for inbred lines of compact cucumbers might be attributable to inbreeding depression.

F_1 and F_2 seed lots were produced in the greenhouse for each of seven crosses among five inbred lines of compact cucumbers. Because of the poor quality of seed produced on *cp cp* plants, all seed lots were produced on *Cp cp* plants which segregated *cp cp* individuals among the progeny. Parental, F_1 and F_2 generations were sown in the field in ten-plant plots on June 16, 1982 at Hancock, WI. Spacing was 30 cm between hills and 1.5 meters between rows. Plots were planted in a randomized complete block design with three blocks. Hills were over-seeded and each was thinned to one compact plant at the two-leaf stage. Because of the maternal regulation of seed quality (3), plants were allowed to open-pollinate to produce fruit.

At maturity, seed from one fruit was harvested from each plant. Seed from all fruit in each plot were pooled to form a seed bulk. Seed bulks were fermented two days at room temperature then washed, dried and packaged. After 15 months of storage in laboratory conditions, two 100-seed samples were counted from each bulk, weighed, treated with a fungicide and sown 2.5 cm deep in a heated sand bench. Emergence testing was conducted using a randomized complete block design with two blocks. All three field bulks for each treatment were represented in each block. Emergence percentage and mean number of days to emergence were recorded for each sample.

Mean values of dependent variables for each generation and cross are presented in Table 1. The F_1 and F_2 generation values for seed weight exceeded the mid-parent value in all seven crosses. F_1 values also exceeded the high parent for four of the seven crosses. The consistent relationship between the inbreeding coefficient and seed weight can be seen in Figure 1. Lines represent the least-squares regression relationships for each cross, where mid-parent values are used for the parental generation.

Table 1. Mean values of seed traits for seedlots produced on various maternal parents.

Maternal Source	Cross * Designation	Seed Weight (g./100 seeds)	Emergence Percentage	Mean # Days to Emergence
Inbreds				
Addis cpcp		.39	1	7.2
GY2 cpcp		.83	60	5.8
Chipper cpcp		.70	7	7.2
GY14 cpcp		.70	20	6.1
8L cpcp		.63	9	6.7
F_1's				
Addis x Chipper	A	.78	9	6.8
GY2 x Addis	B	.66	17	6.4
GY2 x Chipper	C	.78	22	6.6
GY2 x 8L	D	.90	47	5.9
GY14 x Addis	E	.67	17	6.6
GY14 x GY2	F	.89	57	5.3
GY14 x 8L	G	.78	17	7.2
F_2's				
Addis x Chipper	A	.71	25	6.4
GY2 x Addis	B	.60	6	6.9
GY2 x Chipper	C	.66	25	6.4
GY2 x 8L	D	.79	48	6.0
GY14 x Addis	E	.66	3	7.5
GY14 x GY2	F	.79	49	5.3
GY14 x 8L	G	.69	17	6.0
$LSD_{.05}$		.11	19	

* designations in figures 1 and 2.

The relationship between inbreeding and emergence percentage is less clear (Figure 2). Although the slope of the least-squares regression line for generation means across the seven crosses is negative, specific crosses do not show consistently decreased emergence percentage with increased levels of inbreeding.

Figure 1. EFFECT OF LEVEL OF INBREEDING ON SEED WEIGHT

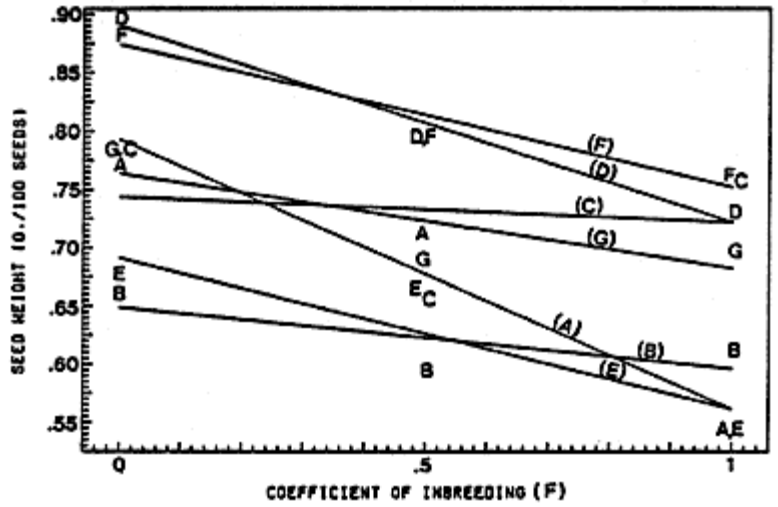
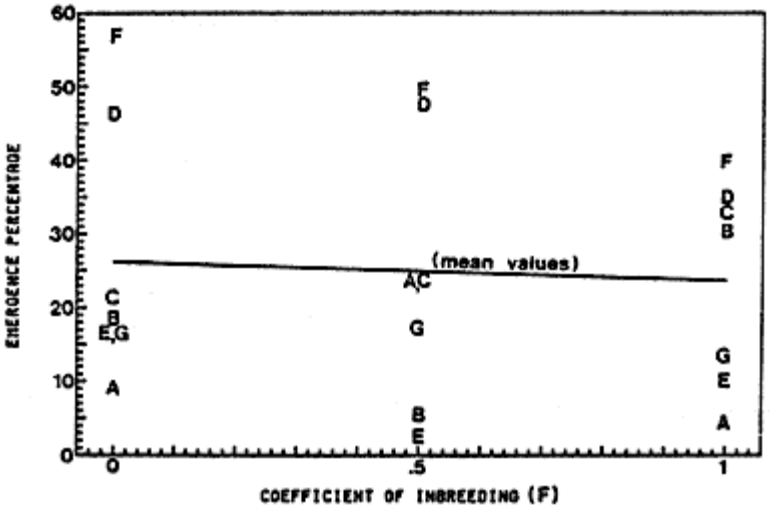


Fig. 2. EFFECT OF LEVEL OF INBREEDING ON EMERGENCE PERCENTAGE



These data clearly indicate inbreeding depression effects for seed weight in compact cucumbers. Whether inbreeding also affects emergence percentage is less evident. The coefficient of variation (CV) for emergence percentage is much larger than that for seed weight, 54 and 11 percent, respectively. The large error variance for emergence percentage makes it difficult to accurately describe trends associated with inbreeding. Previous studies have documented a strong phenotypic association between seed weight and emergence percentage within a heterogeneous compact population (2). It seems likely that with greater experimental precision, inbreeding would be found to be associated with poorer emergence percentages.

However, the average emergence percentage of seed produced on F_1 hybrids in this study is considerably poorer than values obtained for seed lots from open-pollinated compact plants in an adjacent plot. This suggests that factors other than inbreeding are probably also involved in the poor emergence performance of inbreds utilized in this investigation.

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crosses of cucumber. J. Amer. Soc. Hort. Sci. 104:564–567.
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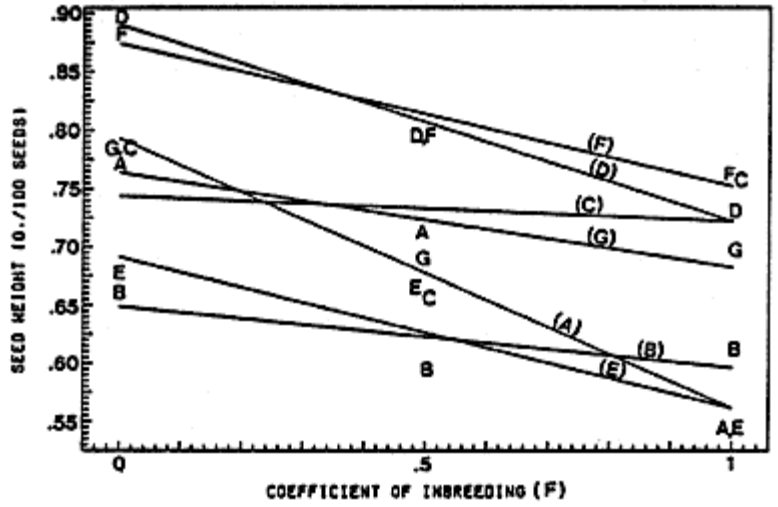
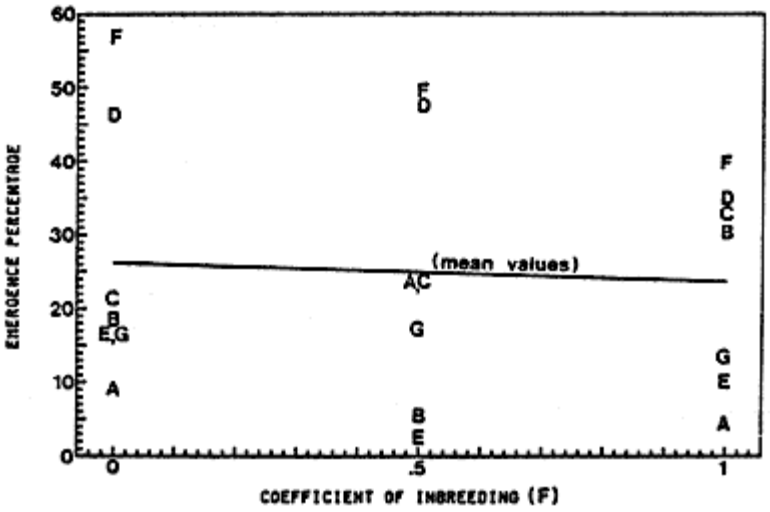


Fig. 2. EFFECT OF LEVEL OF INBREEDING ON EMERGENCE PERCENTAGE



Cucurbit Genetics Cooperative Report 6:7-8 (article 3) 1983

Two Sources Conferring Partial Dominant Resistance to Powdery Mildew (*Sphaerotheca fuliginea* Poll.) in Cucumber

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In cucumber, nearly all crosses of powdery mildew resistant (PMR) x susceptible parents yield fully susceptible F_1s. In a backcross program to transfer PMR from 'Spartan Salad' to 'Marketmore 70', Munger observed one F_1 progeny in which some plants showed partial resistance (1). Omara, by selfing nearly 100 plants of 'Spartan Salad' and testcrossing them to 'Marketmore 70', found that one plant, 77-717 gave an F_1 with uniformly low-intermediate PMR about equivalent to 'Tablegreen 65', while several others gave segregating F_1 progenies. He also found that PI 197088 produced a similar F_1 but it had more tendency to lose resistance as it matured. When 'Tablegreen 65' was crossed with either the PI 197088 or 77-717, PMR in the F_1 is increased to a high-intermediate level similar to 'Poinsett'.

In the present study, PMR from 77-717 has been carried through three consecutive backcrosses to 'Marketmore 70' without selfing until the BC_3. In the F_2 of the BC_3 several plants with high-intermediate and high resistance were tested by crossing with 'Marketmore 70' and 'Tablegreen 65'.

Only the F_2 parents with high resistance produced F_1 plants with more resistance than the other parent. The inheritance of this partially dominant resistance is not clear but is probably relatively simple since populations of 25 to 30 plants per generation have been adequate to permit its selection through 3 backcrosses. Some F_3 progenies from the third backcross appear to have PMR equivalent to 'Marketmore 76' or 'Poinsett'. This suggests that the incorporation of PMR by repeated backcrossing can be speeded considerably by using 77-717 as the resistant parent, thereby eliminating the need to self-pollinate the progeny after each cross. Furthermore, PMR lines bred in this way should produce more resistant F_1s than previous PMR parents.

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Cucurbit Genetics Cooperative Report 6:8-9 (article 4) 1983

Intermediary Inheritance of Glabrousness (*gl*) in Cucumber

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In order to improve the biological control of the glasshouse whitefly *(Trialeurodes vaporariorum)* with the parasitic wasp *Encarsia formosa*, glabrous cucumber mutants were introduced from the USSR and the USA (1). The glabrousness of all mutants investigated was governed by the same recessive gene *gl* (2).

The general horticultural value of the glabrous lines was improved by repeated backcrossing of one of the Russian mutants (Odnostebelnyi 33) with a Dutch glasshouse cucumber variety. Some negative qualities found in all mutants, such as frizzled leaves with pinpoint necrotic spots, stress sensitivity, and poor root systems were persistent despite rigid selection. This approach was, therefore, abandoned after we found an interesting alternative.

During our backcross program we got the impression that heterozygous *(Glgl)* plants were less hairy than homozygous plants. To verify this, 10 randomly chosen plants of two backcross populations (A and B) were investigated in detail. The lower sides of comparable leaves were dusted with green fluorescent powder and the hairs of two leaf areas of 12.5 mm^2 were counted by two independent observers using a binocular microscope. The zygosity of the chosen plants was checked by selfing each plant and observing possible segregations in the progeny. Both of the $B_{1.1}$ populations (A and B) happened to contain 50% heterozygotes, which carried about half the number of hairs of that of the *GlGl* homozygotes. From these data we concluded that the *gl* gene is inherited in an intermediary way. The variation around the mid-parent value was considered non-heritable.

In laboratory and glasshouse studies the possible advantage of hybrids with only half the number of hairs for the mobility and, thus, for the parasitizing efficiency of *Encarsia formosa* (1), will be investigated. The horticultural value of these hybrids was comparable to that of the pubescent parent without any of the above-mentioned negative qualities of the glabrous mutants. It seems, therefore, that those other characters are not inherited in an intermediary fashion.

Table 1. Average numbers of hairs per 12.5 mm^2 on the lower leaf surface of homozygous and heterozygous $B_{1.1}$ plants (4 counts/plant).

Generation	Genotype	Number counted	Average number of hairs	Range of the means per plant
P_1 (pubescent)	*GlGl*	3	42	41 – 44
$B_{1.1A}$	*GlGl*	5	45	39 – 49
	Glgl	5	23	18 – 29
$B_{1.1B}$	*GlGl*	5	47	39 – 51
	Glgl	5	22	19 – 27

Literature Cited

1. Ponti, O.M.B. de. 1979. Breeding glabrous cucumber varieties to improve the biological control of the glasshouse whitefly. Cucurbit Genetics Coop. Rpt. 2:5.
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Cucurbit Genetics Cooperative Report 6:10-12 (article 5) 1983

A System for the Measurement of Foliar Diseases of Cucumber

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Several pathogenic microorganisms cause injury to the foliage of pickling and slicing cucumbers (Table 1). The pathogens may cause injury to all above-ground parts including the leaves, stems, petioles, peduncles and fruit. Cucumber cultivars have been developed with resistance to many of the foliar diseases. In addition, effective chemical controls have been developed for most of the fungal diseases. As the amount of cooperative research among programs increases, it is important that we be able to measure the incidence of disease accurately in order to evaluate genetic resistance and cultural methods of control.

Table 1. Principle diseases and causal agents of foliar diseases of cucumber.

Disease	**Causal Agent**
Anthracnose	*Colletotrichum lagenarium*
Angular leaf spot	*Pseudomonas lachrymans*
Downy mildew	*Pseudoperonospora cubensis*
Powdery mildew	*Erysiphe cichoracearum*
Scab	*Cladosporium cucumerinum*
Cucumber mosaic	Cucumber mosaic virus
Target spot	*Corynespora cassiicola*
Gummy stem blight	*Didymella bryoniae*
Alternaria leaf spot	*Alternaria cucumerinum*
Air pollution	Ozone, sulfur dioxide, etc.

Several systems for rating foliar disease on crop plants have been developed. The systems vary from simple (e.g. + or -, diseased or healthy) to complex (e.g. 1 to 100, percent diseased). Horsfall and Barratt (2) developed a scoring system which is based on the Weber-Fechner Law, that the human eye distinguishes changes on the leaf according to the logarithm of the light intensity. That system (Table 2) has as its midpoint 50 percent foliar disease. One grade above and below 50 percent, the percent disease changes by a factor of two. The system has 12 grades in which the percent disease ranges from 0 to 100. Redman *et al*. (3) developed tables which converted the Horsfall-Barratt system to various percentage estimates of disease. Their scale ranges from 0 to 11 while the original Horsfall-Barratt scale ranges from 1 to 12 (Table 2).

Table 2. Comparison of disease rating scales of Horsfall-Barratt, Redman *et al.* and Jenkins-Wehner.

				Jenkins-Wehner Method		
Horsfall-Barratt score	**Redman et al. score**	**% disease**	**Mean % conversion[z]**	**Score[y]**	**% disease**	**Mean % conversion[z]**
1	0	0	0.00	0	0	0.1
2	1	0–3	2.34	1	0–3	1.5

3	2	3–6	4.68	2	3–6	4.5
4	3	6–12	9.37	3	6–12	9.0
5	4	12–25	18.75	4	12–25	18.5
6	5	25–50	37.50	5	25–50	37.5
7	6	50–75	62.50	6	50–75	62.5
8	7	75–87	81.25	7	75–87	81.5
9	8	87–94	90.63	8	87–100	93.5
10	9	94–97	95.31	9	100	99.9
11	10	97–100	97.66	–	–	–
12	11	100	100.00	–	–	–

[z] Conversion factor is used to convert the score to percent foliage damage.

[y] Verbal description of scores 0 to 9 of Jenkins - Wehner:
0 = no disease; *immune*
1 = few small leaf lesions; *highly resistant*
2 = few lesions on few leaves with no stem lesions; *resistant*
3 = few lesions on few leaves or with superficial stem lesions; *moderately resistant*
4 = few well-formed leaf lesions or superficial stem lesions; *intermediate*
5 = few well-formed leaf lesions or enlarging stem lesions; *intermediate*
6 = many large leaf lesions or deep stem lesions with abundant sporulation, or plant more than 50% defoliated; *susceptible*
7 = many large coalescing leaf or stem lesions, over 75% of plant area affected or defoliated; *susceptible*
8 = plants largely defoliated, leaves or stems with abundant sporulating lesions; *highly susceptible*
9 = plants dead; *highly susceptible*

Our proposed scale for evaluating cucumber foliar disease is a modification of a scale using the scores 1 through 5 developed by Goode (1) for evaluating anthracnose on cucurbits. This system is as follows: 1 = highly resistant or immune, no lesions; 2 = resistant, with a few small leaf lesions; 3 = intermediate, with a few well-formed leaf lesions or superficial stem lesions; 4 = susceptible, with many large leaf lesions or deep stem lesions and usually with abundant sporulation; 5 = highly susceptible, plants dead.

We expanded that scale to include more intermediate categories (Table 2). The scale we developed ranges from 0 to 9 and has the advantage of using only one column on the data sheet instead of two as the Horsfall-Barratt scale does. Our scale is essentially a hybrid Of Goode's scale (1) and the Horsfall-Barratt scale (2). We have condensed Horsfall-Barratt grades 9 (87 to 94%), 10 (94 to 97%) and 11 (97 to 100%) into our grade 8 (87 to 100%) because we have observed that once a cucumber plant reaches that stage of disease (87% foliar damage) it is no longer productive. On the lower end of the scale, it is much easier to detect differences and those differences are significant in predicting disease development. We propose that cucumber foliar diseases be scored in a standard fashion using the 0 to 9 scale.

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A Second Long Hypocotyl Mutant at the *lh* Locus

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Monogenic mutants having an elongated hypocotyl when grown in white light have been described for several loci in plants like *Arabidopsis thaliana* (2) and tomato (3). Compared to the wild type, those mutants show an altered inhibition spectrum which is locus-specific when grown under light of restricted spectral regions. Some of those genes apparently regulate the presence of phytochrome in the hypocotyl. Since cucumber is frequently used for the study of seedling physiology, the presence of such hypocotyl mutants in this species would be very useful for photophysiological research.

Van der Knaap and de Ruiter (1) found such a mutant in the progeny of one of their megurk plants irradiated by a 137 Cs-y source. That monogenic recessive mutant was found to be allelic to a similar mutant described by Robinson and Shail (4) as the F_1 of both mutants also had a long hypocotyl. Some characteristics of the original mutant, such as reduced fertility and strongly-reduced growth of the higher internodes, were not due to pleiotropic effects of the *1h* gene because they segregated independently from that gene in F_2 progenies derived from a cross of that mutant and the cultivar, Stereo.

Preliminary experiments indicate that the mutant reacts to light in a manner similar to hypocotyl mutants of other species, e.g. continuous red light no longer inhibits hypocotyl elongation. A more detailed physiological characterization of the mutant is in progress.

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Ulocladium cucurbitae Leafspot on Cucumber (*Cucumis sativus*)

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In cucumber breeding plots at Ithaca, cucumber mosaic virus (CMV) resistant progenies with ‘Ashley’ and ‘Poinsett’ in their parentage have repeatedly shown more severe leafspot symptoms and earlier defoliation than other cucumbers with comparable CMV resistance. An unusual race of anthracnose was initially suspected, but in most years we saw few lesions on fruit and in one year when they did appear, a study by plant pathology graduate students showed that the organism was race 1 of *Colletotrichum*. The consistently late defoliation of ‘Tablegreen 65’ and early defoliation of ‘Poinsett’-related progenies is the opposite of expectation if anthracnose were involved. Cornell ‘SR551’ and ‘PMR551’ have been outstanding in freedom from leafspot symptoms, seldom being defoliated before frost.

When we learned that ‘Poinsett’ is unusually susceptible to target leafspot caused by *Corynespora cassiicola* and that ‘SR551’ and its hybrids are among the least susceptible to this disease in Florida, we thought the same disease might be present in New York State also. However, several isolations in 1981 and 1982 failed to yield any *Corynespora* here. Instead, spores of the unknown fungus were consistently isolated, both from fields which had not been inoculated with any organism, and from a field inoculated with a strain of *Corynespora* obtained from J. M. Strandberg of Leesburg, Florida. In the latter field, *Corynespora* conidia were also routinely isolated from the plants. The lesions caused by *Corynespora* appeared as dark, sunken necrotic spots, while those incited by the unknown fungus appeared as pale, bleached spots surrounded by alternating concentric rings of dark and pale necrotic tissue. Examination of lesions of the latter type from the field inoculated with *Corynespora* and from uninoculated fields revealed only spores of the distinctive type of *Alternaria*, and never of *Corynespora*.

In order to insure proper identification of the unknown fungus, an isolate and a leaf sample were sent to the Commonwealth Mycological Institute, Kew, England, where the fungus was subsequently identified as *Ulocladium cucurbitae* by S. M. Francis. According to the scant literature available, the first report of *Ulocladium cucurbitae* being pathogenic on cucumber is that of Butler *et al*. (1) in 1979. The disease is quite common in the United Kingdom. The organism has also been isolated from *C. sativus* in New Zealand, Canada, India and the U.S.A., although it is apparently not widespread in those countries.

However, the disease may be more widespread than is commonly thought. This is due to the ability of the organism to produce more than one characteristic spore type, depending upon the environment. On the leaf itself, *Ulocladium cucurbitae* looks more like an *Alternaria* and has only occasional *Ulocladium*-type spores. In culture, the *Ulocladium*-type spores predominate with very few, if any, *Alternaria*-type spores being present (S. M. Francis, personal communication). Simmons (2) has also prepared an excellent overview of the situation.

Koch’s postulates have been verified repeatedly, although effort is still being directed at discerning optimum conditions for artificial inoculation, with hopes of developing a rapid screening method.

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Pickling Cucumber Inbred Line Development by Full-sib Family Selection

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In an inbred-hybrid breeding system, inbred line development or extraction is preceded by a population improvement phase. Full-sib family selection as proposed by corn breeders (1, 2, 4) is a suitable method for extracting inbred lines from two improved populations. This selection procedure involves selfing and crossing between individuals from two populations. Individual crosses are evaluated and the selfed progenies of plants used in the crosses are selected for future population generations. This procedure is followed until the selfed progenies of plants used in the selected crosses are homozygous and homogenous (Fig. 1). An investigation of this procedure in maize suggests that it leads to extraction of inbred lines with improved combining ability with greater efficiency than the more standard inbred-hybrid selection systems (3).

This inbred line development program has been practiced in pickling cucumbers for one year with the goal of increasing fruit yield in a once-over mechanical harvesting system. Two improved pickling cucumber populations, HSE-C_3 (hardwickii semi-exotic, cycle 3) and GS-C_3 (gynoecious synthetic, cycle 3), resulted from three cycles of S_1 selection (5).

Average fruit yield of 106 S_0 x S_0 (HSE-C_3 X GS-C_3) crosses was 2.32 fruit per plant, ranging from 1.06 to 4.88 fruit per plant (Table 1). This average fruit yield was not significantly higher than the average of six check hybrids. Also, mean yield was less than that for a well-adapted hybrid, 'Calypso'. Twenty-two selfed lines from both populations (HSE-S_1 and GS-S_1) were selected on the basis of hybrid performance (selection intensity = ca. 20%) for continuing the selection program. Fruit yield of selected crosses was 3.27 fruit per plant.

Table 1. Summary of a cycle of selection using full-sib family selection, a comparison of number of fruit per plant at optimum once-over harvest time.

Family	S_0 x S_0	S.D.	Range
All crosses (106)	2.32	0.45	1.06–4.88
Selected crosses (22) a	3.27	0.54	2.78–4.88
Average of checks (6) b	1.84	0.39	1.33–2.66
Average of Calypso	2.50	0.45	2.33–2.64
$LSD_{.05}$	0.89		

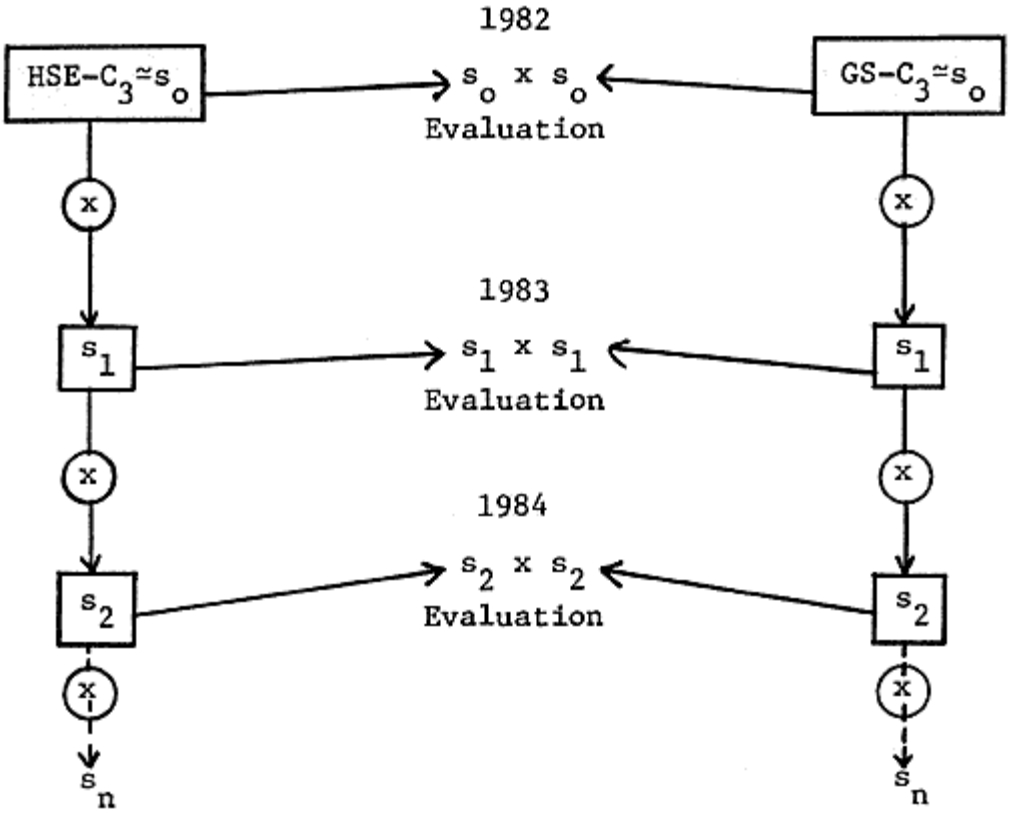

Figure 1. Outline of full-sib family selection.

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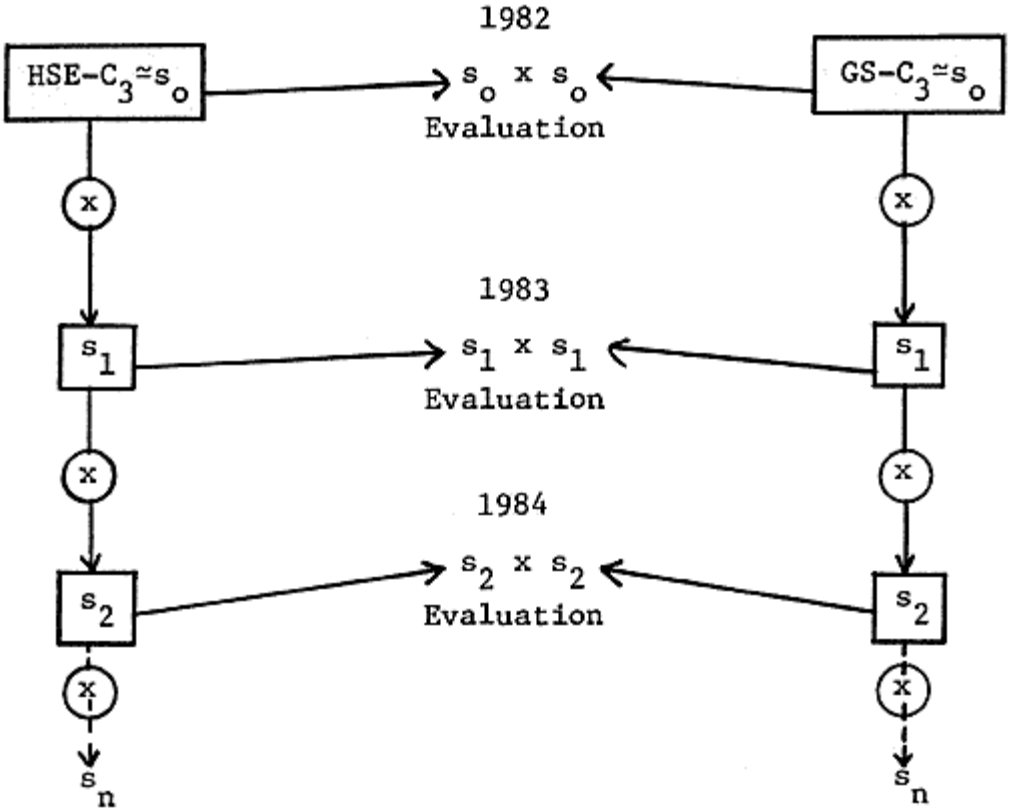
1982
HSE-C3≃So
So x So
Evaluation
GS-C3≃So
x
x
1983
S1
S1 x S1
Evaluation
S1
x
x
1984
S2
S2 x S2
Evaluation
S2
x
x
Sn
Sn

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Pickling Cucumber Population Improvement for Increased Fruit Yield

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Low fruit number per plant (i.e. fruit yield) is the major yield-limiting factor of all existing pickling cucumber cultivars for a once-over mechanical harvesting system. Fruit yield average over three years under commercial field conditions is, about 2.5 fruits per plant per harvest (2). Research efforts focused on the development of new hybrids with higher fruit yield are underway. Increased fruit number per plant leads to higher yield and increases the feasibility of a mechanical harvesting system.

A pickling cucumber population improvement program has been conducted at the University of Wisconsin since 1979. Two divergent populations (HSE=hardwickii semi-exotic population and GS=gynoecious synthetic population) were developed to initiate selection for increased fruit number per plant. Nienhuis (3) evaluated 3 cycles of S_1 progeny selection and found that in all populations (HSE, GS, and HSE x GS)[1] the average rates of gain were highly significant.

This population improvement program has continued and utilizes recurrent selection for specific combining ability (RSC) with gynoecious inbred lines as testers. This procedure has been effective in improving both specific and general combining ability in other crops (1). Also, as suggested by Smith *et al.* (4), this procedure should provide an efficient means of selection (,uniformity of fruit set) and lead directly to development of hybrids.

One cycle of RSC using GY2 and GY14. as inbred testers was completed in 1982. Average fruit yield (at optimum harvest time) for GY2 and GY14 testcrosses of HSE and GS were 2.01, 2.26, 1.64, and 2.13 fruit per plant, respectively (Table 1). Testcross yields were higher than hybrid checks (1.57 fruit per plant). The top 26 lines (HSE) (SI=ca. 25%), 13 lines from testcrosses with both testers, with-an average fruit yield of 2.62 and top 33 lines (GS) (SI=ca. 20%), 15 lines from testcrosses with GY2 and 18 lines from testcrosses with GY14, with an average fruit yield of 2.38 were selected for further population improvement.

Table 1. Summary of one cycle of recurrent selection for specific combining ability for increased fruit yield in two divergent populations, HSE and GS, using GY2 and GY14 as testers.

Population	Testers	Number of Testcrosses	Average Fruit No. Per Plant	Range [a]	Average of Selected Lines [b]	Average Fruit No. Per Plant of Selected Lines [c]
HSE	GY2	74	2.01	0.67-3.24	2.59 (SI=18%)	2.62 (SI=ca.20%)
	GY14	74	2.26	1.41-5.02	2.66 (SI=18%)	
GS	GY2	112	1.64	0.06-2.79	2.19 (SI=13%)	2.38 (SI=ca.25%)
	GY14	112	2.13	0.90-2.88	2.54 (SI=16%)	
Hybrid Checks [d]			1.57			

[a] Yield on GY2 was decreased by the incidence of scab.

[b] Based on separate testers.

[c] Based on populations.

[d] Included three gynoecious F_1 hybrids (Calypso, Calico, and Southern Belle) and three monoecious cultivars (Clinton, Liberty and Wisc. SMR 18).

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	GY14	112	2.13	0.90-2.88	2.54 (SI=16%)	
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[b] Based on separate testers.

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Genetic Evidence for Substantial Lateral Growth of Pollen Tubes in the Cucumber Ovary

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Competition of two types of pollen for the available ovules impedes the success of mentor pollen aiding interspecific crosses in cucumber (2). Mixed pollinations such as those involving mentor pollen are only feasible if pollen can be collected from the anthers in reasonable quantity in order to be mixed. The very sticky pollen of cucumber does not permit this. Therefore, we simulate mixed pollination by applying pollen from a staminate flower of each of the two pollen parents to the same pistillate flower. We realize that we can hardly control the relative amounts of pollen in this way. Moreover, the order in which the two types of pollen are applied influences the outcome of the competition as was shown by differences in segregation for marker genes following double pollinations involving seedling marker lines in apple and cucumber (4, 1).

Application of different pollen types on separate lobes of the stigma could possibly substitute for our poor simulation of the mixed pollination technique for intraspecific pollen competition studies. The small experiment described here was prompted by Robinson's (3) suggestion that pollen tubes of cucumber do not always grow straight downwards, but exhibit some lateral growth, fertilizing ovules in locules not directly below the pollinated stigmatic lobe.

Eleven pistillate flowers of a glabrous breeding line (*gl gl*) were pollinated with both self pollen (*gl*) and that from a gynoecious standard line G6 (*Gl*) (following silver thiosulfate treatment). Each of the three stigmatic lobes of every flower was pollinated separately by one staminate flower of either of the two lines, mainly on the apical tip and outer side of the lobe. A small marking on the ovary with a felt-tip pen ensured later identification of the lobes. The mark expanded with growth but remained clearly visible and it apparently did not harm the fruit. Of six flowers, two lobes of each received *Gl* pollen and one lobe received *gl* pollen (A-type). For five additional flowers this was reversed (B-type). Three fruits of each type of cross set well. At harvest, the three locules of each fruit were separated and transversely cut into three segments of equal length for seed processing. The resulting nine seed lots per fruit were sown and seedlings scored for glabrousness. Results given in Table 1 are combined for all three fruits per type of cross.

This type of double pollination resulted in normal fruit and seed set. The numbers of seeds per locule were also approximately equal. The percentage of glabrous offspring per type of cross reflected fairly closely the relative amounts of pollen applied: 21% following 2:1 treatment in type B (33% expected); 57% following 1:2 treatment in type B (67% expected). Between locules there were no differences in percentage of glabrous offspring. This is also true for separate locule segments in the B-type of cross. In the A-type the variation between locule segments is larger, but it is inconsistent. The partly aberrant frequencies in the third segments are based on very small seed numbers and are not considered.

These preliminary data indicate that pollen tubes of either type grew in equal frequency into each of the three locules irrespective of the lobe on which the pollen was deposited. This implies much more lateral growth of pollen tubes than Robinson (3) concluded earlier. I conclude that this type of double pollination has potential use in pollen competition studies.

Table 1. Percentage of glabrous offspring per locule segment (number of seedlings measured) following double pollinations.

A. *glgl* x (2 *Gl* + 1 *gl*)	**Fruit locule / pollinated with**		
Fruit segment	**I / *Gl***	**II / *Gl***	**III / *gl***
Blossom end	18 (69)	27 (83)	23 (103)
Middle	16 (74)	17 (105)	25 (84)
Peduncle end	22 (9)	0 (9)	9 (21)
Mean (total)	19 (152)	20 (197)	19 (208)

B. *gl*/*gl* x (2 *gl* + 1 *Gl*)	**I / *gl***	**II/ *gl***	**III/ *Gl***
Blossom end	53 (86)	58 (88)	59 (86)
Middle	56 (78)	57 (88)	55 (93)
Peduncle end	83 (6)	85 (13)	64 (11)
Mean (total)	55 (170)	59 (189)	57 (190)

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Results of Linkage Studies and the Need for a Cooperative Effort to Map the Cucumber Genome

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Since the first comprehensive compilation of the genes of the Cucurbitaceae (1), several additions have been published by the Cucurbit Gene List Committee of the Cucurbit Genetics Cooperative (CGC). Last year the total number of identified genes of the cucumber stood at 80 and several new ones were described in CGC Report No. 6. However, data on linkage relationships of these genes are still scant and scattered, although the cucumber with only seven chromosomes offers ample opportunity for linkages (much to the annoyance of many breeders).

There is an urgent need for compiling all available linkage data, and adding new results in order to increase our knowledge about the cucumber genome. In addition to this, linkage groups need to be identified with specific chromosomes, for example by analysis of trisomics.

In Table 1, some new recombination percentages are reported for four pairs of genes used in research at the IVT. Linkage tests according to Strickberger (2) showed that glabrous (*gl*) and divided leaf (*dvl*) are weakly linked (recombination percentage 40%). The gene-pair *dvl* and resistance to scab (*Ccu*) segregated significantly different from the expected 9:3:3:1 ratio, but the recombination was estimated as 46%. The two genes are, therefore, virtually independent. Also, the genes *gl* and bitterfree (*bi*) behaved independently with a non-significant deviation from the expected ratio. The genes *bi* and *dvl* also segregated independently. Deviations from the 3:1 ratio for some of the *dvl* segregations indicated that this marker gene could not always be reliably identified at the seedling stage. Further classifications with this mutant will be made in a later growth stage on the basis of the typical corolla shape as well as the leaves. The gene appears to be very lightly linked to a locus governing determinate growth.

More intimate knowledge of the genome of a species has greatly stimulated breeding research in several crops, and it also seems to play an important role in choosing model plants for novel plant breeding techniques. Tomato, petunia and pea appear to be favored for genetic engineering research in horticultural crops. Cucumber is an important crop as well, but with many problems still to be solved.

We propose that the CGC extend the effort started by the Gene List Committee and compile and publish a provisional linkage map of the cucumber. Further studies on linkage must be stimulated and possibly coordinated to avoid duplication and to ensure the fastest progress.

Table 1. Recombination percentage (%), size of F_2 populations for linkage tests (N), and calculated chi-square ratios for the 9:3:3:1 ratios (X^2) for four pairs of genes.

Gene pair	**%**	**N**	**X^2**
dvl / gl	40	247	9.13*
dvl / bi	50	249	3.62
dvl / Ccu	46	223	6.56*
gl / bi	44	330	4.85

*Significant at P = 0.05

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Cucurbit Genetics Cooperative Report 6:24 (article 12) 1983

Umbrella Leaf: A Gene for Sensitivity to Low Humidity in Cucumber

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In a previous program to introduce parthenocarpy into the pickling cucumber, de Ponti (unpublished data) noticed distinct differences between breeding lines in their sensitivity to low relative humidity (RH). Newly-formed leaves of sensitive plants expanded unevenly: the leaf margin grew less than the leaf blade, resulting in downward (or sometimes upward) curled leaves reminiscent of an umbrella. Similar symptoms are caused by toxic concentrations of boron in the soil or nutrient solution. Occasionally, the phenomenon occurs in standard cultivars when a period of cloudy weather is followed by strong, dry winds under open sky, causing a fast decline in the relative humidity of the glasshouse.

The character appeared to be recessively inherited. Appropriate crosses were made, and analyzed using the Chi-square test, Samples of two F_2 populations, along with the reciprocal F_1s and the sensitive and nonsensitive parent, were grown on glasshouse benches in the summer of 1981 and 1982. The plants were kept under a tent of clear plastic for 14 days following transplanting in order to keep the RH high. Temperature was approximately 26°C day/20°C night, The symptoms showed approximately one week after the removal of the tent (drop in RH). Virtually all plants could clearly be classified as either normal or sensitive. The results of the tests were remarkably similar (Table 1).

We concluded from the data that the sensitivity is controlled by one single recessive gene. In view of the characteristic shape of sensitive leaves and according to the rules for nomenclature of cucurbit genes, we propose to designate the gene *umbrella leaf* (*ul*). The exact origin of the mutant in our material could not be traced, We emphasize that the expression of the gene depends somewhat on the environment. This makes the gene an interesting character for plant physiological studies into the nature of leaf development. The gene is being used in linkage studies at our institute.

Table 1. Frequencies of sensitive (*ul*) and normal plants in progenies from crosses involving *umbrella leaf*.

	1981		1982			
Generation	**Normal**	**Sensitive**	**Normal**	**Sensitive**	**Ratio of Normal: Sensitive**	**X^2 for 3:1**
P_1 sensitive	1	10	0	10	1:20	–
P_2 normal	8	0	10	0	18:0	–
F_1 (P_1 x P_2)	24	0	18	0	42:0	–
F_1 (P_2 x P_1)	23	0	20	0	43:0	–
F_2 (P_1 x P_2)	79	23	75	23	3.3:1	0.43^{ns}
F_2 (P_2 x P_1)	83	23	81	19	3.9:1	2.33^{ns}

Cucurbit Genetics Cooperative Report 6:25-26 (article 13) 1983

Variation of Galactinol Synthase Activity in Cucumber Leaves

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Galactinol synthase (GS) catalizes the following reaction in cucumber leaves:

UDP-galactose + myoinositol galactinol + UDP

Galactinol is the immediate substrate from which galactose is transferred to sucrose to form raffinose, and a second galactose is transferred from galactinol to raffinose to form stachyose. Raffinose and stachyose are the major sugars transported by cucumbers, although sucrose may also be transported. Recent studies have shown that leaves of different species have widely varying levels of GS activity (1). More importantly, the level of activity of this enzyme was positively correlated (r = +0.84) with the concentration of raffinose saccharides in the leaves and negatively correlated (r = -0.73) with leaf sucrose. Thus, GS activity may control carbon partitioning between sucrose and the raffinose saccharides in leaves.

The objectives of the present study were to determine the levels of activity of GS in leaves of five diverse lines of *Cucumis sativus*.

Five cultivars of lines of cucumber ('Windermoor Wonder', 'Calypso', 'Sumter', PI 228238, and LJ 90430) were planted in the greenhouse in a randomized complete block design with 3 replications in early August, 1982. All of the lines. tested were *Cucumis sativus* var. *sativus* except LJ 90430, which is var. *hardwickii*. All plants were maintained in a vegetative condition by removal of all flower buds as they appeared. Plants were trained to a single main stem by removal of all lateral buds as they appeared. When the plants had grown to an average of 12 nodes, leaf blades were removed from the 5th, 7th, and 8th nodes from the growing terminal (,counting down from the youngest leaf). Fresh weights were recorded, and GS activity was determined on these samples essentially by procedures described elsewhere (1, 2).

Mean fresh weights of leaves at the 3 node positions and GS activity of these leaves are shown in Fig. 1. The activity of the enzyme increased as leaves expanded, which confirms other unpublished data from our laboratory.

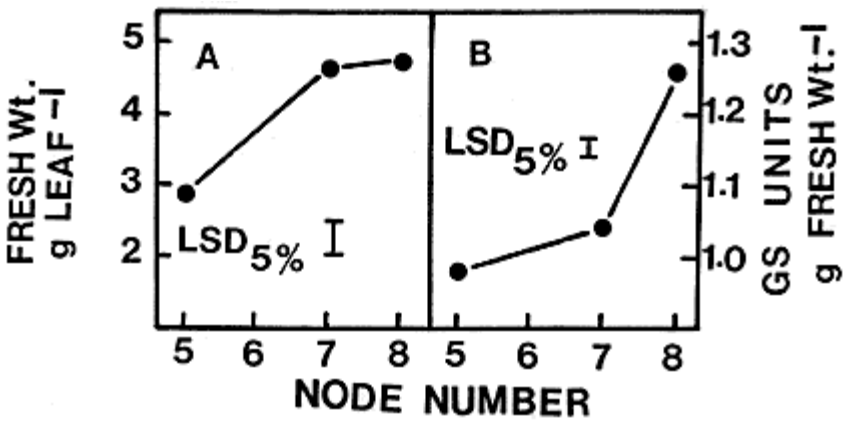

Figure 1. (A) Fresh weight of leaves from nodes 5, 7 and 8. (B) GS activity in leaves from 5, 7 and 8. Data are means of 3 replications and 5 lines of *Cucumis sativus*.

Variability among lines was significant only at the 10% level (Table 1). This variation is small by way of comparison to variability between different plant species which have been shown to vary from 0 to as high as 2.5 units of GS per gram fresh weight of leaves (1).

The five lines studied here were selected to represent a maximum range in leaf GS activity identified from a preliminary study (data not shown) in which 13 different lines were assayed. Based on these tentative results, identification of *Cucumis sativus* lines varying widely in leaf GS level and the presumed differences in leaf sugar composition which might be associated, will probably be achieved only be screening large populations.

Table 1. *Cucumis sativus* lines in order by mean galactinol synthase (GS), activity in their leaf blades.[z]

Cultivar or Line	**GS Activity[y] Units/gram fresh weight**
Windermoor Wonder	1.23
PI 233238	1.22
LJ 90430	1.07
Calypso	1.06
Sumter	0.90
LSD (10%)	0.22

[z]Data are means over 3 node positions and 3 replications of 2 subsamples each. There was no line x node interaction.
[y]A unit is that amount of enzyme which forms 1 mol of galactinol min^{-1} at 30°C.

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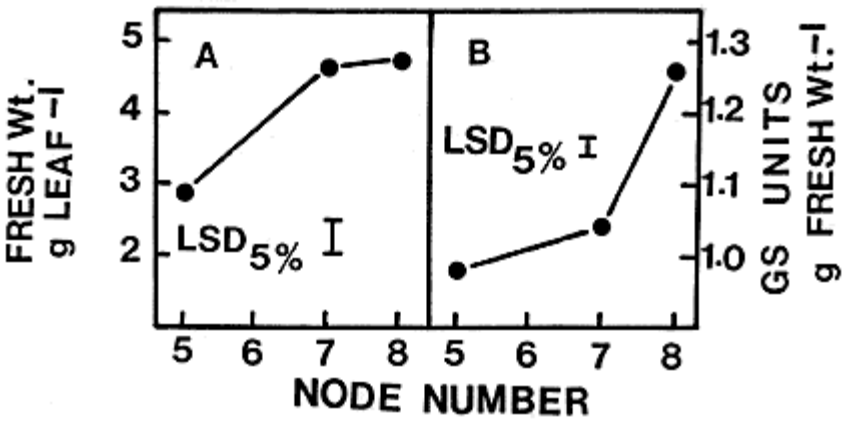
A
B
FRESH Wt.
g LEAF -1
GS UNITS
g FRESH Wt.-1
LSD5%
LSD5%
5
4
3
2
1.3
1.2
1.1
1.0
5 6 7 8 5 6 7 8
NODE NUMBER

Cucurbit Genetics Cooperative Report 6:27-28 (article 14) 1983

Different Resistance of Non-bitter Cucumbers to *Tetranychus urticae* in the Netherlands and the USA

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Opinions on the relation between the bitter principle cucurbitacin-C and resistance to the spider mite *Tetranychus urticae* are not unanimous. North American authors as DaCosta and Jones (1) and Gould (2) hypothesized a causal relation between bitterness and resistance to *T. urticae*, whereas in Europe, de Ponti (3) hypothesized only a genetic relation in terms of linkage of genes for resistance and bitterness.

In accordance with the latter hypothesis, de Ponti (4) succeeded in selecting some non-bitter lines whose resistance approached that of their bitter progenitors (Table 1). These lines were selected both in climate rooms, measuring oviposition of the spider mite; and in the glasshouse on hydroponics, measuring the development of damage on a scale of 0 to 5 after artificial infestation with 10 female mites per plant.

Table 1. Comparison of two glasshouse tests in the Netherlands and a field test in North Carolina (USA) for resistance of cucumber to *T. urticae.* Only the final observation is listed. Damage ratings are recorded on a scale of 0 (no damage) to 5 (maximal damage).

		Damage Rating		
Cultivar or line	**Bitterness**	**1981**	**1982**	**1982**
G6	-	3.8 a	4.1 a	3.9 a
F_6 (H x R)	+	1. 6 b	2.0 b	0.5 c
F_5 (H x V)	+	1.5 b	1.6 b	0.3 c
F_5 (G6 x F_5 (H x V))	-	1.9 b	1.9 b	3.3 a
F_3 (G6 x F_3 (H x V x H x R))	-	1.8 b	2.5 b	3.9 a
Calypso	+			1.1 c
Marketmore 76	+			2.1 b
Marketmore 80	-			3.4 a
G6 = susceptible check; H = Hybrid long green pickle; V = Varamin; R = Robin 50.				

Figures followed by the same letter do not differ significantly from one another at the 5% level.

During the sabbatic leave of de Ponti at the NCSU Department of Entomology, we studied the performance of these resistant lines under field conditions at a location in Chowan County, North Carolina with a known high natural population of *T. urticae.*

During the field test in May through July 1982 conditions were dry, hot and windy, totally different from the glasshouse environment in the Netherlands. Damage ratings were scored as described for the glasshouse test. Both in the Netherlands and the United States, randomized designs were used with 7 and 4 repetitions respectively.

The resistance of the bitter lines was consistent, independent of location. In the United States the difference between the resistant lines and the susceptible check, G6, was even larger than in the Netherlands. The non-bitter resistant lines selected

in the Netherlands, however, show hardly any resistance in the United States. From the present data, it is difficult to conclude whether that was due to differences in the environment, in the mite population, or both. In fact, these data support the earlier mentioned hypothesis of a causal relation between resistance and bitterness. We have to keep in mind that the described conditions in North Carolina are generally considered as promoting the formation or accumulation of cucurbitacins in plant tissues. Further investigations, mainly in the Netherlands, will try to clarify these contradictions, the more so as the reduction in resistance of one of the non-bitter lines in 1982 compared to 1981 is somewhat alarming, The possibility that there exists two different types of mite resistance in cucumber must certainly be considered.

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Screening Cucumber for Resistance to Belly Rot Caused by *Rhizoctonia solani*

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Belly rot of cucumber (*Cucumis sativus* L.) caused by *Rhizoctonia solani* Kuhn is an important disease in the southern U.S.A. The average annual loss of cucumbers to belly rot in the U.S. was estimated to be 7 to 9% (5). A limited degree of control can be obtained by the use of mulches and/or fungicides (2, 3), as well as plowing to a 0.20 to 0.25 m depth before planting (2). Regardless of the control methods used however, *Rhizoctonia solani* Kuhn, being a soil inhabitant, becomes quickly re-established (1, 4).

Host resistance would be an economical method of control if a source of resistance were found. Single gene resistance has not been identified, but low to moderate levels of resistance exist in some lines. Therefore, recurrent selection appears to be the best approach. The objectives of this study were to develop methods for screening for belly rot resistance, and to identify sources of resistance to be used in a recurrent selection program.

Methods. The four isolates of *Rhizoctonia solani* Kuhn used in these studies were collected by Dr. S. F. Jenkins. The isolates were tested for pathogenicity, and then increased on potato dextrose agar. Inoculum was produced by introducing pieces of the inoculated agar 1 cm^2 into heat-resistant bags containing 300 ml of oat grains and 200 ml of water, all of which had been previously autoclaved. That inoculum, at the rate of 1600 grains/m^2 (1 grain/$in.^2$) of surface soil, was used for the 1981 study. All other studies used a rate of 3200 grains/m^2. All tests were run on fruit having a diameter of approximately 55 mm, usually considered to be oversize for both pickling and slicing types. All fruit were scored 6 to 12 days after inoculation for percent of the fruit infected with lesions (number of lesions was not a useful scoring method).

In the 1981 initial tests, a single 3 m plot of each of 1063 *Cucumis* lines (mostly cucumbers) was planted at the Horticultural Crops Research Station at Clinton, North Carolina on May 27. One oversize fruit was harvested on July 21 from each plot and taken to Raleigh. Fruit were placed on greenhouse soil beds that had been inoculated with *Rhizoctonia solani*, and scored 6 days later for percent lesions.

In the 1982 lab test, plastic flats (450 x 520 mm) were filled to a depth of approximately 50 mm with steam sterilized soil. The most resistant and most susceptible lines from the 1981 test, along with several check lines (174 lines in all), were planted June 7, 1982 in 1.5 m plots at the Central Crops Research Station at Clayton, North Carolina. Oversize fruit free of lesions were harvested, taken to the lab and placed in flats so that neither the blossom nor the peduncle end were touching the soil surface. The flats were then watered and covered with newspaper. The soil was kept damp by daily misting. Temperatures in the greenhouse ranged from 24°C at night to 33°C during the day. After 12 days, the fruit were scored individually for percent lesions. The experiment was a completely random design with 174 lines and 3 replications.

The 174 lines in the 1982 greenhouse test were also tested in the field to verify their disease reaction. The lines were planted on May 13, 1982 at the Horticultural Crops Research Station at Clinton, North Carolina in a randomized complete block design with 2 replications. Each line was planted in 1.5 m plots on 1.5 m centers with 1.5 m alleys between plots. Plots were inoculated at ‘tip-over’ and ratings were made on individual fruit selected randomly from the plot 19, 24, 30 and 34 days later.

Results. Data from the 1981 and 1982 laboratory tests and from the 1982 field test were used to select the lines that were consistently resistant or susceptible. Ten resistant lines and 7 susceptible lines were identified for further testing in 1983 (Table 1). Most of the lines selected were plant introductions and may, therefore, be segregating for resistance. Most of the resistant lines were pickling cucumber types with tender skin, so resistance does not appear to be linked with undesirable fruit characteristics. The line PI 163216 had 0% fruit damage in all 3 of the tests and should be investigated further.

Table 1. Belly Rot resistance (percent of fruit surface infected) and fruit characteristics of the 10 most resistant and 7 most susceptible lines from 2 laboratory and 1 field test.

			Percent of fruit surface infected in 3 separate tests				
Rank	**Cultivar or Line**	**Origin**	**Lab 1981**	**Lab 1982**	**Field 1982**	**Fruit type[z]**	**Spine color[y]**
1	PI 163216	India	0	0	0	S	B
2	PI 285606	Poland	0	-	0	P	W
3	PI 271328	India	0	-	0	P	B
4	PI 357852	Yugoslavia	0	-	0	S	S
5	PI 280096	USSR	0	-	0	P	B
6	PI 197088	India	0	-	0	P	B
7	PI 212985	India	0	-	-	P	B
8	Mariner	Joseph Harris	0	-	-	P	W
9	P 51	Hollar	0	-	-	S	W
10	Pioneer	Northrup-King	0	1	0	P	W
1057	PI 344433	Iran	25	-	16	S	B
1058	PI 267741	Japan	0	1	13	S	S
1059	PI 181752	Syria	35	2	18	S	S
1060	PI 418962	China	0	3	8	-	-
1061	PI 177360	Turkey	0	10	9	S	B
1062	PI 169382	Turkey	1	12	8	S	B
1063	PI 419108	China	0	12	7	S	W
LSD (5%)				7.2	8.9		
Mean (all lines)				3.1	3.3		
CV (%)				11.5	12.6		

[z] Fruit type: P = pickle, S = slicer.

[y] Spine color: B = black, W = white, S = segregating.

Correlations were run for belly rot resistance of the lines in the 3 tests. None of the correlations was significant, and most were near zero. That indicates that the 3 tests varied in the way the lines reacted in each. The non-significant correlations among test results may also have been due to missing data, especially for the susceptible lines which were often eliminated from the tests by other diseases such as anthracnose.

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Preliminary Evaluation of Isozyme Polymorphisms in *Cucumis*

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Recently, several horticulturally important enzyme systems have come under investigation in the genus *Cucumis* (1, 2, 4). These systems and others have proven useful in studying the biochemistry (3, 5, 6, 7, 9, 10, 11, 12, 13, 14) of this genus and the taxonomy (8) of the *Cucurbita*. In addition, Robinson (11) has employed electrophoresis as an enzymatic tool for studying breeding material in his research program.

Limited information exists on linkage relationships and chromosomal mapping in *Cucumis*. It would be useful, therefore, to obtain reproducible and precise genetic markers which might lead to the characterization of linkage groups and eventually to the formation of a chromosome map of this horticulturally important genus.

With this in mind, a study was initiated to: 1) survey the relative activity of 47 general metabolic enzymes and general protein in different tissues of selected *Cucumis* ssp., 2) determine which of these enzymes would give acceptable resolution for genetic analysis, and 3) determine the amount of enzyme polymorphism which exists in a broad based collection of *Cucumis* ssp.

Mature fruit, seed and cotyledons of two inbred *C. sativus* var. *sativus* lines (Gy2 and USDA 1379) and a *C. sativus* var. *hardwickii* (LJ 90430) representative were examined by horizontal starch gel electrophoresis using four buffer systems. Seeds were sampled as both imbibed (aerated in water at 32°C for 4 hrs) and sprouted (aerated in water at 32°C for 24 hrs; radicle = 5 mm), while cotyledons were harvested from two-week old seedlings grown in light (green) and in darkness (etiolated). The enzymes and general protein assayed (Table 1) showed differential activity within and between the tissues studied. There were no species differences observed with regard to specific activity within tissues but interspecific enzyme polymorphisms were evident. Enzymes were categorized as to their potential usefulness as genetic markers on the basis of their relative activity and resolution.

Green cotyledons were determined to be the tissue of choice for subsequent studies investigating the amount and types of available polymorphic loci. Sixty-four individuals (49 var. *sativus*, 7 var. *hardwickii* and 8 *Cucumis* species) were drawn from the *Cucumis* collection and were examined electrophoretically for 19 enzymes. Of these 19 enzymes, GPI, GR, MDH-NADP, PEP-PAP, PGD, and PGM were found to be polymorphic.

Enzyme	Abbreviation	C. sativus tissue: Fruit	Seed: Sprouted	Seed: Imbibed	Cotyledons: Green	Cotyledons: Etiolated
Aspartate aminotransferase	AAT	1[a]	1	1	1	1
Acid phosphatase	ACP	2[b]	2	2	1	1
Adenosine deaminase	ADA	2	2	2	2	2
Alcohol dehydrogenase	ADH	2	1	1	2	1
Aldolase	ALD	2	1	1	1	1
Adenylate kinase	AK	1	1	1	1	1
Alkaline phosphatase	AKP	2	1	2	1	1
Catalase	CAT	2	1	2	2	2
Creatine phosphokinase	CPK	2	1	1	1	1
Diaphorase	DIA	2	1	1	1	1
Esterase	EST	1	1	1	1	1
Fructose diphosphatase	FDP	2	1	1	1	1
Fumarase	FUM	2	1	1	2	2
Galactosaminidase	GAM	3[c]	3	3	3	3
Glyceraldehyde-3-phosphate dehydrogenase	GAPDH-NADP	3	3	3	3	3
Glyceraldehyde-3-phosphate dehydrogenase	GAPDH-NAD	2	1	1	1	1
Glutamine dehydrogenase	GDH-NADP	2	1	1	1	1
Guanine deaminase	GDA	2	2	2	2	2
B-glucosidase	B-GLU	2	1	1	1	1
Glucose-6-phosphate dehydrogenase	G6PDH	2	1	1	1	1
Glucosephosphate isomerase	GPI	1	1	1	1	1
Glutamic pyruvic transaminase	GPT	2	1	1	1	1
Glutathione reductase	GR	2	1	1	1	1
Glucoronidase	GUS	1	2	2	1	1
Hydroxybutyric dehydrogenase	HBDH	2	2	2	2	2
Isocitrate dehydrogenase	IDH	1	1	1	1	1
Lactate dehydrogenase	LDH	2	2	2	2	2
Leucine aminopeptidase	LAP	1	1	1	1	1
Manatol dehydrogenase	MADH	2	2	2	2	2
Malate dehydrogenase	MDH	1	1	1	1	1
Malic enzyme	ME	2	2	2	2	2
4-Methylumbelliferyl phosphatase	MUP	2	1	2	1	1
Octanol dehydrogenase	ODH	2	1	1	2	2
Peptidase with glycyl-leucine	PEP-GL	3	3	3	3	3
Peptidase with leucyl-alanine	PEP-LA	1	1	1	1	1
Peptidase with leucyl-leucyl-leucine	PEP-LLL	1	1	1	1	1
Peptidase with phenyl-alanyl-proline	PEP-PAP	1	1	1	1	1
Peroxidase	PER	2	2	2	2	2
Phosphogluconate dehydrogenase	PGD	1	1	1	1	1
Phosphoglycerate kinase	PGK	3	3	3	3	3
Phosphoglucomutase	PGM	2	1	1	1	1
Pyruvic kinase	PK	3	3	3	3	3
General protein	PRO	2	1	2	1	1
Sorbitol dehydrogenase	SDH	2	2	2	2	2
Shikimic dehydrogenase	SKDH	1	1	1	1	1
Succinate dehydrogenase	SCDH	2	2	2	2	2
Triose phosphate isomerase	TPI	1	1	1	1	1
Xanthine dehydrogenase	XDH	2	2	2	2	2

[a] 1 = activity with adequate resolution for possible analysis.

[b] 2 = no activity

[c] 3 = activity with inadequate resolution for possible analysis.

Studies are now underway to determine the genetic basis and inheritance of these polymorphic enzymes. When this is accomplished, identification of linkage groups and chromosome mapping of *Cucumis* may be possible.

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Enzyme	Abbreviation	C. sativus tissue				
			Seed		Coty-ledons	
		Fruit	Sprouted	Imbibed	Green	Etiolated
Aspartate aminotransferase	AAT	1[a]	1	1	1	1
Acid phosphatase	ACP	2[b]	2	2	1	1
Adenosine deaminase	ADA	2	2	2	2	2
Alcohol dehydrogenase	ADH	2	1	1	2	1
Aldolase	ALD	2	1	1	1	1
Adenylate kinase	AK	1	1	1	1	1
Alkaline phosphatase	AKP	2	1	2	1	1
Catalase	CAT	2	1	2	2	2
Creatine phosphokinase	CPK	2	1	1	1	1
Diaphorase	DIA	2	1	1	1	1
Esterase	EST	1	1	1	1	1
Fructose diphosphatase	FDP	2	1	1	1	1
Fumarase	FUM	2	1	1	2	2
Galactosaminidase	GAM	3[c]	3	3	3	3
Glyceraldehyde-3-phosphate dehydrogenase	GAPDH-NADP	3	3	3	3	3
Glyceraldehyde-3-phosphate dehydrogenase	GAPDH-NAD	2	1	1	1	1
Glutamine dehydrogenase	GDH-NADP	2	1	1	1	1
Guanine deaminase	GDA	2	2	2	2	2
B-glucosidase	B-GLU	2	1	1	1	1
Glucose-6-phosphate dehydrogenase	G6PDH	2	1	1	1	1
Glucosephosphate isomerase	GPI	1	1	1	1	1
Glutamic pyruvic transaminase	GPT	2	1	1	1	1
Glutathione reductase	GR	2	1	1	1	1
Glucoronidase	GUS	1	2	2	1	1
Hydroxybutyric dehydrogenase	HBDH	2	2	2	2	2
Isocitrate dehydrogenase	IDH	1	1	1	1	1
Lactate dehydrogenase	LDH	2	2	2	2	2
Leucine aminopeptidase	LAP	1	1	1	1	1
Manatol dehydrogenase	MADH	2	2	2	2	2
Malate dehydrogenase	MDH	1	1	1	1	1
Malic enzyme	ME	2	2	2	2	2
4-Methylumbelliferyl phosphatase	MUP	2	1	2	1	1
Octanol dehydrogenase	ODH	2	1	1	2	2
Peptidase with glycyl-leucine	PEP-GL	3	3	3	3	3
Peptidase with leucyl-alanine	PEP-LA	1	1	1	1	1
Peptidase with leucyl-leucyl-leucine	PEP-LLL	1	1	1	1	1
Peptidase with phenyl-alanyl-proline	PEP-PAP	1	1	1	1	1
Peroxidase	PER	2	2	2	2	2
Phosphogluconate dehydrogenase	PGD	1	1	1	1	1
Phosphoglycerate kinase	PGK	3	3	3	3	3
Phosphoglucomutase	PGM	2	1	1	1	1
Pyruvic kinase	PK	3	3	3	3	3
General protein	PRO	2	1	2	1	1
Sorbitol dehydrogenase	SDH	2	2	2	2	2
Shikimic dehydrogenase	SKDH	1	1	1	1	1
Succinate dehydrogenase	SCDH	2	2	2	2	2
Triose phosphate isomerase	TPI	1	1	1	1	1
Xanthine dehydrogenase	XDH	2	2	2	2	2

[a] 1 = activity with adequate resolution for possible analysis.

[b] 2 = no activity

[c] 3 = activity with inadequate resolution for possible analysis.

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Resistance of Cucumber to the Pickleworm

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Pickleworm (*Diaphania nitidalis* Stoll.) is one of the three most important insect pests of pickling cucumber (*Cucumis sativus* L.) in the southern U.S.A. Cucumbers have been tested for pickleworm resistance by several researchers (1, 2, 3, 4, 5), and some lines have been identified as having some resistance. However, the resistance was not demonstrated to be horticulturally useful.

Control of pickleworm is useless unless done before the larvae become established in the fruit. Genetic resistance, therefore, would be most effective if it acted to prevent oviposition by adult females, or feeding by larvae. We determined that antibiosis to larvae would be the easier trait to test and to select for, so a detached leaf test was developed. The objectives of this study were to develop a test for detached leaves of cucumber for pickleworm antibiosis, and to screen cucumber lines for leaf antibiosis using pickleworm larvae.

Preliminary Test. A preliminary test was used to determine the optimum conditions for running a detached leaf test using field-grown plants and first instar pickleworm larvae. We determined that the test should be run using 2 ml of distilled water added to 2 layers of filter paper in 100 mm diameter petri plates to which 1 cucumber leaf and 5 pickleworm larvae were added. The leaf was folded with the abaxial side in, and the larvae placed inside the folded leaf.

Field Test. Cucumber lines were obtained from as many sources as possible to make a collection of 1160 cultivars and breeding lines of pickling and slicing cucumbers (including the U.S. plant introduction collection). The lines were planted May 27, 1981 at Clinton, NC and leaves were harvested June 23 and July 14. The youngest fully-expanded leaf was harvested from one plant in each plot on each harvest date, placed in a plastic bag, and stored in a cooler. The following day, leaves were placed in petri plates with larvae and kept at room temperature for 5 days. Leaves were scored for pickleworm feeding damage using a scale of 1 to 9 (1 = no damage, 9 = completely eaten between leaf veins).

Laboratory Studies. Of the 1160 lines tested, the 18 most resistant and 18 most susceptible were retested in Charleston, SC using several laboratory tests. The tests were run in Fall, 1981, and consisted of a detached leaf test and a preference test.

Detached Leaf Test. A leaf was selected from the upper third of each plant of each entry (usually 10 plants/entry), trimmed to an area of approximately 100 cm^2, and placed on a moist piece of filter paper in a 100 mm x 15 mm plastic petri plate. Six newly-hatched pickleworm larvae were placed on the abaxial surface of the leaf; the plate was closed and secured with a strip of parafilm around the plate. Plates were held at 24°C, and after 6 days, were opened to count the larvae and score the leaves for damage (using the scale 1 to 9).

Preference Test. A 28 mm leaf disc of each line to be tested was laid on moist filter paper in a petri dish next to similar piece of leaf from 'Columbia' (the check cultivar). The leaf circles were 12 mm apart, and in this space were placed 5 newly-hatched larvae. Ten plates were prepared for each test, and were wrapped with parafilm. After 24 hrs. the larvae on each leaf circle were counted. A X^2 test was used to determine if an entry was significantly less preferred.

Results. Of the 1160 lines tested in the initial (2-replication) screening test, 36 were selected for retesting in the laboratory at Charleston (18 resistant and 18 susceptible). Of those, 8 were selected for further studies (5 resistant and 2 susceptible). The 8 selected lines, and their performance in the pickleworm resistance tests, are shown in Table 1. Correlations among the 3 tests were high, but not always statistically significant because of the small number of lines involved. Of particular interest is the large negative correlation between the detached leaf and preference tests (r = -0.70). That indicates that lines with some leaf antibiosis tended to be preferred over the check line in the preference test. The 8 lines will be retested in the lab and field to verify their resistance or susceptibility and to further refine the lab test.

Table 1. Performance of 8 selected cucumber lines in 2 antibiosis tests and 1 preference test.

Rank	Cultivar or line	Seed source	Detached-leaf test score[z] Clinton	Detached-leaf test score[z] Charleston	Preference test[y]	Line classification[x]
1	C541 C2	Joseph Harris Co.	3.0	3.1	54	R
2	Femscore	VanderPloeg	3.0	3.2	37	R
3	PI 205996	Sweden	3.0	3.2	55	R
4	RS 79031	Royal Sluis	3.0	3.3	53	R
5	Earlipik 14	Northrup-King Co.	3.5	1.5	56	R
1158	MSU 581 H	Mich. State Univ.	5.5	5.0	40	S
1159	PI 263079	USSR	6.5	4.3	42	S
1160	VDP No. 328	VanDerPloeg	6.5	4.5	39	S

[z]Leaf damage scored 1 to 9 (1 = no damage, 9 = leaf tissue between veins completely eaten).

[y]Percent of larvae on test line (remainder are on the check cultivar, Columbia).

[x]R = resistant, S = susceptible.

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Effect of Unequal Competition from Bordering Rows on Pickling Cucumber Yield Trial Results

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Plant breeders usually test new experimental lines for several years in replicated, multiple-harvest trials to determine whether the line should be released for production in a particular growing area. However, because of limitations on the amount of land available for trials, or on the amount of seed available for each experimental line, trials are often planted with unbordered plots. Thus, border rows are used only around the outside of the trial so that the lines are not being tested in monoculture, but rather in mixed plantings with different genotypes in adjacent plots.

Competition between different genotypes has been recognized as an important factor causing bias in yield trials of some crops, such as soybean (2). Unbordered plots of soybeans are acceptable for the northern U.S.A., but not for the southern U.S.A. where more foliage growth occurs (1). The objective of this experiment was to determine whether unequal competition occurs in pickling cucumber yield trials planted with unbordered plots.

Methods. Two hybrids (‘Calypso’ and ‘Southern Belle’) and an inbred (‘M 21’), all developed at North Carolina State University, were chosen as pickling cucumbers adapted to the area that had different growth habits. ‘Calypso’ is a tall, indeterminate cultivar, ‘M 21’ is a dwarf, determinate line, and ‘Southern Belle’ is a medium-size, indeterminate cultivar. The 3 lines were planted May 17, 1982 in 3-row plots 4.6 m wide and 6 m long in a randomized complete block design with 6 replications. The 3 lines were planted in 9 combinations of border and center rows. Thus, each of the 3 lines were planted in center rows with either ‘Calypso’, ‘Southern Belle’ or ‘M 21’ in the border rows to simulate bordered or unbordered plots. The center row of each plot was harvested 6 times (twice weekly) from June 24 through July 12. Fruit were graded into 4 sizes by diameter (No. 1 was <26mm, No. 2 was 27–38 mm, No. 3 was 39–50 mm, No. 4 was >51 mm), counted and weighed. Fruit value ($/ha) was calculated using $0.31, $0.14, $0.09, and $0.00 dollars/kg for grades 1, 2, 3 and 4 respectively ($14.00, 6.50, 4.00 and 0.00 dollars/cwt, respectively).

Results. Yield of the dwarf line, ‘M 21’, was significantly reduced when it was grown adjacent to rows of the tall cultivars, ‘Calypso’ and ‘Southern Belle’ (Table 1), Yield of ‘M 21’ was reduced 13% from that of bordered plots (‘M 21’ in the border rows) when the medium-size cultivar, ‘Southern Belle’, was grown in the border rows, and 20% when the large cultivar, ‘Calypso’, was grown in the border rows.

Table 1. Yield of 3 pickling cucumber lines in bordered (same line in border rows) and unbordered (different line in border rows) plots.[z]

Line planted in the 3-row plot		Total yield		Yield ($/ha) in harvest				
Center	**Borders**	**$/ha**	**q/ha**	**1**	**1–2**	**1–3**	**1–4**	**1–5**
M 21	M 21	2511^{b}	435^{b}	277^{b}	672^{b}	1281^{b}	1918^{b}	2091^{b}
	S. Belle	2192*	392^{ns}	290^{ns}	657^{ns}	1119^{+}	1649*	1814*
	Calypso	1999**	353*	271^{ns}	555^{ns}	980**	1505**	1647**
S. Belle	M 21	2161^{ns}	495^{ns}	623^{ns}	1080^{ns}	1498^{ns}	1876^{ns}	1973^{ns}
	S. Belle	2054^{b}	463^{b}	584^{b}	1052^{b}	1442^{b}	1788^{b}	1870^{b}
		ns	ns	ns	ns	ns	ns	ns

	Calypso	2118	506	557	1073	1444	1803	1929
Calypso	M 21	2014^{ns}	492^{ns}	503^{ns}	1124^{+}	1470^{ns}	1782^{ns}	1862^{ns}
	S. Belle	1935^{ns}	481^{ns}	515^{ns}	975^{ns}	1315^{ns}	1651^{ns}	1762^{ns}
	Calypso	1954^{b}	475^{b}	473^{b}	990^{b}	1356^{b}	1661^{b}	1771^{b}
LSD (5%)		278	71	80	148	180	224	226
Mean (all treatments)		2104	454	455	909	1323	1737	1858
CV (%)		11	13	15	14	12	11	10

[z]Vine lengths at first harvest for ‘M 21’, ‘Southern Belle’ (S. Belle) and ‘Calypso’ were 37, 47 and 67 cm, respectively. Data are means over 6 replications and 6 harvests.

[ns,+,*,**]Yield not significantly different from bordered plot (b), and significantly different at the 10, 5 and 1% levels, respectively.

Cumulative yield of unbordered plots of ‘M 21’ was reduced both in fruit value and in fruit weight, but only after the second harvest (of 6). That indicated that problems occurred only after the cultivars in the border rows grow large enough to compete with the dwarf plants in the center row of the plot.

Yields of ‘Calypso’ and ‘Southern Belle’ were not significantly affected by the presence of either tall or dwarf lines in adjacent rows. Thus, it appears that yield trials can be conducted with unbordered plots, provided that dwarf, determinate lines are tested in separate trials from tall, indeterminate lines.

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Field Evaluation of Melon Aphid Resistant Cantaloupe Breeding Lines for Susceptibility to the Cucumber Beetle Complex

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In the early 1950s, Michelbacker et al., (1) reported extensive damage of muskmelon seedlings and fruits by the striped and spotted cucumber beetles in Northern California. Damage by the beetles in our aphid resistant 'Hales Best Jumbo' (HBJ) breeding lines has increased steadily over the past 4 to 5 years even though HBJ was reported as relatively resistant to the beetles, in the seedling stage. To determine if we selected for susceptibility to the beetles during selection for aphid resistance 15 advanced aphid resistant breeding lines were evaluated relative to their respective recurrent parents for susceptibility to seedling and fruit damage by the cucumber beetle complex in Orange County, California.

We used Quisumbing and Lower's (2) experimental design for evaluating beetle resistance in cucumber. Each plot consisted of 3 hills; 15–30 seeds per hill. Entries were arranged in a randomized complete block design with 6 replications. Hills were thinned to 2 plants at the 3 to 7 leaf stage. The rogued plants were saved and assessed for beetle damage. A minimum of 10 fruit (harvested over several dates) per plot were evaluated; the mean number of fruit evaluated/plot was 18. Insect damage was evaluated on a plot basis.

Insect damage ranged widely between plots for both seedlings and fruit. At the seedling stage, the aphid resistant (AR) parent 91213 (PI 371795 inbred) was the least damaged with a mean rating of 4.89; the most damaged was PI 222187 with a mean rating of 6.58. PI 222187 was reported as resistant in the mid-West (3). The entries ranked from least to most damage were as follows: ‘Gulfstream’, ‘HBJ’, ‘PMR5’, ‘PMR45’, ‘Perlita’, 17013 and ‘Topmark’. Of the 15 AR lines tested, 2 were significantly more damaged and 1 was significantly less damaged than their respective recurrent parents.

The mean fruit damage rating of 91213 was 2.61 which was significantly different ($P<.05$) from the other 23 entries whose ratings varied from 19.66 for PI 222181 to a high of 50.15 for AR Perlita breeding line 31197. Fruit damage of the 7 cultivars tested was not significantly different from PI 222181. The most damaged cultivar was HBJ with a mean of 46.06, followed by ‘Topmark’, ‘Perlita’, ‘PMR5’, ‘PMR45’, ‘Gulfstream’. The least damaged was 17013 with a mean of 27.82. None of the AR lines were significantly more damaged than their recurrent parents.

Correlations between fruit and seedling damage and callus and seedling damage were low; $r = 0.17$ and 0.13, respectively. Thus, we were not selecting for cucumber beetle susceptibility while selecting for aphid resistance. Seedling and fruit damage should be evaluated when selecting for cucumber beetle resistance in muskmelon.

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Peat Pellet Inoculation: A Potential Rapid Screening Method for *Fusarium* Resistance in *Cucumis melo* L.

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Greenhouse tests for *Fusarium* resistance in muskmelon typically involve inoculation by dipping young melon plants into spore suspensions (2, 3) or growing in infested soil (1). These methods are time-intensive, cumbersome, and often injurious to the seedlings. If the plants were inoculated in their seedling containers, then a minimal amount of time and labor would be required to screen for *Fusarium* in progeny trials. The seedlings would also sustain less damage.

Jiffy-7 peat pellets (Jiffy Products, Ltd., Shippegan, Michigan) are commonly used for melon transplants. Our objective was to determine if they could absorb and hold sufficient *Fusarium* inoculum to induce infection.

Spore suspensions of *Fusarium oxysporum* f. sp. *melonis* Race 1, isolated from a Maryland melon growing area, were prepared by inoculating flasks containing Richard's solution (5); these flasks were agitated for three weeks. The contents of the flasks were strained through four layers of cheesecloth to separate out all but the conidia. The concentration of the spore suspension used in this study was 135,000 spore/ml.

In early March, seeds of each of 11 muskmelon cultivars and lines were planted in moist, expanded Jiffy-7 peat pellets, 2 seeds per pellet. After seedling emergence, the pellets were thinned to one plant each. Each treatment combination consisted of six pellets in a plastic "market pack" container. Two replicates were used for both inoculated and control treatments for each entry.

When the plants reached the first true-leaf stage, the pellets were allowed to dry for 48 hours. A small piece of polyethylene film was placed under the pellets in each container. Fifty ml of the spore suspension was poured into the middle of each of the treated containers so that the pellets would absorb approximately equal amounts. Fifty ml of tap water was similarly applied to each control container.

The plants were rated for disease reaction seven days later, using a scale where 0= completely resistant, and 3= completely susceptible. The rating for analysis of variance was the difference between the mean ratings of the inoculated and control units for each rep of each entry.

Analysis of variance indicated significant differences between cultivars and lines at the 5% level of significance. The ranking of reaction ratings (Table 1) corresponds to a pattern expected from other reports of disease resistance and our own experience. Resistance to *Fusarium* is complicated, involving both genetic and environmental factors. For instance, temperature is known to affect the level of resistance in muskmelon (4). In our study, a nearly constant daily temperature of 30°C permitted optimum disease development, making the rating of reaction to disease more accurate.

Table 1. Disease reaction ratings of 11 muskmelon entries.[z]

Entry	Rating	Entry	Rating
Perlita	0.05	Golden Beauty Casaba	1.80
Saticoy	0.33	Hale's Best 36	1.82
Star Trek	0.75	Hearts of Gold	1.92
Summett	1.00	Tamdew	2.00
Harvest Queen	1.67	K 11	2.17
MD 6353	1.67		

[z] LSD 5% = 1.17

For these reasons, we do not suggest this method or modifications of it will be a panacea for those breeding for *Fusarium* resistance. However, we believe that eventually this system could be used in a breeding program where the breeder wants to eliminate progeny from a population expected to be largely susceptible. Extension of this method might permit the screening of large numbers of seedlings, perhaps by dipping seedling flats into spore suspensions. In addition, this procedure could have value in screening for other soil-borne pathogens. The time saved using this method could be enormous.

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A Long Internode Mutant in Muskmelon

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Abnormally long veined plants occurred in 7 of 10 F_2 sib progenies from the 11th backcross generation of a cross of 'PMR 45' with aphid resistant 90234, derived from PI 371795 (1). The 7 progenies segregated 109 normal:31 long vine plants (X^2=0.6095, P=0.3–0.5). The mutant plants were characterized by longer internodes compared with the normal segregates.

Greenhouse data from two of these families confirmed the field data and clarified some of the other phenotypic differences between the long vine and normal segregates. Progenies 48763 and 48764 segregated 73 normal:27 long vine plants (X^2=0.2133, P=0.5–0.7). Mean first internode lengths of 2.3 cm for normal and 8.4 cm for long vine segregates of 48764 at 19 days after planting were significantly different at ^{t}0.001. Progeny 48763 showed that the effect of this mutant on internode length persisted beyond the first internode of the main stem (Table 1). There was no significant difference for number of nodes on the main stem or vine fresh weight between normal and long vine 48763 segregates.

Table 1. Mean internode lengths (cm) of normal and long internode segregates of progeny 48763 at 30 days after planting.[z]

Phenotype	Main stem	Lateral branches		
		1st	2nd	3rd
Normal	4.2**	4.1	5.4*	3.4
Long internode	7.7	5.0	4.8	4.2

[z]Significant differences within columns at the ^{t}0.005 (*) and ^{t}0.001 (**) levels.

Internode length of the lateral branches appears to be unaffected by this mutation, although the mean internode length of the 2nd lateral of the normal segregates was significantly, but not greatly longer than that of the long vine segregates (Table 1). Number of nodes on the 1st and 3rd lateral branches were not significantly different between the two phenotypes, but they were significantly different at the ^{t}0.001 level on the 2nd lateral branch: 7.3 nodes on the normal segregates versus 3.4 on the long vine segregates. This may be due to random variation in development of lateral branches (some appear to be determinate while others are indeterminate), or it could be an artifact of greenhouse culture.

Thus, this mutant affects the internode length of the main stem, but not of the lateral branches. The name *long mainstem internode* and symbol *lmi* are proposed for this gene.

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A Third Male Sterile Gene in Muskmelon

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A third male sterile gene was discovered in PI 321005 (a cross between Georgia 47 and Smith's Perfect) by the second author at Leesburg, Florida in 1975. Four F_2 progenies scored in the greenhouse segregated 176 fertile:56 male sterile, a close fit to the expected 3:1 monogenic ratio (X^2 = O.0919, P = 0.80–0.90). Three testcross families segregated 100 fertile:76 male sterile, a loose fit to the expected 1:1 ratio (X^2 = 3.2727, P = 0.05–0.10).

Flowers on this male sterile are phenotypically distinct from those on *male sterile-1* and *male sterile-2* (1, 2). The anthers are approximately the same size on fertile and male sterile plants, but those on male sterile plants have a dull, waxy, translucent appearance. Male sterile plants are easily identified.

This male sterile is not allelic to *ms-1* or *ms-2*: all progenies from reciprocal crosses with *ms-1* and *ms-2* were fertile. The linkage relationship of this gene with *ms-1* and *ms-2* is unknown. The name *male sterile-L* and symbol *ms-L* are proposed for this gene.

Field data indicate that this male sterile line does have good fruit quality and makes a good hybrid parent. Limited quantities of seed will be made available under a separate release notice in 1983.

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Independent Assortment of *Red Stem* and *Yellow Green* in Muskmelon

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Five F_2 and 15 repulsion phase backcross (BC) families were scored for *red stem* (2) and *yellow green* (3) seedling marker genes. Pooled segregation data indicate independent assortment between these two loci (Table 1).

Table 1. Segregation data for *red stem* and *yellow green.*

	Phenotype						
	Normal		Yellow green		Single Factor X^2		Linkage X^2
Generation	Normal	Red stem	Normal	Red stem	*r*	*yg*	
F_2	272	69	89	30	0.1855	2.9861	4.2705
BC	946	883	1042	940	6.1424	7.1437	13.6853

F_2 segregations (by family and pooled) were good fits to the expected 3:1 single factor and 9:3:3:1 dihybrid ratios. BC segregations (by family and pooled) were, however, poorly fitted to the expected 1:1 single factor and 1:1:1:1 dihybrid ratios. BC, contingency table (1), linkage X^2 =0.2760 which confirmed the F_2 data. Thus, these two loci are not linked.

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Linkage of *Red Stem* and *Male Sterile-1* in Muskmelon

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The seedling marker gene *red stem* (3) was crossed with *male sterile-1* (1) to determine the linkage relationship between these two loci. Three F_2 families segregated 559 green, fertile:195 green, male sterile:221 red stem, fertile:2 red stem, male sterile, X^2=66.6316, which strongly suggested linkage between these loci. Eleven repulsion phase backcross (BC) progenies segregated in a poor fit to the expected 1:1 single factor and 1:1:1:1 dihybrid ratios (Table 1).

Table 1. Repulsion phase backcross segregation data for *red stem* and *male sterile-1.*

	Phenotype						
	Normal		**red stem**		**Single Factor X^2**		**Linkage X^2**
	fertile	male sterile	fertile	male sterile	*r*	*ms-1*	
Deviation	484	990	1127	243	3.8030	50.2405	711.5384
Heterogeneity					14.6701	42.1054	

Two of the 11 BC progenies had a poor (P<0.05) fit to the expected 1:1 ratio for *red stem.* Seven progenies had a poor fit to the expected 1:1 ratio for *male sterile-1.* The BC, contingency table (2), linkage X^2=711.5384 which strongly supported the F_2 data. The recombination fraction, *p* (2) between these loci was 0.2556±0.0081.

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Potential Sources of Sudden Wilt Resistance in Muskmelon

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Sudden wilt (*Pythium ultimum* and *P. aphanidermatum*) of muskmelon has been of increasing importance in California and in Arizona. The disease causes rapid wilting and collapse of the vines just prior to harvest. In the fall of 1981, sudden wilt reached epidemic levels in the Imperial and Palo Verde valleys of California when periods of extremely hot (45°C+) daytime temperatures that induced wilting were followed by short, shallow irrigations.

In 1981, 350 breeding lines, cultivars and plant introductions were planted in mid-July at the U. S. Department of Agriculture, Imperial Valley Conservation Research Center, Brawley, California. Entries were planted in 20-plant plots consisting of 10 hills spaced 0.75 m apart; beds were spaced on 2.4 m centers. Four seeds were planted per hill; hills were thinned to 2 plants at the 1 to 2 leaf stage of growth. Sudden wilt symptoms were rated on a plot basis in September. Most of the entries that did not wilt or wilted only slightly in the 1981 planting were replanted in mid-July, 1982 for sudden wilt observation.

Reaction to sudden wilt varied widely between entries in 1981. Most cultivars and advanced breeding lines were severely wilted and necrotic, but several entries showed little or no wilting. Male sterile breeding lines and various cultivars were moderately wilted. Inbred derivatives and F_1 hybrids of PI 125861 and breeding line 61090, F_1 hybrid Fla 76-71L (from G. W. Elmstrom, Leesburg, Florida), and breeding line W4 (2), were free of wilt or slightly wilted (Table 1). The highest rated entry in 1981 was 92393, an F_1 hybrid between PI 125861 and 61090 (Table 1). Resistance to sudden wilt is available in two muskmelon types (Table 1) following the classification of Naudin (3).

Table 1. Field ratings[z] of potential sources of resistance and standard cultivars of muskmelon; mean of two replications.

	Year			
Entry	**1981**	**1982**	**Type**	**Comment**
92393	9	9	*inodorus*	F_1 (PI 125861 x 61090)
92392	8	5	*inodorus*	PI 125861 inbred
92395	7	-	*inodorus*	F_1 (*ms-l* x PI 125861)
W4	7	-	*reticulatus*	WMVI resistant
Fla 76-71L	7	7.5	*reticulatus*	F_1
31537	7	-	*reticulatus*	*ms-2* inbred
61090	7	8.5	*inodorus*	powdery mildew resistant honeydew
PMR 45	1	4	*reticulatus*	standard cultivar
Topmark	3	7	*reticulatus*	standard cultivar
Green Flesh Honeydew	2	5	*inodorus*	standard cultivar

[z]Wilting rating scale: 1=necrosis; 3=severe; 5=moderate; 7=slight; and 9=none.

Sudden wilt was not as prevalent in 1982; there were virtually no reports of sudden wilt in commercial fields. Wilt was again, however, in epidemic proportions in the breeding trials. That wilt was not as severe as in 1981 was shown by the seasonal differences in ratings of ‘PMR 45’, ‘Topmark’ and ‘Green Flesh Honeydew’. Entries that were most resistant in 1981 were

resistant in 1982, with the exception of 92392 (Table 1).

Data from the hybrid 92393 suggest that resistance is conditioned by two or more genes or alleles that combine for higher level of resistance than in the parents. The source of wilt resistance in 61090 is unknown. It's pedigree is complex and includes 'PMR45', commercial honeydew, resistant cantaloupe (1) and PI 124111.

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An Improved Method of BA Application for the Promotion for the Promotion of Fruit Set in Muskmelon

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The artificial cytokinin N^6-benzyladenine (BA) greatly improves the percentage of fruit set in hand-pollinated muskmelon (1). This effect is probably even more pronounced in situations where emasculation is involved or where pollinations are made by inexperienced persons. It has been standard procedure here and, as far as we know, elsewhere to apply 1% BA in lanolin to the base of the ovary after pollination. This mixture is difficult to apply, being very thick at Ithaca temperatures, and ovaries are sometimes damaged mechanically in the process.

In 1982 we tried applying BA in a lanolin emulsion and found this a great improvement. To maintain about 1% BA in the lanolin after the emulsion dried, we dissolved 0.5 g BA in 10 ml of 70% ETOH and added it to the hot mixture of 9 g stearic acid, 3.18 ml morpholine, 120 ml distilled water and 48 g lanolin, the formula of Warmke and Blakeslee (2) for applying colchicine. (See their paper for details of preparing the emulsion.) The consistency of the emulsion did not vary greatly over the usual range of temperatures and could be stored and applied easily with a plastic squeeze bottle having a small tip. We used bottles that originally contained nasal sprays. There was much less wastage of the emulsion, and it was possible to apply a thinner and more uniform coating than with the paste. It was also faster to use, less messy, and less damaging to the ovaries.

Shortly after starting to use BA in lanolin emulsion we observed that nearly all pollinations made with it were setting fruit and promptly abandoned other methods. We have, therefore, no data to show that it gives a higher percentage of fruit set than BA in lanolin paste, but even if set were no better, ease of usage in itself justifies the emulsion method.

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Two Alleles for Watermelon Mosaic Virus 1 Resistance in Melon

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Two sources of resistance to Watermelon Mosaic Virus 1 (WMV-1) have been used independently. In the U. S., Webb and Bohn (10) found some resistant (symptomless) plants in PI 180280 from India. Cantaloup lines with this resistance have been released: B66-5 by Webb (8), and WMR 29 by Bohn *et al.* (2). Resistance is governed by one dominant allele symbolized *Wmv-1* by Webb (9). In Guadeloupe (French West Indies) Quiot *et al.* (5) confirmed the resistance of B66-5, and found that PI 180283 from India was also resistant to local isolates. Kaan (3) reported monogenic dominant control of resistance in PI 180283. Anais and Kaan (1) selected the resistant Charentais-type breeding line 72025 from PI 180283. Sowell and Demski (6) compared the reactions of PI 180280 and PI 180283 to WMV-1 and concluded that mechanisms of resistance in these two lines could be similar according to the color and dimensions of local lesions. PI 124112 has also been reported as reacting with local necrotic lesions (7), but apparently has not been used in breeding programs.

Lecoq *et al.* (4) described WMV-1 in France where it has only recently become widespread on melon. We compared the behavior of the resistant lines B66-5, WMR 29 and 72025 towards French isolates (E2 and E115). B66-5 and WMR 29 exhibit no symptoms or local necrotic lesions; 72025 reacts with systemic necrotic lesions that are often followed by a top necrosis and death of the plants.

F_2 progenies of crosses between B66-5 or 72025 and susceptible Charentais lines, segregated 3/4 symptomless:1/4 with typical vein clearing symptoms (Table 1). These results confirm the analysis of Kaan (3) and Webb (9) that resistance is controlled by a single dominant gene. In F_2 progenies between B66-5 or WMR 29 and 72025 we found no susceptible plants (i.e. with vein clearing symptoms); 1/4 exhibited top necrosis (typical of 72025) and 3/4 were symptomless (Table 1). These results suggest multiple alleles for WMV-1 resistance which may be symbolized as follows: $WMV\text{-}1^1$ from PI 180280, $Wmv\text{-}1^2$ from PI 180283, and $Wmv\text{-}1^+$ (susceptible). The order of dominance is $Wmv\text{-}1^1 > Wmv\text{-}1^2 > Wmv\text{-}1^+$.

From a practical point of view, $Wmv\text{-}1^1$ should be used instead of $Wmv\text{-}1^2$ which conditions for top necrosis and death of the plants with isolates such as E2 or E115.

Table 1. Segregation in F_2 progenies after inoculation of E2 strain of Watermelon Mosaic Virus 1.

		Number of plants with the same symptoms as:				
F_2 Progeny	**Test**	**72025**	**B66-5**	**Charentais**	**X^2 (3:1)**	**Probability (%)**
(72025 x Charentais)	1	72		28	0.480	30–50
line FR2	3	75		25	0.000	>99
	Sum	147		53	0.240	50–75
(B66-5 x Charentais)	1		76	24	0.53	75–90
line BRICHE	3		74	26	0.053	75–90
	Sum		150	50	0.000	>99
(B66-5 x 72025)	2	28	78		0.113	50–75
	3	26	74		0.053	75–90
	Sum	54	152		0.162	50–75

(WMR 29 x 72025)	2	25	81		0.113	50–75

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Chiasma Frequency in Different Sex Forms of Muskmelon

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The pairing behavior of chromosomes at meiosis is closely associated with recombination. Chiasma frequency is a cytological measure of such recombinations. The relationship of breeding system with chiasma frequency and recombination in crop plants has been dealt by many workers (1, 4). There are no reports of the comparative chiasma frequencies of the different sex forms of muskmelon. Trevedi and Roy reported the chiasma frequency in an andromonoecious variety (5). We compared chiasma frequency of 6 sex forms of muskmelon: andromonoecious, monoecious and hermaphrodite which are phenotypically stable, and gynomonoecious, gynoecious and androecious which are phenotypically unstable. The latter three forms were obtained only in segregating populations.

The cytological technique comprised of fixation of male or hermaphrodite flower buds for 24 hours in acetoalcohol (1:3) mixed with 2–3 drops ferric acetate. These were then squashed in 1% acetocarmine. Bisexual flowers were induced on the gynoecious entries by treating with 500 ppm silver nitrate. The mean number and type of bivalent, mean number of chiasmata per PMC and chiasmata per bivalent were calculated from observation of 100 PMC per variety (Table 1).

The hermaphrodite and andromonoecious varieties had comparable chiasma frequency which was higher than the monoecious varieties (Table 1). The unstable gynomonoecious, gynoecious and androecious varieties were intermediate in chiasmata frequency and were comparable to each other. The high frequency of ring bivalents is attributed to increased chiasma frequency.

The extent of self pollination is comparatively high in andromonoecious and hermaphrodite varieties even though they are naturally cross pollinated by insects. In monoecious varieties the self pollination varies 0–10% (6). Chiasma frequency varies considerably within the same plant. In those forms with a high frequency of self pollination, variability within the gene pool is ensured by higher chiasma frequency. This phenomenon has been discussed by Stebbins (4), Rees (3), Grant (1), and Jones and Rees (2). It is also interesting to note that chiasma frequency is high (25–29) in the andromonoecious varieties which are highly domesticated compared to the monoecious varieties (21–22) which are semi-wild non-dessert types.

Table 1. Chiasma frequency in sex forms of muskmelon.

Variety	Sex form[z]	Number of bivalents per PMC: Ring Range	Ring Mean	Rod Range	Rod Mean	Chiasmata per PMC: Mean	± SE	Chiasmata per bivalent
Oriental Melon	AM	10-12	11.08	0-1	0.73	29.28	0.25	2.44
Casaba	AM	10-12	11.60	0-2	0.40	27.68	0.28	2.31
Planters Jumbo	AM	10-12	11.12	0-2	0.83	26.45	0.23	2.20
Honey Dew	AM	10-12	11.22	0-2	0-78	25.69	0.24	2.14
Crenshaw	AM	9-12	10.59	0-3	1.41	25.66	0.32	2.14
Arka Jeet	AM	10-12	11.57	0-2	0.43	26.34	0.24	2.20
Durgapura Madhu	AM	11-12	11.66	0-1	0.34	26.04	0.25	2.17
Herma-1	H	11-12	11.22	0-1	0.74	26.42	0.18	2.20
Herma-2	H	11-12	11.65	0-1	0-35	28.10	0.24	2.34
Mon-2(IARI)	M	9-12	10.55	0-3	1.45	22.80	0.35	1.90
Mon-3(IARI)	M	8-11	10.40	1-4	1.59	22.38	0.24	1.87
Nakkadosakaya (AP)	M	6-11	9.84	1-6	3.10	22.59	0.26	1.88
Kachri	M	8-11	10.16	1-4	1.84	22.49	0.27	1.87
Budamkaya (AP)	M	6-11	8.90	1-6	3.10	22.34	0.31	1.86
Kakri of north India (*C. melo* var. *utilissimus*)	M	8-12	9.60	0-4	2.40	21.92	0.21	1.83
Phut (*C. melo* var. *momordica*)	M	7-12	9.04	1-5	2.91	21.20	0.19	1.77
Gynomonoecious	GM	10-12	11.53	0-2	0.42	24.68	0.39	2.06
Gynoecious	G	10-12	11.56	0-2	0.50	24.51	0.26	2.01
Androecious	A	8-12	10.38	0-4	1.60	23.71	0.28	1.98

[z]AM = andromonoecious; H = hermaphrodite; M = monoecious; GM = gynomonoecious; G = gynoecious; A = androecious.

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Planters Jumbo	AM	10-12	11.12	0-2	0.83	26.45	0.23	2.20
Honey Dew	AM	10-12	11.22	0-2	0-78	25.69	0.24	2.14
Crenshaw	AM	9-12	10.59	0-3	1.41	25.66	0.32	2.14
Arka Jeet	AM	10-12	11.57	0-2	0.43	26.34	0.24	2.20
Durgapura Madhu	AM	11-12	11.66	0-1	0.34	26.04	0.25	2.17
Herma-1	H	11-12	11.22	0-1	0.74	26.42	0.18	2.20
Herma-2	H	11-12	11.65	0-1	0-35	28.10	0.24	2.34
Mon-2(IARI)	M	9-12	10.55	0-3	1.45	22.80	0.35	1.90
Mon-3(IARI)	M	8-11	10.40	1-4	1.59	22.38	0.24	1.87
Nakkadosakaya (AP)	M	6-11	9.84	1-6	3.10	22.59	0.26	1.88
Kachri	M	8-11	10.16	1-4	1.84	22.49	0.27	1.87
Budamkaya (AP)	M	6-11	8.90	1-6	3.10	22.34	0.31	1.86
Kakri of north India (*C. melo* var. *utilissimus*)	M	8-12	9.60	0-4	2.40	21.92	0.21	1.83
Phut (*C. melo* var. *momordica*)	M	7-12	9.04	1-5	2.91	21.20	0.19	1.77
Gynomonoecious	GM	10-12	11.53	0-2	0.42	24.68	0.39	2.06
Gynoecious	G	10-12	11.56	0-2	0.50	24.51	0.26	2.01
Androecious	A	8-12	10.38	0-4	1.60	23.71	0.28	1.98

[z]AM = andromonoecious; H = hermaphrodite; M = monoecious; GM = gynomonoecious; G = gynoecious; A = androecious.

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Development of Embryoid-like Structures from *Cucumis melo* L. Callus *In Vitro*

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Members of the Cucurbitaceae have been grown in tissue culture to yield callus cultures (3) and shoot tip cultures (2, 6). The subject has been partially reviewed by Bottino (1). The production of adventitious shoots from *Cucurbita pepo* L. has been reported by Jelaska (3). In this paper we report the development of numerous shoots from *Cucumis melo* L.

Seeds of 'Harper Hybrid' muskmelon, 'Oliver's Pearl Cluster' honeydew melon and 'Takii's Honey', a Japanese honeydew melon, were surface disinfested with a 10% Clorox bleach solution and 0.1% Triton X-100 surfactant for 15 minutes followed by two 5-minute rinses with sterile distilled water. The Seeds were transferred onto a proliferation media consisting of Murashige and Skoog (MS) high mineral salts (4) supplemented with (mg/liter): 6-benzylaminopurine (2.0), naphthalene acetic acid (0.1), myo-inositol (100) and Staba vitamins (5). Sucrose was added to the medium at 30 g/liter. The medium was adjusted to a pH of 5.7 with KOH and HCl. Difco Bacto agar was added at 6 g/liter, melted and dispensed into 25 x 150 mm culture tubes at 8 ml/tube, then autoclaved for 15 minutes at 15 pounds pressure per square inch. The cultures were grown at about 23°C under cool white fluorescent illumination of about 300 foot candles with a 16-hour day length. In some cases, the seed coat was partially removed to speed germination. 'Harper Hybrid' muskmelon shoot tips were gathered from the field and disinfected in 10% Clorox for 10 minutes. All other procedures were identical to those used for seeds.

Six to eight weeks were required for the seeds to germinate when their seed coats were intact. This period was reduced to 9–14 days with partial seed coat removal. Thirty-three days after germination, the healthy cotyledons developed callus and embryoid-like bodies on their margins. These organized differentiating calli were divided into quadrants and subcultured at 4- to 6-week intervals. Contamination rates with shoot tips were very high and only about 1% of the cultures survived. This could be attributed to the hairy buds and field conditions. The surviving shoot formed callus and embryoid-like structures within 30 days. The embryoids of the cultures developed shoots which emerged from the callus-embryoid mass. These structures can be freely sub-cultured and they proliferate rapidly (Table 1). These cultures are being utilized to explore the role of growth regulators in root and shoot differentiation.

Table 1. Growth and development of *Cucumis melo in vitro*.

Explant source	No. explants	No. germinating or surviving	Number of embryoids/mo.	
			1st subculture	Subsequent subculture
Seeds				
Oliver's Pearl Cluster	10	1	2.2 X	4 X
Takii's Honey	10	2	2.5 X	4 X
Shoot tips				
Harper Hybrid	85	1	2 X	4 X

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The Importance of Cultural Practices in Materializing Yield Potential in a Tetraploid Watermelon Cultivar

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Breeding programs in watermelons are undertaken to improve one or more characteristics. Sometimes the process results in genotypes that differ dramatically from existing cultivars. However, new developments are usually tested under prevailing cultural practices. The net result of this procedure is often to the detriment of the new genotype. The more revolutionary the genotype, the less likely it will manifest its full potential under existing cultural practices. One way of solving the problem would be to develop cultural practices better suited to the newly developed genotype.

A prime example would be the case of the polyploids. The use of triploids has been emphasized (3, 6, 7, 8) because of their seedlessness, high quality, higher yields as compared with tetraploids, and protection of the product. Despite all their merits, triploids are still regarded as a novelty crop grown mostly in home gardens. Inherent difficulties in seed production, resulting in a high cost of seeds, and in cultural practices prevented the widespread distribution of triploid watermelons. Although tetraploids tend to have smaller fruits than their corresponding diploids (3), they in some cases excel in fruit quality as compared with diploids (1, 4) and have better germination than triploids (6). Seed yields and adaptation of tetraploids can be improved over time (1, 2). Needless to say, the cost of tetraploid seed production is lower than that of triploids, and allows consideration of a large scale commercial crop.

The tetraploid cultivar 'Alena', which was developed from the diploid 'Sugar Baby' (4), was released after several years of testing under various cultural practices (5). When grown using traditional practices, 'Alena' exhibited underdeveloped vegetative growth, resulting in low yields of small fruits. A study was undertaken to compare some vegetative characteristics of 'Sugar Baby' and 'Alena'. Five plants of each cultivar were grown at Newe Ya'ar from a late April seeding with spacing 1.0 m in the row and 2.0 m between rows; plants were grown under traditional cultural practices. Number of side branches, total number of nodes on the main stem and side branches, and length of branches were observed and recorded. The study terminated at the date of opening of the first female flower. 'Alena' flowered 20 days later than 'Sugar Baby'. At the time of flowering, 'Alena' plants were appreciably smaller than those of 'Sugar Baby', having half the number of side branches, 65% the number of nodes, and half the total lengths of main stem plus side branches. This indicates that 'Alena' needs a stimulating treatment to increase the rate and volume of vegetative development prior to flowering.

Accordingly, two experiments were conducted at Newe Ya'ar in spring 1981 to compare the performance of 'Alena' and 'Sugar Baby' under two cultural regimes, the first using traditional watermelon cultural practices ("Sugar Baby Regime") and the second using practices which were expected to enhance the vegetative development of 'Alena' ("Alena Regime"). The experiments were planted side-by-side and received at the time of seedbed preparation a basic dressing of 61.75 kg P/ha placed under the rows, and 158 kg N/ha incorporated into the beds. The Sugar Baby Regime received no additional top-dressing, whereas the Alena Regime consisted of a top-dressing of 49.4 kg/ha of 20-20-20 plus trace elements applied at the 4-leaf stage and 29.64 kg N/ha applied at the onset of fruit set. Irrigation was by the drip method at weekly intervals according to evaporation from pans, from the onset of fruit development to the first signs of fruit maturity. In accordance with the late ripening of 'Alena', the Alena Regime included two more weekly irrigations than the Sugar Baby Regime. The experiments were laid out on elevated beds in adjacent plots in a randomized block design with four replicates using a population of 24,700 plants/ha, spaced in pairs at 40 cm in the row and 2.0 m between the rows.

The results presented in Table 1 demonstrate that 'Alena' can give satisfactory yields, equal to those of 'Sugar Baby', on the condition that it is provided with an intensive fertilization and irrigation regime. The Alena Regime was recommended to farmers as a guide for growing 'Alena' in Israel (5), and yields of high quality fruits ranging from 49–79 tons/ha were obtained with this regime. Thus, designing cultural practices according to the characteristics and mode of development of 'Alena' brought about the commercial utilization of this cultivar in Israel.

Table 1. Effect of the two fertilization and irrigation regimes on yield and yield components of Alena and Sugar Baby.

Regime	Yield/100 m^2 (kg)	Fruits/plant	Fruit weight (g)
Sugar Baby Regime			
Sugar Baby	641**	1.07**	2240**
Alena	386	0.91	1640
Alena Regime			
Sugar Baby	581	0.98	2120
Alena	585 ns	1.02 ns	2137 ns

**Significant at 1% level; ns = not significant.

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The Relationship Between Fruit Lesions and Foliage Destruction of Watermelon Biotypes Inoculated with Race 2 Anthracnose

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This study was undertaken to determine whether resistant biotypes (1), have fewer fruit lesions than susceptible cultivars and also to determine if spore production was effected on fruit sections from fruit on resistant vines.

Seven replications of five plant introductions and two cultivars were transplanted in peat pellets. Four weeks after transplanting, both hills of each biotype were sprayed with a suspension of anthracnose spores diluted to a concentration of 1250/ml from a green bean culture. The progress of the disease was monitored weekly, first by lesion counts and then by defoliation. At maturity, vine defoliation, fruit lesions and fruit weight were observed. Lesion-free fruit were cut into sections and frozen. Frozen sections were later sampled using a no. 4 cork borer to remove 1 inch cylindrical sections. These cylinders were placed into 18 mm tubes and autoclaved. These sterile rind cylinders were then inoculated with a loop of a suspension of 1000 spores/ml and incubated at 80 degrees F on a 12 hour light:dark cycle for six days. The contents of each tube was mixed with 5 ml of water, filtered through cheese cloth and made up to a volume of 10 ml. Two spore counts from 8 tubes were made on a hemacytometer.

The susceptible cultivars had no more primary lesions than the resistant plant introductions, The progress of the disease was uniform. Eighty-one days after inoculation, differences between susceptible and resistant types could be distinguished (Table 1). High numbers of fruit lesions were not confined to the so-called susceptible cultivars (Table 2). However, lesions did not continue to enlarge and rot fruit of resistant cultivars. Spore counts on rind sections (Table 2) were consistent with other resistance indices in the case of PI 299379. PI 299379 had the least defoliation, the lowest number of lesions per fruit and the lowest production of spores on rind sections. These data are consistent with previous observations, ‘Charleston Gray’ lost more foliage but had fewer fruit lesions than ‘Allsweet’. PI 271778 showed less resistance than 189225 or 271775 in previous tests.

Table 1. Progress of anthracnose infection in resistant and susceptible biotypes of watermelon as measured by defoliation.

	Days after Inoculation[a/]					
	25	31	39	73	81	98
Biotype	**Dead leaves**			**Percent defoliation**		
PI 189225	1.64	1.64	8.60	41	55	53
PI 271775	0.79	1.54	8.80	44	30	47
PI 271778	1.21	2.29	6.80	48	60	74
PI 271779	1.31	1.64	6.50	39	33	58
PI 299379	1.14	1.21	8.40	36	38	44
Charleston Gray	0.85	3.21	9.30	62	88	96
Allsweet	0.86	3.65	7.80	48	92	80
				LSD	12	

[a/] Sprayed with a 1250 spores/ml suspension at three weeks.

Table 2. Anthracnose resistance indices in resistant and susceptible biotypes of watermelon.

Biotype	Percent defoliation	Lesions per fruit (range)	Spores (10^7)[a/]
PI 189225	53	3.0 (0–8)	1.43
PI 271775	47	2.5 (0–8)	---
PI 271778	74	15.1 (0–50+)	1.84
PI 271779	58	10.0 (0–50+)	4.34
PI 299379	44	1.4 (0–7)	0.34
Charleston Gray	96	19.0 (5–50+)	1.00
Allsweet	80	28.0 (2–30)	0.94
		LSD	1.61

[a/]Spore counts on sterile one inch cylindrical rind sections after six days incubation at 80 degrees F in a 12 hour light:dark regime.

In conclusion, fruit lesions are not always correlated with defoliation and demonstrate more variability than defoliation, The use of rind sections as an index of resistance may prove worthwhile, but later observations suggest that living tissue is best for bioassays of resistance.

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Presence of Factors for Delayed Germination in *Citrullus lanatus* and *Citrullus colocynthis*

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Citrullus lanatus PI 299379 and PI 189225 and *Citrullus colocynthis* 'R309' show delayed germination. Since these three genotypes have shown resistance to race 2 anthracnose, we have been particularly interested in germination because poor germination hinders genetic studies.

Shimotsuma (2) studied the hybrid *C. lanatus* x *C. colocynthis* and observed that only about 50% of the F_1 pollen contained a full complement of chromosomes. Cytogenetic abnormalities in the interspecific hybrid could lead to reduced germination. Lockerman and Putnam (1) reported the presence of inhibitors in the seed coat of cucumber seed. Sowell (personal communication) noted that leaching increases germination in certain *Citrullus* PI's.

Germination data from families of *C. lanatus* and *C. colocynthis* 'R309' are given in Table 1. Note that less than 1% of the 'R309' seed and 1.4% of the 299379 seed germinated in an 8 day period, Reciprocal crosses between 299379 and 'R309' and subsequent progeny showed delayed germination. However, seed from 'R309' x ('R309' x 299379) backcross showed faster germination than either parent.

Table 1: Germination of Seed from Citrullus lanatus ('New Hampshire Midget', PI 299379, PI 189225) and Citrullus colocynthis 'R309' and F1, F2 and Backcross Progeny.

ID	Code	Parents Female	Parents Male	Seed Plant.	Seed Germ.[a]
NHM	A	A	A	288	185
299379	B	B	B	288	4
189225	C	C	C	288	146
R309	D	D	D	288	2
		R309 x 299379			
F1		D	B	96	0
F1		B	D	96	0
F2		(DxB)	(DxB)	96	4
BC1		D	(DxB)	96	18
BC2		(DxB)	D	96	0
BC3		B	(DxB)	96	1
BC4		(DxB)	B	96	0
		R309 x New Hampshire Midget			
F1		A	D	96	0
F1		D	A	96	21
F2		(AxD)	(AxD)	96	30
BC1		D	(AxD)	96	36
BC2		(AxD)	D	96	6
BC3		A	(AxD)	96	50
BC4		(AxD)	A	96	3
		R309 x 189225			
F1		D	C	96	2
F2		(DxC)	(DxC)	96	70
BC1		D	(DxC)	96	30
BC2		(DxC)	D	96	0
BC3		C	(DxC)	96	57
BC4		(DxC)	C	96	16

ID	Parents Female	Parents Male	Seed Plant.	Seed Germ.[a]
	299379 x New Hampshire Midget			
F1	A	B	96	65
F1	B	A	96	62
F2	(AxB)	(AxB)	96	49
BC1	B	(AxB)	96	13
BC2	(AxB)	B	96	36
BC3	A	(AxB)	96	38
BC4	(AxB)	A	96	43
	299379 x 189225			
F1	B	C	96	7
F1	C	B	96	1
F2	(BxC)	(BxC)	96	0
BC1	B	(BxC)	96	3
BC2	(BxC)	B	96	0
BC3	C	(BxC)	96	48
BC4	(BxC)	C	96	11
	New Hampshire Midget x 189225			
F1	A	C	96	7
F1	C	A	96	43
F2	(AxC)	(AxC)	96	80
BC1	A	(AxC)	96	77
BC2	(AxC)	A	96	85
BC3	C	(AxC)	96	51

[a] Number of seed germinating after 8 days.

Distinct differences between 'R309' and 299379 are evident when these genotypes are crossed with 'New Hampshire

Midget' (NHM). Neither 'R309' nor 299379 showed a reciprocal difference in the F_1 generation. However, germination was nil for 'R309' as a pollen parent in the F_1 whereas germination was relatively good for 299379. In fact, in all families surveyed, almost no germination resulted from using 'R309' as the pollen parent. Additional investigation is necessary to determine whether delayed germination or inviable embryos predominate in this instance.

Recessiveness is indicated in the delayed germination of 299379 since the F_1 progeny from crosses with NHM germinated normally and the slowest rate of germination was recorded for the backcross 299379 x (NHM x 299379) and its reciprocal. In the cross with 189225, dominance is indicated by the low numbers of germinating seed in the F_1, F_2 and progeny from the backcrosses with 299379. Backcrosses with 189225 resulted in substantial germination.

Considerable variability in rate of germination and in actual germination given an unlimited time frame appears to exist in these genotypes. More work will be required to ascertain the genetic basis for these atypical germinating types.

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Table 1: Germination of Seed from *Citrullus lanatus* ('New Hampshire Midget', PI 299379, PI 189225) and *Citrullus colocynthis* 'R309' and F1, F2 and Backcross Progeny.

ID	Code	Parents		Seed	
		Female	Male	Plant.	Germ.[a]
NHM	A	A	A	288	185
299379	B	B	B	288	4
189225	C	C	C	288	146
R309	D	D	D	288	2
		R309 x 299379			
F1		D	B	96	0
F1		B	D	96	0
F2		(DxB)	(DxB)	96	4
BC1		D	(DxB)	96	18
BC2		(DxB)	D	96	0
BC3		B	(DxB)	96	1
BC4		(DxB)	B	96	0
		R309 x New Hampshire Midget			
F1		A	D	96	0
F1		D	A	96	21
F2		(AxD)	(AxD)	96	30
BC1		D	(AxD)	96	36
BC2		(AxD)	D	96	6
BC3		A	(AxD)	96	50
BC4		(AxD)	A	96	3
		R309 x 189225			
F1		D	C	96	2
F2		(DxC)	(DxC)	96	70
BC1		D	(DxC)	96	30
BC2		(DxC)	D	96	0
BC3		C	(DxC)	96	57
BC4		(DxC)	C	96	16
		299379 x New Hampshire Midget			
F1		A	B	96	65
F1		B	A	96	62
F2		(AxB)	(AxB)	96	49
BC1		B	(AxB)	96	13
BC2		(AxB)	B	96	36
BC3		A	(AxB)	96	38
BC4		(AxB)	A	96	43
		299379 x 189225			
F1		B	C	96	7
F1		C	B	96	1
F2		(BxC)	(BxC)	96	0
BC1		B	(BxC)	96	3
BC2		(BxC)	B	96	0
BC3		C	(BxC)	96	48
BC4		(BxC)	C	96	11
		New Hampshire Midget x 189225			
F1		A	C	96	7
F1		C	A	96	43
F2		(AxC)	(AxC)	96	80
BC1		A	(AxC)	96	77
BC2		(AxC)	A	96	85
BC3		C	(AxC)	96	51

[a]Number of seed germinating after 8 days.

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Resistance to Anthracnose in Cucurbits - An Overview

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The genetics of anthracnose resistance and the physiology of anthracnose resistance are approaching the integration stage in cucurbits.

Barnes and Epps (1) reported that two types of resistance to anthracnose exist in cucumber. Several genes control immunity, and a single dominant gene imparts a high level of resistance. Busch and Walker (2) verified this report and noted that cell walls thicken in the resistant tissue infected by the fungus.

Robinson et al (9) noted that several reports indicated that a single dominant gene controlled resistance to anthracnose in watermelon. Suvanprakorn and Norton (12) reported that resistance to race 2 in the three PI's was controlled by a single dominant gene. We find that resistance to race 2 can be governed by several genes. However, we reported previously in this newsletter (11) that a hypersensitive response to race 2 may be controlled by a single dominant gene that lacks 100% penetrance.

Since the report by Busch and Walker (2) that cell wall changes occur in the host, the relationship of anthracnose to its host has been studied in several cucurbits. Caruso and Kuc (3) showed that systemic protection against anthracnose in watermelons and muskmelons could be induced by a small dose of the pathogen. Hammerschmidt and Kuc (6, 7, 8) later reported changes in isoperoxidases and enhanced lignification in response to a challenge dose of the pathogen in protected cukes. Love and Rhodes (9) noted significant differences in the isoperoxidase profiles of resistant and susceptible watermelon genotypes in response to infection. Touze and Rossignol (13) reported an increase in lignin, notedly guaiacol and p-coumaryl lignin in watermelon, in response to a challenge dose of the pathogen. Esquerre-Tugaye and Mazau (5) reported that the cell wall protein, extensin is modified by *C. lagenarium* in *Cucumis melo*.

The isoperoxidase system in *Cucurbita pepo* is similar to that in *Cucumis* and *Citrullus* (4), but the effect of anthracnose on this system has not been studied.

We have the genetic material to investigate how the fungus induces changes in the isoperoxidase system which may in turn control lignification. Vance (14) suggested that information on the inheritance of induced lignification is essential to full understanding of the role of lignification in resistance.

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The Inheritance of the 'Moon and Stars' Variegation in *Citrullus lanatus*

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Seeds from an old cultivar of watermelons, labeled 'Moon and Stars', were obtained from an unidentified farmer in North Carolina several years ago. Its origin is not known. The 'Moon and Stars' pattern is an impressive number of yellow spots, varying in size from microscopic to large portions of the leaf at maturity, that begins to appear on the first true leaf. It has no effect on the vigor of the plant. The fruit are also variegated, but the color of the flesh is not affected.

A cross was made with a pale seedling mutant. The F_1 progeny were all spotted, the F_2 progeny segregated 3:1 spotted:normal, reciprocal backcrosses with normal parent segregated 1:1, and the backcross with the spotted parent produced all spotted progeny, One backcross with the normal parent did not fit a 1:1 segregation ratio. Some spotted seedlings were probably not scored because seedlings were examined before the full development of the first true leaf (Table 1).

It is concluded that 'Moon and Stars' is a simple dominant character.

Table 1. Segregation of 'Moon and Stars' variegation pattern in parents, F_1, F_2, and backcross progeny in *Citrullus lanatus*.

Generation	Classes		Expected ratio	X^2	p
	Spotted	Nonspotted			
'Moon and Stars' (M&S)	All	None	1:0	0	1.0
Pale Seedling (ps)	None	All	0:1	0	1.0
F_1	All	None	1:0	0	1.0
F_2	130	46	3:1	0.49	0.50–0.75
	51	17	3:1	0.00	>0.99
F_1 x ps	54	88	1:1	8.14	0.001–0.01
	77	93	1:1	1.52	0.20–0.30
F_1 x M&S	181	0	1:0	0	1.0
ps x F_1	84	74	1:1	1.38	0.20–0.30

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Overcoming the Silvering Disorder of *Cucurbita*

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Silver mottling of leaves is a widely known characteristic of cultivated *Cucurbita* which is controlled oligogenically. This mottling generally occurs as patches in axils of leaf veins (2, 3, 4, 6).

Silvering of leaves, sometimes confused with silver mottling, is considered to be a serious physiological disorder affecting summer squash in Israel. The phenomenon is most common in summer and during hot spells and is associated with a lack of fruit set (1).

Silvering, which has been observed to occur as early as the third true leaf, appears in and on both sides of the upper surface of the main leaf veins in mild cases, but in more acute cases can also appear in secondary and the smallest of leaf veins. In severe instances, successively developing leaves become less green and more silvery until entirely silvered leaves appear. Concomitant with the silvering is a whitening of stems, petioles, flower buds, and ovaries. Fruit set is markedly reduced or absent. Plants less severely affected will set some fruit, but in dark green-fruited cultivars the fruit will be light in color and in precociously yellow-fruited cultivars the fruit will be streaked green or entirely green.

The silvering problem has been observed on numerous occasions across a wide spectrum of cultivars and races of *C. pepo* and *C. moschata.* It has been seen especially frequently in commercial fields of local cultivars in Israel and was serious among late summer and autumn greenhouse-grown transplants in our breeding nursery in three consecutive years. Thus, an understanding and solution of this problem became imperative.

An interesting case occurred in autumn 1981. Seedlings of a breeding line closely related to 'Benning's Green Tint', a scallop cultivar of *C. pepo* having unmottled leaves, were transplanted after expansion of the cotyledons to soil mounded on straw bales in the greenhouse. Irrigation was applied using the drip method, with 20-20-20 fertilizer plus trace elements applied through the irrigation system. As the plants grew and true leaves appeared, some began losing turgor during the heat of the day. At the third leaf stage, some plants began showing silvering with successive new leaves becoming more silvery until entirely silvered leaves appeared. These plants were observed to undergo extensive turgor loss during the day from which they did not recover overnight. A few scattered plants remained green for the first 10 leaves or so. Gradually, they began showing turgor loss and the newer leaves began showing silvering. It was at this time that the frequency and quantity of irrigation was increased several fold. Plant turgor increased noticeably, and one week later, on the slightly silvered plants, the newly developing leaves were green. On the heavily silvered plants, successive newly developing leaves were less silver and more green until finally, five to eight leaves later, completely green leaves were formed. It must be emphasized that heavily silvered plants exhibited a developmental leaf sequence of green to silver to green.

After these observations in autumn 1981, care was taken to provide enough irrigation to plants to prevent turgor loss, in both greenhouse and field-sown plants. However, in some cases, even saturation of the soil may not be enough to prevent turgor loss and leaf silvering completely. The plants usually overcome the problem eventually, probably due to the onset of cooler temperatures and, in the case of transplants, recovery of the root system.

The structural basis of silver mottling has been described by Scarchuk and Lent (3) but the physiologically caused silvering has not been studied anatomically, to the best of our knowledge. However, a preliminary check of chlorophyll content revealed no differences between green and silvery leaves.

Shifriss (5) described a line which is almost completely silvery and which he noted to be a "low seed producer". This is consistent with the observations that silvery plants set few or no fruit. How silvering and impaired reproductive capability are connected is a matter for speculation. One possibility would be that silvering lowers the rate of photosynthesis in affected plants.

Summer squash in Israel is commonly grown under regimes of supplemental irrigation or early spring seeding with no

irrigation (1) and no rain falls from late spring until autumn, This would explain the importance of the silvering disorder in Israel and its lack of importance in regions with frequent rainfall during the growing season, or where summer squash is grown under an intensive irrigation regime.

The ability to produce silvery foliage appears to be inherent in *Cucurbita* plants and is probably an adaptation allowing them to survive periods of inadequate water supply.

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Effect of Fruit Thinning on Dry Matter Accumulation and Variability in *Cucurbita maxima* Winter Squash

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In breeding efforts to develop small-fruited bush strains of *C. maxima* winter squash, we have encountered problems in obtaining strains with consistently high dry matter in the pericarp of fruit. Preliminary observations suggested that this variability occurred among fruit on the same plant as well as resulting from year to year differences among plants. In the summer of 1982 we compared dry matter content in fruits of a bush and a vine cultivar of *C. maxima* to ascertain if there were differences among fruit in accumulation of dry matter according to position and time of pollination.

The bush strain ‘Gold Nugget’ and the vine strain ‘Buttercup’ were planted in a bush-vine split plot with five replications and two plants per plot. ‘Buttercup’ plants were allowed to set fruit naturally. ‘Gold Nugget’ received three treatments: natural fruit set, plants thinned to four fruits, and plants thinned to three fruits. Data were obtained on position of fruit on plant and time of pollination.

Fruit thinning significantly increased fruit size and % dry matter of the pericarp (Table 1). Although total fresh weight of fruit decreased with decreased numbers of fruit per plant, the total dry weight of pericarp did not, and, in fact, was significantly greater on plants thinned to three fruits. Fruit size and total fresh weight of fruit per plant varied more on unthinned than on thinned plants; whereas, the variability in fruit dry weight was greatest on thinned plants. Surprisingly, variability in % dry matter, an important quality component, was as high or higher in fruit of thinned as in those unthinned plants.

Table. 1. Effects of fruit thinning on yield components in 'Gold Nugget' squash and a comparison of dry matter accumulation and variability in 'Gold Nugget' (bush) and 'Buttercup' (vine) squash.[a]

Treatment	Ave. fruit size (kg)	Ave. fruit fr. wt. per plant (kg)	Ave. fruit dry wt. per plant (kg)	% dry matter pericarp
Gold Nugget				
3 fruit/plant	1.0 ± 0.1	3.1 ± 0.4	0.56 ± 0.10	18.0 ± 2.6
4 fruit/plant	0.9 ± 0.1	3.5 ± 0.4	0.46 ± 0.08	12.6 ± 1.2
Natural set (8.2)	0.6 ± 0.1	5.2 ± 1.3	0.45 ± 0.06	8.6 ± 1.2
Buttercup				
Natural set (8.4)	2.0 ± 0.2	16.7 ± 3.1	4.1 ± 0.7	24.9 ± 1.4

[a]Under low density spacing: 3' x 6' (within x between row) for ‘Gold Nugget’, and 6' within row with no guard rows for 'Buttercup'.

Because of the indeterminate and branching growth habit of ‘Buttercup’ as contrasted to ‘Gold Nugget’, fresh and dry weight yields were much higher in the former cultivar. Of more importance from a quality standpoint, % dry matter in the pericarp was higher and variability in % dry matter was lower in ‘Buttercup’ than in ‘Gold Nugget’.

In ‘Gold Nugget’ a significant positive correlation (r = 0.52) was, found between time of pollination and % dry matter with the natural fruit load. We observed a similar relationship in a bush breeding line which normally sets 3 to 5 fruits per plant. Time

of pollination did not affect % dry matter in fruit of ‘Buttercup’. In selecting bush genotypes for high dry matter, sampling techniques should be used which take into account the above relationship between date of pollination and % dry matter of pericarp.

Our results to date indicate that multi-fruited bush plants of *C. maxima* tend to set too many fruit relative to their photosynthetic capacity. This results in low mean dry matter content in the pericarp of fruit. We have selected small-fruited strains which set fewer fruits and exhibit higher % dry matter in the pericarp, but these strains still lack the fruit uniformity desirable in commercial cultivars. Bush cultivars of *C. maxima* appear most suitable for home gardeners because of their small space requirement. In those bush strains which set numerous fruit, fruit thinning could be recommended for increasing % dry matter and cooking quality of fruits.

Cucurbit Genetics Cooperative Report 6:73-74 (article 37) 1983

A Report of Cucurbitacin Poisonings in Humans

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The tetracyclic triterpenoid cucurbitacins, bitter substances of the Cucurbitaceae, are highly toxic to mammals with intraperitoneal median lethal dose values for pure Cucs in the mouse of 1.2 mg Cuc A/kg; 1.0 mg Cuc B/kg; 6.8 mg Cuc C/kg and in the rat 2.0 mg Cuc A/kg (1). Cases of stock poisoning, especially in times of drought, have been recorded in South Africa after feeding on *Cucumis leptodermis* Schwerch, *C. africanus* L., and *C. myriocarpus* Naud. (2).

Cucurbitacins have been bred out of cultivated fruit but are typically present in large amounts in wild cucurbits. This laboratory, however, was recently consulted about a number of cases of human poisoning over the period of a year from the consumption of commercially produced zucchini (*Cucurbita pepo* L.) in Australia. Characteristic symptoms included a bitter taste in the mouth, stomach cramps, diarrhea and occasionally collapse (Mr. M. Herrington, Horticulturist Redlands Horticultural Research Station, Queensland, Australia, personal communication). In one case after five people consumed approximately 700 g each of zucchini within a 6 hour period, two people collapsed and the others suffered severe cramps and diarrhea. The consumption of bitter tasting zucchini prior to the onset of symptoms implicated cucurbitacins.

Analysis of a freeze-dried sample of very bitter zucchini provided to us by the Redlands Horticultural Research Station determined beyond question that cucurbitacins were present. A well established bioassay technique using TLC and Diabroticite beetles showed an R_f value corresponding to Cucurbitacin E-glycoside (Figure 1) (3). The identity of the Cuc was qualitatively verified by high pressure liquid chromatography (HPLC) using a Waters model M-45 single pump system with a radially compressed octadecyl silane column with a solvent of 73% methanol and a flow rate of 1 ml/min. The five major cucurbitacins of *Cucurbita*-B, D, E, I and E-glycoside can be separated by HPLC (4). Standard Cuc E-glycoside extracted from *Cucurbita texana* and verified by mass spectrometry, was co-injected with the sample and retention times were identical. Quantitative determination of the Cuc content by UV absorption spectrometry at 210 nm revealed 1.12 mg Cuc E-glycoside/g fresh wt. fruit (if one assumes a loss of 90% moisture with drying). This remarkably high level of cucurbitacin is comparable to that of many wild cucurbits and undoubtedly could account not only for the bitter taste of the zucchini cultivar but the symptoms of poisoning reported in Australia.

So, far, based on traces back to grower's fields, only one cultivar, a widely grown hybrid zucchini, has been implicated. In the one instance where the culprit plant producing the bitter fruit was identified, the plant's leaves showed more silvering, the fruits were shorter, broader and somewhat lighter in color, and the mature fruit was yellow and somewhat warty in contrast to the normal black green smooth rind. Further studies of the basis for Cuc synthesis in the zucchini are currently in progress with seed from this plant.

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E-gly
std.
bitter
cv.

Cucurbit Genetics Cooperative Report 6:75-76 (article 38) 1983

Intense Bitterness in Commercial Zucchini

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Twenty-two cases of food poisoning associated with intensely bitter zucchini were recorded by Queensland health authorities between November, 1981 and December, 1982.

In case studies symptoms of illness were apparent 1 to 2 hours after consumption. Ingestion of about 3 g of bitter zucchini was sufficient to incite nausea followed by collapse, with severe stomach cramps lasting 3 days, and diarrhea which persisted longer. Vomiting was seldom associated. The extremely unpleasant taste penetrated entire meals and usually prevented ingestion. However, mastication of affected fruit or swallowing small amounts of associated vegetable was often sufficient to produce diarrhea and less frequently, stomach cramps.

Complaints were traced back through the marketing chain to identify the cause. Although environmental conditions are known to promote bitterness in cucumbers (1), no conditions were consistently implicated with zucchini. The cultivar Blackjack was in production on all 20 farms identified in initial successful tracebacks and was the only cultivar being grown on 16 of these farms.

'Blackjack' has been the main cultivar grown in Queensland for 10 years. However, one traceback has now also implicated 'Castle Verde'.

Plants producing bitter fruit are apparently rare in commercial zucchini crops and we are unaware of their occurrence elsewhere. Examination of up to 2000 plant samples in commercial plantings which were the source of bitter fruit in consumer samples has failed to isolate “bitter” plants.

A single plant producing intensely bitter fruit was identified in a commercial zucchini crop not involved in poisoning complaints. The cultivar used, while producing dark green fruit, is uncertain. Selfings were not successful. However, seed produced by open-pollination was collected from this plant and 36 progeny evaluated.

The progeny was considered a backcross and plants segregated, 20 producing bitter fruit to 16 producing non-bitter fruit. This is consistent with the single dominant gene hypothesis for bitterness (2) (chi square = 0.44, P = 0.52). At early anthesis bitterness of the leaf (detectable only at the junction of petiole and lamina) exactly corresponded with bitterness of fruit.

Although the field-identified bitter zucchini plant had more silvering, lighter green colored immature and yellow mature fruit, and had shorter fruit, there were no good associations between these characters and bitterness in its progeny. Selfings and outcrossing are being carried out on selected plants.

Cucurbitacin E., Cuc. I and Cuc. E-glycoside have been identified in extracts from samples of bitter fruit.

The results confirm the intense bitterness in commercial zucchini is of genetic origin. The presence of such plants is of concern.

In a separate incident 21 progeny from a bitter accession of *C. pepo,* 'Custard Squash' (origin unknown) was also evaluated. The progeny was considered as a F_2 and plants segregated for fruit bitterness, 16 bitter to 5 non-bitter. However, bitterness of leaves segregated 5 bitter to 16 non-bitter and so there was a poor association of bitter leaves with bitter fruit. Plants which had bitter leaves also had bitter fruit but plants without bitter leaves sometimes had bitter fruit.

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Market inspectors, extension officers and food technologists of the Queensland Department of Primary Industries, chemists of the Queensland Government Chemical Laboratory, inspectors of the Queensland, New South Wales and Victorian Health Departments and a plant breeder of the Department of Agriculture (Victoria) contributed information contained in this report.

Cucurbit Genetics Cooperative Report 6:77-78 (article 39) 1983

Overview - The *Cucurbita* Species

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The genus *Cucurbita* is spread through America. Several species *(C. moschata, C. maxima, C. pepo, C. mixta, C. ficifolia)* are cultivated in Latin America. Cultivation is mostly in a few plants usually within a field of corn with or without other plants. The fruits are harvested mostly mature as needed or wanted in the household; at the end of the season fully matured fruits are picked and stored in the house or on the roof. Depending on temperatures, fruits keep from 2 to 6 months. Relatively little gets to the market although in the market days in any town one will find 5–10 fruits handled by the sales women. There are several collections available (see IBPGR publication on Cucurbit Genetic Resources to be published in 1983), but agriculturists in Latin America who handle genetic material of *Cucurbita* spp. are few. To our knowledge only Mexico (INIA), Colombia (ICA-Palmira), Brasil (Piracicaba), Peru (UNA-La Molina) and Costa Rica (CATIE-Turrialba), have looked at partial variability. No systematic efforts, to collect cultivated land races or home selections has been made. T. W. Whitaker and others have made expeditions to collect in several areas. T. W. Whitaker probably has seen more *Cucurbita* variability than any other scientist and published extensively on those observations. Still, with regards to accessions of cultivated material of Latin America, the number of collections and their evaluation has been a very haphazard process; *Cucurbita pepo* is probably better known than the other cultivated species.

Cucurbita spp. are losing ground to other crops due to changes in land use pattern and technological emphasis in monoculture. It is very probable: that the variability available is now in more remote and traditional agricultural areas.

A concentrated effort is needed by several scientists taking responsibility for certain countries or regions in Latin America in collaboration with local Latin American horticulturists to do a systematic collection and evaluation of genetic material based on an analysis of what is available in each country or region. A preliminary list of people and areas in Latin America is shown (Table 1).

Table 1. Preliminary list of Latin American horticulturists working with *Cucurbita* spp. germplasm.

Area or Country	Institution(s)/Person	Species Emphasized
Mexico	INIA (CIAB) - J. Labor de	*C. pepo. C. moschata, C. mixta, C. ficifolia*
Guatemala	ICTA - O. Morocco?	"
Other Central America	CATIE - H. Heinz?	"
Venezuela	U.S. - C. Liars	*C. moschata, C. maxima*
Colombia	ICA (Palm ira) - J. Armadillo	Low altitude types *(C. moschata)*
	ICA (Tidbit) - F. Digital	High altitude types *(C. maxima)*
Ecuador	INIAP	
Peru	UNA-La Molina - F. Degrade	*C maxima, C. moschata, C. ficifolia*
Brasil	ESALQ-Piracicaba - Rochelle?	*C. moschata, C. maxima*

? = Scientists have not been specifically consulted at this time.

In evaluation, a descriptor list is proposed in the IBPGR publication, but the main practical problem is to find the field size needed to evaluate an appropriate number of plants per accession and a good number of accessions (in cases of polymorphic populations, using 6 m^2 per plant, one hectare would be needed to plant 30 to 50 accessions and 30 to 50 plants per accession) under appropriate isolation. I have used rows of close planted corn between accessions to reduce cross pollination.

Some collection activities could be financed with IBPGR collaboration since *Cucurbita* spp. have a high priority within the vegetables.

Funding or support for increment and preliminary characterization can also be partially available from IBPGR.

Any ideas or suggestions from colleagues would be most welcome. It is especially important if anyone is interested in collaboration with a specific colleague, from the accompanying list. Please send them to: Miguel Holle, IBPGR Regional Offices of Latin America, cv/o CIAT, Apart ado 6713, Cali, Colombia.

Cucurbit Genetics Cooperative Report 6:79-81 (article 40) 1983

Controlling Cucumber Beetles and Corn Rootworm Beetles with Baits of Bitter Cucurbit Fruit and Root

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Wild species of Cucurbitaceae are well known for producing the intensely bitter oxygenated tetracyclic triterpenoids, the cucurbitacins (Cucs). These Cucs are kairomones for the herbivorous beetles of the tribe Luperini (Chrysomelidae, sub family Gallerucinae) that includes some of the most destructive insects of cucurbits and corn. The Cuc kairomones act as arrestants and compulsive feeding stimulants for the Diabroticina beetles of the new world and the Aulacophorina beetles of the old world and the beetles can readily detect them in nanogram quantities (1, 3).

This laboratory has been investigating the use of bitter *Cucurbita* baits containing very small amounts of carbamate, organophosphate, or pyrethroid insecticides for monitoring Diabroticina beetle populations or for mass destruction IPM programs (2, 4, 5). From studies over three summer seasons it appears that dried, ground *Cucurbita* fruits or roots containing Cuc contents of 0.1–0.3% are especially suitable ingredients for poisoned baits. Three plant sources of Cucs have been studied: a) *C. andreana* x *C. maxima* fruit averaging 5.0 mg Cucs B and D/g dry wt., b) *C. texana* x *C. pepo* containing equal amounts of Cucs E and E-glycoside at 6.1 mg/g (F_1 fruit) or 3.0 mg/g (F_2 fruit), and c) *C. foetidissima* roots with 4.0 mg Cucs E and I/g. Under field conditions, all three of these baits were effective in promoting arrest and compulsive feeding of the corn rootworms (*D. virgifera* LeConte WCR, *D. undecimpunctata howardi* Barber SCR, and *D. longicornis* Say NCR) and the striped cucumber beetle (*Acalymma vittata* Fab.). In laboratory tests, the baits were also effective against the banded cucumber beetle (*D. balteata* LeConte) and the western spotted cucumber beetle (*D. u. undecimpunctata* Mann.).

These air dried and ground Cucurbit baits were impregnated with a variety of insecticides including the carbamates - carbaryl, carbofuran, bendiocarb and methomyl; the organophosphates - trichlorfon, malathion, dimethoate, terbufos, and isofenphos and the pyrethroids - fenvalerate, permethrin, cypermethrin, decamethrin, and Pay-Off^R. From laboratory and field studies it was concluded that the most effective toxicants for use with the ground baits were: methomyl, carbofuran, terbufos, and isofenphos at 0.1% and decamethrin at 0.01% w/w. These baits were broadcast at rates of 10 to 100 lb/A in cucurbit, sweet corn, and dent corn plots with high populations of Diabroticina beetles (1–25 beetles per plant). Evaluations of the effectiveness of the baits were made by a) comparing pre- and post- treatment counts of live beetles on the plants, b) counting dead or moribund beetles on the ground after the treatment, and c) measuring beetle catches on “sticky traps” baited with the sex pheromones of the southern and western corn rootworms. The results demonstrated that these poison bait applications at 10 to 30 lb. per A. produced reductions of adult Diabroticina beetles of 75–99+% within 1 to 3 days. The methomyl and isofenphos baits were effective at rates of 4.5 to 13.5g active ingredient per A and the decamethrin bait at application rates as low as 0.45 g per A. These substantial reductions in beetle populations resulted from insecticide application rates of about 1% those used in conventional spray applications, i.e. 1–2 lb. per A.

The following experiment on late sweet corn plots of 0.05A containing about 500 plants, treated by broadcast of 0.1% methomyl baits at 30 lb. per A (13.5g of methomyl per A) demonstrates the effectiveness of the bait applications.

	Days after treatment	No. beetles per plant WCR	SCR	NCR	No. beetles dead or dying on ground WCR	SCR	NCR	Percent control
A.	C. andreana x C. maxima bait							
	pretreatment	23.70	1.00	0.56	0	0	0	--
	1	0.53	0.44	0.0	11,147	379	250	100% (ground)
	2	0.04	0.24	0.40				97.3% (plant)
	11	0.0	0.12	0.095	17*	114*	0*	99.1% (plant)
B.	C. foetidissima bait							
	pretreatment	10.48	0.26	0.62	0	0	0	
	1	0.74	0.29	0.0	4,370	251	128	91.0% (ground)
	2	0.56	0.30	0.0				92.3% (plant)
	11	0.02	0.06	0.0	4*	152*	0*	99.3% (plant)

*dying (moribund) beetles observed on ground in both plots for the 11 days after treatment indicating lengthy persistence.

From the experiments performed over the past three years, we conclude that dry poison baits formulated from ground bitter *Cucurbita* spp. or cultivars provide a superior technique for controlling adult cucumber beetles and corn rootworm beetles attacking cucurbits and corn. The use of the baits can provide adequate protection of these crops from adult beetle attacks at minimal dosages of insecticide and with minimal damage to populations of beneficial insects. This use of baits is therefore especially suitable for IPM programs. More research is needed to determine how the use of bitter cucurbit baits for adult corn rootworms might fit into long-term control programs for corn rootworms attacking field corn.

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	Days after treatment	No. beetles per plant WCR	SCR	NCR	No. beetles dead or dying on ground WCR	SCR	NCR	Percent control
A.	*C. andreana* x *C. maxima* bait							
	pretreatment	23.70	1.00	0.56	0	0	0	--
	1	0.53	0.44	0.0	11,147	379	250	100% (ground)
	2	0.04	0.24	0.40				97.3% (plant)
	11	0.0	0.12	0.095	17*	114*	0*	99.1% (plant)
B.	*C. foetidissima* bait							
	pretreatment	10.48	0.26	0.62	0	0	0	
	1	0.74	0.29	0.0	4,370	251	128	91.0% (ground)
	2	0.56	0.30	0.0				92.3% (plant)
	11	0.02	0.06	0.0	4*	152*	0*	99.3% (plant)

Cucurbit Genetics Cooperative Report 6:82-83 (article 41) 1983

Progress and Procedures in Breeding CMV Resistant *C. pepo* L.

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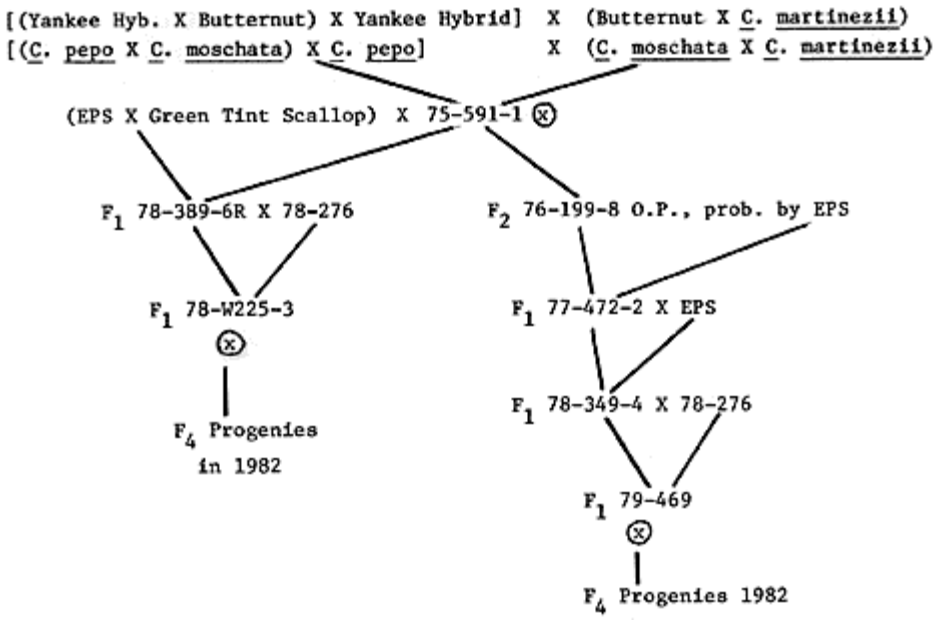
After many years of attempting to use cucumber mosaic resistance derived from PI 176959, a *C. pepo* from Turkey, recent efforts have concentrated on *C. martinezii* which is proving a far better source of resistance. Nevertheless, 3 lines derived from crosses with PI 176959 have been extremely useful in two ways: 1. As parents in complex crosses which also involve *C. martinezii* and 2., as checks for evaluating levels of resistance. The latter use may be the more important. Many levels of reaction to CMV exist in *C. pepo* and these unfortunately are expressed as drastic differences from one test to another rather than as gradations in symptom expression in a given test. We have come to use six varieties and breeding lines as checks in most CMV-inoculated plantings to evaluate the level of resistance in newer lines. They are ranked from most susceptible to most resistant in the following list:

1. 'Early Prolific Straightneck' (EPS). Uniformly susceptible in all tests. Highly stunted or killed when inoculated at any age. Usually severely affected from natural infection in field at Ithaca, NY.
2. 'Zucchini' and 'Caserta'. Usually as badly stunted as EPS when inoculated at cotyledon stage, especially in the greenhouse from fall to early spring. Hard to infect as plants become older. When grown in the field without artificial inoculation, they are sometimes severely stunted and mottled but in other seasons are essentially unaffected by CMV while EPS nearby is stunted or killed. They sometimes look healthy through most of the season but die suddenly toward the end after producing several fruits. ‘Caserta’ sometimes survives when ‘Zucchini’ does not, but the average difference is not great.
3. 78-274 and 78-276. F_5 progenies from [(PI176959 x Yankee Hybrid) F_5 x EPS x EPS]. Plant and fruit type similar to EPS. Variable reaction to CMV much as described for ‘Zucchini’ and ‘Caserta’ but usually less affected than those varieties. When grown in the field at Ithaca without artificial inoculation, they usually produce a crop while EPS fails. However, in a late-planted farm test near Albany, NY, these lines looked no more resistant than EPS. While infection with a different virus is not entirely ruled out as an explanation, we conclude that their resistance to cucumber mosaic is too risky for New York conditions and try to eliminate progenies of this level. They are useful as parents to improve EPS type without going back to the completely susceptible EPS; all our present lines of EPS type have one of these in their parentage.
4. 73-604. F_8 progeny from PI 176959 x ‘Yankee Hybrid’ (3) used as parent in 1966 to start the backcross progenies just described. A viney plant with short cylindrical tan fruit. Almost never shows symptoms from natural infection in the field and after young seedlings are inoculated for field plantings, most plants show only slight symptoms. Some runners may show severe symptoms when fruit is maturing. Some plants may show strong symptoms in early inoculated greenhouse tests but these show marked recovery and many show only slight or no symptoms. This has been our most resistant check line; its level of resistance seems fully adequate for any situations we have encountered in growing summer squash.
5. Two families designated as 469 and W225 are of more recent origin, include in their parentage both *C. martinezii* and 78-276 (listed under 3 above) and constitute our most advanced material with a uniformly high level of CMV resistance. Numerous F_4 lines of both families were grown in 1982 and some seem to be true-breeding for even higher CMV resistance than 73-604 (number 4 in list above).

Both are recognizably of summer straightneck fruit type but vary in shape and wartiness. Both have plants that are slightly less compact than summer squash and W235 has distinctive mottled leaves. The 469 family is susceptible to powdery mildew while the W225 has some highly PMR plants.

We encourage anyone interested in CMV resistance in *C. pepo* to obtain seed of the above lines to compare with the resistance of their own material, to evaluate the severity of natural infection, or to use as parents.

The parentage of the 469 and W225 families is given below. In this diagram a series of 2 numbers designates a row while 3 numbers designates a single plant. 75-591-1 was a plant selected for powdery mildew resistance by Contin (1, 2) from the complex hybrid he made, using as female parent the interspecific backcross population developed by Wall & York (4) and maintained at Cornell by periodic isolated increase.



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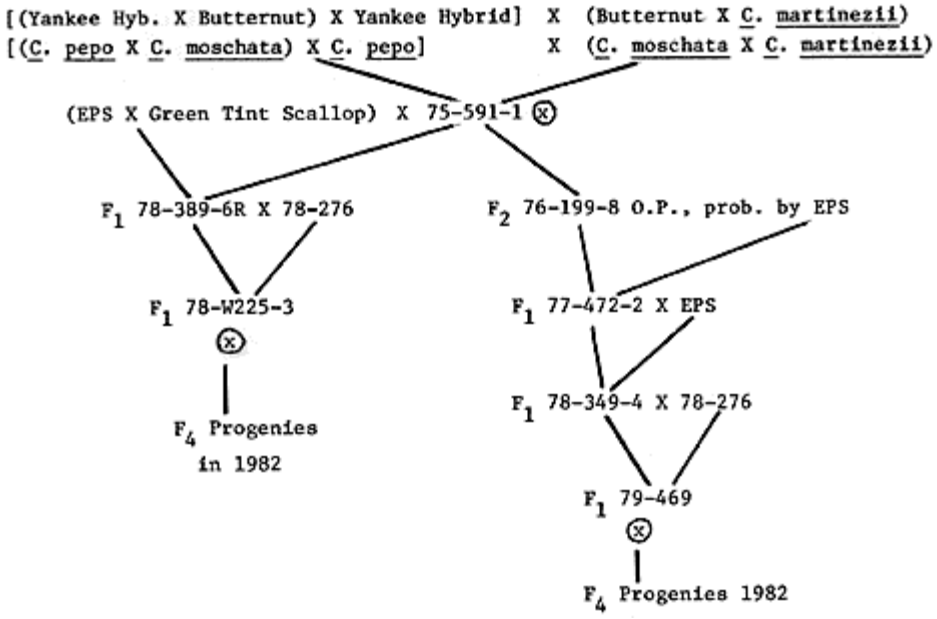
[(Yankee Hyb. X Butternut) X Yankee Hybrid] X (Butternut X C. martinezii)
[(C. pepo X C. moschata) X C. pepo] X (C. moschata X C. martinezii)
(EPS X Green Tint Scallop) X 75-591-1 ⊗
F1 78-389-6R X 78-276
F2 76-199-8 O.P., prob. by EPS
F1 78-W225-3
⊗
F4 Progenies
in 1982
F1 77-472-2 X EPS
F1 78-349-4 X 78-276
F1 79-469
⊗
F4 Progenies 1982

Cucurbit Genetics Cooperative Report 6:84-85 (article 42) 1983

Growth of Parthenocarpic and Seed-bearing Fruit of Zucchini Squash

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Large differences in parthenocarpic fruit set amongst zucchini squash cultivars were reported (1). Selection for parthenocarpy was successful and a breeding line with high tendency to parthenocarpic fruit set under Dutch early spring glasshouse conditions was offered to interested breeders.

Three progenies of this line were evaluated in a spring trial in 1982. The plants were transplanted March 8 in an insect-free glasshouse with approximately 23°C days and 12°C nights nights in 3–7 replicated of 5 plants each, and parthenocarpic fruit production was measured until the end of April. Some results are in Table 1.

Table 1. Parthenocarpic fruit set of zucchini squash in the glasshouse (1982).

Population	Number of plants	Percentage fruit set	Numbers of fruit per plant	Yield (g) per plant	Percentage class 1 fruit
DG-4	25	87	4.4	1152	58
DG-4 x	35	77	4.7	1219	58
Poseidon	15	51	2.5	706	43
Poseidon x DG-4	25	50	2.3	618	48
Elite	15	17	1.4	306	19

Three levels of parthenocarpy can be distinguished. Lines DG-4 and DG-4 x represent the highest level, both for percentage fruit set, mean number of fruits per plant in the first three weeks of harvest, fruit yield, and percentage of fruits in class 1 (normal shaped, regular sized fruits). The figures listed for DG-4 x are the means of three separate inbred lines which behaved similarly. Apparently, further selection for parthenocarpy has not had success. Standard cv. Elite (commonly grown in the Netherlands) had a very low level for all four parameters listed in the table. The percentage fruit set was higher this year than in last year's trial for all cvs. The ranking of cvs. remained the same. The high light intensity of this spring may have contributed to the good fruit set.

The hybrid progeny Poseidon x DG-4 behaved similarly to 'Poseidon' with respect to parthenocarpy, although it was intermediate for other plant and fruit characters. We consider this as preliminary evidence that the high level of parthenocarpy in DG-4 is a recessively inherited character. More advanced progenies are being tested to answer this question.

Towards the end of the trial a number of female flowers of several genotypes were hand-pollinated and the length of developing fruits was measured daily for 8 days, and one more time after 12 days. Simultaneously non-pollinated parthenocarpic (developing) and non-parthenocarpic fruitlets of the same lines were also measured. Some results are in Figure 1.

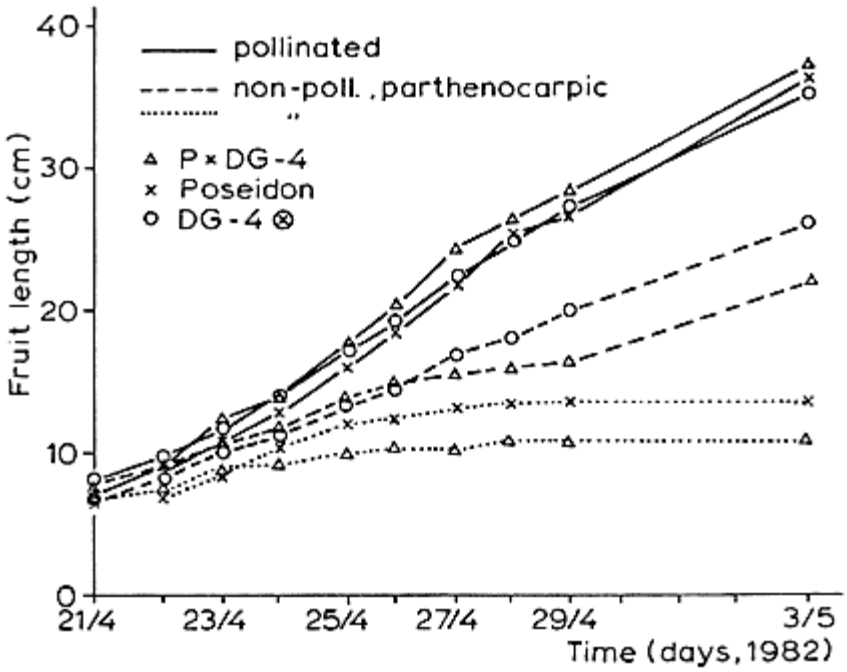

Figure 1. Mean length growth of pollinated and non-pollinated flowers of squash.

Figure 1 presents preliminary data on the length growth of pollinated and nonpollinated ovaries of 3 genotypes in this study. Each line is based on only 2–4 fruits. The growth of parthenocarpic fruits of DG-4 x approximated 1.6 cm/day during the first 8 days. The pollinated fruits of all genotypes grew about equally fast at approximately 2.4 cm/day. Both fruit types did not stop growing even after 12 days. Non-parthenocarpic fruits elongated slightly before rotting away. It appears, then, that parthenocarpic fruits make indeed a less rigorous harvesting schedule possible. A yield comparison of pollinated and parthenocarpic producing plants is planned.

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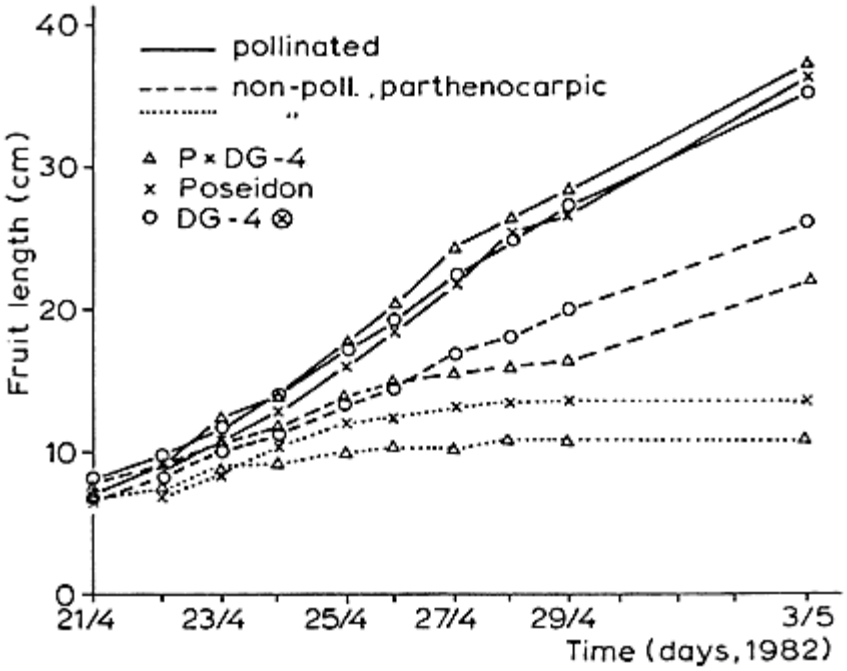
pollinated
non-poll., parthenocarpic
"
P × DG-4
Poseidon
DG-4 ⊗
Fruit length (cm)
0
10
20
30
40
21/4
23/4
25/4
27/4
29/4
3/5
Time (days, 1982)

Cucurbit Genetics Cooperative Report 6:86-87 (article 43) 1983

On Regreening of *Cucurbita pepo* L. Fruit

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The effect of *B* on precocious yellowing of *C. pepo* fruits has been reported in detail (1). However, during our studies on the-pigmentation of *C. pepo* fruits (2) a number of significant observations regarding fruit coloring were made which indicate directions for further study. Whereas standard *(bb)* fruits were susceptible to regreening in storage, precocious *(B-)* fruits were relatively resistant. The most striking example of this difference was observed during the fall of 1982. Small Sugar (SS) pumpkins, *bb* and *Bb* genotypes, were grown in the field in New Brunswick, New Jersey during the summer of 1982 for experimental purposes and the remaining fruits were harvested in mid-September and distributed to departmental staff members for ornamental purposes. At the time of harvest, the *bb* and *Bb* fruits were indistinguishable on the basis of rind color, all falling within the 5 YR and 7.5 YR color classification of Munsell (3). Approximately ten fruits of each genotype were kept in fluorescent-lit offices, frequently in mixed *bb* and *Bb* groups of two or three fruits. By the end of November, all of the *bb* fruits, and none of the *Bb* genotype, had begun to regreen.

Another example of the effect of *B* on regreening was in the progeny of the cross Early Prolific (EP) *Bb* x Table King (TK) *bb*. Only two *Bb* and one *bb* fruit were observed over a long period of time. By 50 days past anthesis (d.p.a.), the three fruit were yellow (10 YR according to Munsell) but soon afterwards the *bb* fruit began to regreen and at 160 d.p.a. it was almost completely dark green while the *Bb* fruits were unchanged.

Not all *bb* genotypes, however, are equally susceptible to regreening. The most striking example of differences was observed between the EP x TK *bb* fruit previously described as regreening and the *bb* progeny of SS *Bb* x TK *bb*. Two *bb* fruit from the SS *Bb* x TK *bb* cross were observed to turn from green to orange at approximately 50 d.p.a. By 80 d.p.a., the two *bb* fruits were completely orange and hardly distinguishable from their *Bb* counterparts and remained orange at 160 d.p.a. Differences in regreening susceptibility were also observed with respect to intensity of regreening.

These observations may be explained in terms of plastid transformations. The reversion of chromoplasts to chloroplasts has been reported in *C. pepo* var. *ovifera* fruits (4) but only in tissue which had previously changed from green to yellow (chloroplast to chromoplast). However, Ljubesic (5, 6) observed that in bicolor *C. pepo* (from which *B* is derived (1)) the green portion contained chloroplasts which later developed into chromoplasts while the yellow portion was characterized by chromoplasts derived directly from proplastids. If the action of gene *B* in fruit skin is at the plastid transformation level rather than at the carotenoid biosynthesis level *per se* (2), then *B* may be viewed as effecting direct proplastid to chromoplast development as well as inhibiting either proplastid to chloroplast or chromoplast to chloroplast development. Accordingly, the term "regreening" is inappropriate for *B*-genotypes. However, *B*-fruits do occasionally express greening when stressed in some manner, e.g. water stress (7) and virus infection.

The process of regreening, or post-maturation greening, in *C. pepo* has yet to be studied in detail. The physiological genetics of plastid reversions in *C. pepo bb*, the effect of *B* on plastid development, and the physiological effect of virus and environmental factors in causing greening even in *B* fruit are all topics that warrant further investigation.

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Cucurbit Genetics Cooperative Report 6:87-88 (article 44) 1983

On Spotting of *Cucurbita pepo* L. Fruit

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A number of *C. pepo* cultivars are characterized by fruits with either a "lace-like pattern" or subtle spotting (1). Even the dark-green zucchini squashes, when viewed closely, exhibit small light green specks throughout the surface of the fruit. Barber (2) correlated these spots with stomata but did not explain their cause. Paradermal sections of 'Fordhook Zucchini' (FZ) showed that the flecks or spots occurred below stomata and that the spots became recognizably large in areas where a number of stomata were aggregated. Cross sections of these areas showed that the cells in the subepidermal layers contained no chromoplasts or chloroplasts and, depending on the number of stomata in the aggregate, the colorless area extended. a few or many cell layers deep. Accordingly, white spots would then be plastidless areas that extend down to the lignified layer beneath the hypoderm while light green spots would be due to plastid-filled cells viewed through a few layers of plastidless cells. This effectively creates a “window” to the lower hypodermal cell layers.

Some FZ x Early Prolific F_2 segregants had dark green fruit with conspicuous light green-cream spots. After 50 days past anthesis, the lighter spots turned yellow-cream while the dark green "background" remained. Cross sections of tissues of these fruit showed that the light green-cream spots were due to plastidless areas beneath stomata which served as a "window" to the lower cell layers which were filled with chloroplasts. However, when the chloroplasts of the inner cell layers converted to yellow chromoplasts the color change was observed through the "window".

The ability of different subepidermal cell layers to undergo differential plastid development is no doubt very important in determining the different pigmentation patterns of *C. pepo* fruit. For example, in one F_2 segregant from FZ x Small Sugar the fruit developed a shiny black skin, similar to FZ. Actually, its subepidermal layer was made up of two somewhat distinct layers: a heavily pigmented upper layer with a very high chloroplast concentration and a lighter pigmented lower layer with a sparser chloroplast concentration. Portions of the dark layer degreened without converting to chromoplasts, unmasking the lighter green area below. Portions of the lighter green area did develop chromoplasts yielding a fruit with dark green, light green and orange splotches.

The genetic and physiological factors determining which cell layers undergo plastid development remain to be delineated. However, a developmental and histological approach to fruit pigmentation in *C. pepo* would no doubt add to our further understanding of this colorful subject.

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Cucurbit Genetics Cooperative Report 6:89-90 (article 45) 1983

Reflected Light Spectra from Silvery and Nonsilvery Leaves of *Cucurbita pepo*

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The silvery-leaf trait is conditioned by gene *M*. This gene can bring about a breakdown of intercellular cohesion in the upper tissue of the leaf, leading to air spaces between the palisade cells as well as between the palisade and epidermal layers. The air spaces modify the reflection of light and this in turn results in silvery appearance. Three major factors contribute to variations in the silvery-leaf trait. (i) Cell position. The most vulnerable cells to the action of *M* are located in axils of leaf veins. (ii) Modifier genes. These profoundly affect the time, intensity, and extent of *M* expression. (iii) Nongenetic influences which include temperature. Leaves of some *M/M* lines exhibit a mottled pattern and leaves of other *M/M* lines manifest a silvery expression that is uniform over their entire surface (2, 3, 4).

Reflected light spectra were obtained from leaves of three distinct lines, using Shimadzu Digital Double-Beam Spectrophotometer (Bausch & Lomb). The three lines were 'Early Prolific Straightneck' bearing green leaves, *m/m*; an unnamed inbred bearing mottled leaves, *M/M*; and 'NJ260' bearing uniformly silver leaves, *M/M* plus modifier genes which extend and intensify the expression of *M* over the leaf surface. These lines were grown under controlled conditions of 16 hr photoperiod light of 33 x 10^3 lu/m^2 90% of which was from fluorescent tubes and 10% from incandescent bulbs, 22°C in day and 20°C at night. Samples were taken near the tips of well-expanded leaves. The reflected light spectra of leaves and aluminum foil are shown in Fig. 1. In this figure the leaves of the three lines are referred to by their colors: *Green*, *Mottled*, and *Silvery*. Note that within the range of 700 to 400 nm Silvery reflects more light than Mottled and Mottled more than Green. In 6 tests the results were essentially the same. However, preliminary results showed that some intensely mottled leaves reflect as much light as some uniformly silvery leaves.

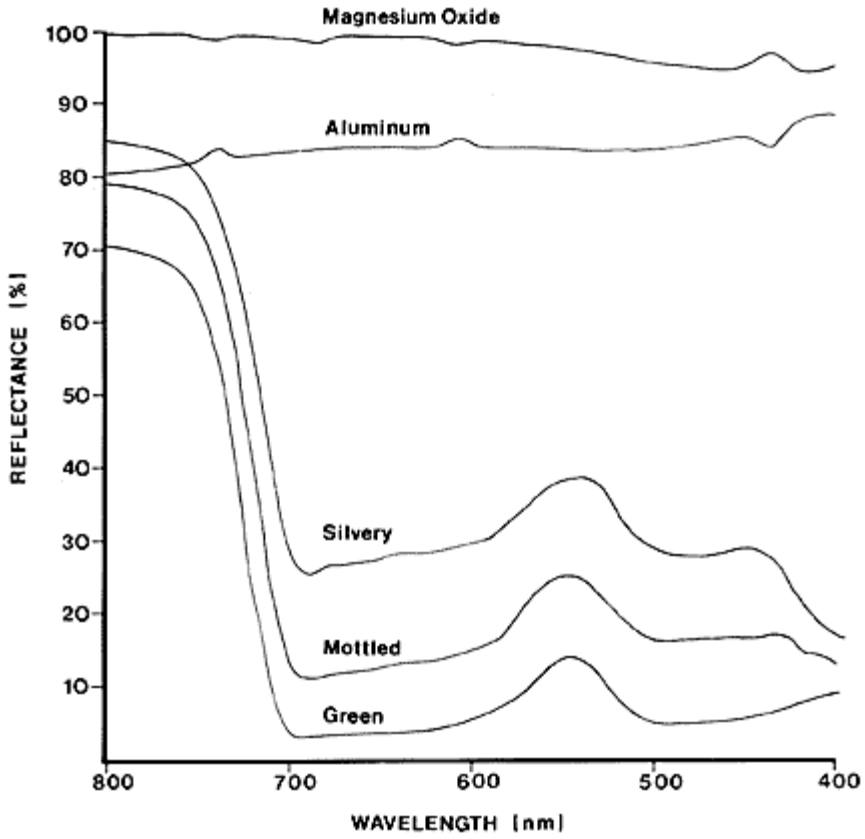

Fig. 1. Reflected light spectra of green, mottled, and silvery leaves. Aluminum foil was used for comparison.

Although field observations (3) and experimental data (1) suggest that gene *M* can partially protect *Cucurbita* plants against aphid-transmitted virus diseases, we are still searching for more critical evidence. According to my initial hypothesis, silvery leaves either repel aphids in a way analogous to aluminum mulch (the light effect) or the air spaces in these leaves slow down the speed of virus multiplication (3). But even if *M/M* plants tend to escape aphid-transmitted virus diseases, it would be necessary to determine whether a silvery or a mottled line is the desirable breeding material because the present silvery line (NJ260) is slightly sensitive to wilting under some field conditions.

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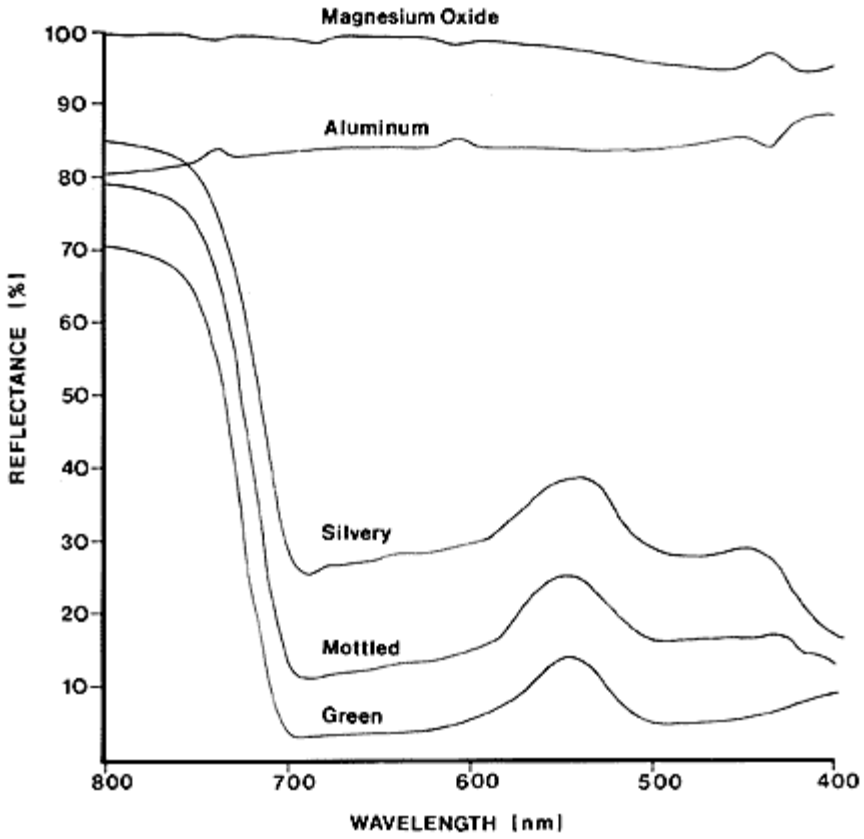
[1]I thank Ron Prokopy for use of his spectrophotometer and Frank Durmmand for his help.


Magnesium Oxide
Aluminum
Silvery
Mottled
Green
100
90
80
70
60
50
40
30
20
10
REFLECTANCE [%]
800
700
600
500
400
WAVELENGTH [nm]

Cucurbit Genetics Cooperative Report 6:91 (article 46) 1983

Influence of Temperature and Humidity on Longevity of Squash Pollen

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It would be convenient in squash breeding to store pollen for extended periods, particularly with late maturing or photoperiodic germplasm that does not flower sufficiently early to permit field pollinations. With many crops, pollen can be stored for six months or more in a desiccator kept in a freezer. We were unsuccessful, however, when we stored squash pollen in this way.

Pollen was germinated in Brewbaker and Kwack (1) medium with a modified sucrose concentration of 15% in order to investigate the influence of storage conditions on longevity of 'Early Prolific Straightneck' squash pollen. Good germination was obtained with fresh pollen, but it remained viable for only 4 hours in a $CaCl_2$ desiccator kept in a freezer at -20°C. Pollen kept at the same temperature but not in a desiccator had an equally short storage life.

Squash pollen is a very sensitive to low humidity as well as freezing. When stored in a growth chamber at 30°C, pollen kept at ambient (46%) relative humidity lost viability within 2 hours, but pollen at 100% RH and the same temperature still had good germination after 5 hours storage.

The rapid loss of pollen viability at high temperature and low humidity raised questions about our field pollination procedure, in which closed staminate flowers collected at 7 am are stored in paper bags under even more adverse field conditions, and used for pollination during the next 5 hours. This procedure appears satisfactory, however, since the humidity within the flower is sufficiently high to protect the pollen from desiccation. Pollen removed from anthers and stored at 30°C and ambient humidity had only 5% germination after 2 hours storage, but pollen kept under the same conditions except for not being detached from the anther had as good (55%) germination after 5 hours as detached pollen stored at 100% RH and 30°C.

Tests to prolong pollen longevity by storage in organic solvents (acetone, petroleum ether, or dimethyl sulfoxide), in nitrogen atmosphere, or by quick-freezing in dry ice dissolved in acetone were not successful. Although none of the treatments permitted pollen from the field to be stored long enough to be used in winter greenhouse pollinations, pollen storage for short periods is possible and can be useful in squash breeding, particularly for crosses with plants not flowering simultaneously. A simple and effective procedure is to collect male flowers the day before anthesis, store them on moist blotters in a sealed container in a refrigerator until the female parent flowers, and then keep them at room temperature for an hour to induce dehiscence. Crosses can be made between plants flowering up to 2 weeks apart in this way.

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Cucurbit Genetics Cooperative Report 6:92 (article 47) 1983

Hybridization of *Cucurbita pepo* with Disease Resistant *Cucurbita* Species

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Several *Cucurbita* species, mostly non-cultivated, are sources of resistance to cucumber mosaic, watermelon mosaic-1, watermelon mosaic-2, squash mosaic and powdery mildew (3). Through embryo culture, *C. pepo* was hybridized successfully with *C. martinezii* (now considered synonymous with *C. okeechobeensis*), *C. lundelliana*, *C. ecuadorensis*, *C. palmeri*, and *C. ficifolia*.

Crosses between *C. pepo* and *C. martinezii* have been reported only once previously (1). In the present study six F_1 plants of *C. martinezii* x *C. pepo* were obtained by making 206 pollinations and using embryo culture. These F_1 plants were self-fertile and produced a large amount of F_2 seed. Reciprocal backcrosses of F_1 and F_2 plants have produced only a few viable seeds. The backcross plants obtained show adequate self-fertility. In a population of over 100 F_2 seedlings inoculated with CMV, all showed symptoms initially but about 25 recovered to be worthy of transplanting to the field and 2 were outstanding in freedom from symptoms. Late in the season four plants without symptoms were tested for the presence of CMV and none was found. Another F_2 population was inoculated with WMV2 and several symptomless plants were found in it. Finally, 35 plants were inoculated with WMV1 and 1 plant became symptomless after showing faint mottling initially. Cuttings of this plant are available on request. Backcrossing the best F_2 plants to *C. pepo* has given small amounts of seed from some but not from others.

Crosses between *C. pepo* and *C. ecuadorensis* have also been reported previously, but only once (2). In the present study, 30 pollinations of *C. pepo* x *C. ecuadorensis* yielded 11 F_1 plants through embryo culture, all from one fruit of 'Foodhook Zucchini'. F_2 seed was not obtained; the F_1 produced few male flowers and these not at the same time as females. The F_1 plants in the greenhouse were pollinated by various *C. pepo* and several hundred embryos, some well developed, were cultured to yield 20 backcross plants for the field in 1982. Limited amounts of self- and open-pollinated seed were obtained from most of these; backcrosses were not attempted because the population was considered too small to test for resistance to the several diseases of interest. Many cuttings from the F_1 plants were also grown in the field and from numerous pollinations with *C. pepo*, several dozen plump seeds have been obtained. The F_1 plants remained free of viral symptoms in a field where cucumbers and squash had high incidence of infection with CMV and WMV2, but their powdery mildew resistance was relatively low.

The cultivated *C. ficifolia* was hybridized directly, through embryo culture, with 3 other cultivated species: *C. pepo*, *C. moschata*, and *C. maxima*. All F_1 plants were characterized by high male and female sterility. The backcross of *C. ficifolia* x *C. pepo* to *C. pepo* yielded 5 male- and 5 female-sterile plants.

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Cucurbit Genetics Cooperative Report 6:94-95 (article 48) 1983

Mentor Pollen in an Interspecific Cross in *Cucumis*: Effects of Irradiation Dose and of Order of Application of the Two Types of Pollen

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In recent years we regularly used irradiated mentor pollen (IMP) as a pollination aid in interspecific hybridization in *Cucumis*. When the control cross fully failed, the IMP-technique resulted in a high percentage of fruit set, but the number of hybrid embryos in those fruits was generally low (2, 3). Under conditions permitting regular fruit set and embryo development, the IMP-technique still increased fruit set, but strongly decreased the number of embryos (1). In *Populus* the low hybrid seed yield in IMP-aided crosses was interpreted as due to competition of the IMP with the fresh foreign pollen for the available ovules (4). This could also be the reason for our low hybrid embryo yield. We routinely used mentor pollen irradiated with 1 kGy (100 krad), and we always applied the IMP first and the foreign pollen directly thereafter. In an effort to decrease the competitive fertilizing ability of the IMP, we compared mentor pollen irradiated with different doses and we studies the effect of the order in which IMP and paternal pollen were applied.

The cross *Cucumis metuliferus* Naud. (Gene bank no. (Gbn) 0164) x *C. zeyheri* 2x Sond., a selected clone of Gbn 0181 (5) was chosen for the experiment. The same cross was used before in studies on the efficacy of pollination aids (1, 2). Plants were grown in 25 1 plastic containers with Trio peat soil in an insect-proof glasshouse in the summer of 1982. Irradiation of the pollen was conducted as described earlier (3) and this pollen was used within 3 hrs after irradiation. All pollinations were made during the period from June 22 till July 7. All treatments (see Table 1) were carried out on two dates, except those with 3 kGy pollen. Fruits were weighed and dissected to check for ovules with embryos, starting three months after harvest.

Table 1. Effects of irradiation does of mentor pollen and of the order of application of the two types of pollen in the cross *Cucumis metuliferus* Naud. (M) x *C. zeyheri* 2x Sond. (Z).

Treatment	No. of pollinations	No. of fruit set	Average fruit weight (g)	Percentage of fruits with embryos	No. of embryos in the fruits containing embryos
M x Z	10	0	-	-	-
M x 0 kGy M	3	3	147	100	111, 335, 370
M x 1 kGy M	13	12	86	0	-
M x 2 kGy M	9	9	70	0	-
M x 3 kGy M	5	5	46	0	-
M x (0 kGy M + Z)	3	3	146	100	120, 325, 471
M x (1 kGy M + Z)	10	10	99	20	2, 2
M x (2 kGy M + Z)	9	7	82	71	1, 1, 1, 2, 19
M x (3 kGy M + Z)	5	4	41	100	1, 1, 3, 8

M x (Z + 0 kGy M)	6	5	137	100	110, 216, 225, 299, 315
M x (Z + 1 kGy M)	11	11	95	36	1, 3, 3, 9
M x (Z + 2 kGy M)	10	9	76	67	1, 4, 5, 8, 10, 17
M x (Z + 3 kGy M)	5	3	33	67	5, 30

The results are in Table 1. The failure of fruit to set in the control cross likely was caused by bright and warm weather during the pollination period. Earlier we found successful fruit set only under cool weather conditions (1). The average fruit weight decreased with increasing irradiation dose of the IMP. The same trend was observed for the number of developed ovules (260, 100, 70, and 40 ovules per fruit at 0, 1, 2, and 3 kGy, respectively). All fruits of the control self-pollination contained embryos, but no embryos developed after pollination with IMP only., With double pollinations, all fruits contained many embryos when fresh self pollen was used. All these embryos likely originated from selfing. The percentage of fruits with embryos was very low after double pollinations with 1 kGy IMP, but increased with higher irradiation dose. All these fruits contained few embryos, which should all be hybrids according to our earlier experience (2). The number of embryos after double pollination with IMP increased slightly with higher irradiation dose. Contrary to expected, the higher irradiation dose did not seem to decrease the competitive ability of the IMP. However, in view of the reduced fruit weight and number of ovules at higher irradiation dose, we believe that the competitive ability had in fact decreased but the effect of this decrease was counteracted by the reduced capacity of the IMP to perform certain functions in fruit growth. The number of embryos in the double pollination with IMP was slightly higher when the paternal pollen was applied prior to the IMP than in the reverse order. An explanation for this may be that pollen which is applied first very likely occupies the best sites of the stigmatic surface. This pollen may also have a numerical advantage over the pollen which is applied later. In the double pollinations with fresh self pollen, the reverse was found, supporting the conclusions that these embryos all resulted from selfing.

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Cucurbit Genetics Cooperative Report 6:96-98 (article 49) 1983

An Efficient Procedure to Screen for Resistance to Root Knot Nematodes in Cucurbits

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Screening for resistance to root knot nematodes is normally carried out in nematode-infested soil. Seeds, seedlings or young plants are placed in the infested soil and, after several weeks to months, root knot development and/or number of egg masses are observed on the rootball or on roots washed free of soil. We have used this method for testing accessions of wild species of *Cucumis*, melons and cucumbers for resistance to *Meloidogyne incognita* Chitw. However, we found it time-consuming and, due to loss of roots during washing, not very accurate. Besides it required much glasshouse space, the more so since intervening crops of tomato appeared necessary to keep the infestation level of the soil up to standard. We therefore welcomed the opportunity to adapt for use with root knot nematodes an efficient mass screening method for resistance to sugar beet nematodes developed by Lubbers and Toxopeus (1).

Pregerminated seeds are sown in 36 ml PVC tubes open at both ends and filled with silver sand moistened with nutrient solution. The tubes are arranged in asbestos containers, which are kept in a growth cabinet at 24°C, 70% RH and 10 hr days ca. 30 W/m^2 light intensity. In this environment the plants form a miniature vine with very small leaves with a reasonably normal root system. In this way we can test up to 2700 plants on 1 m^2 in about 5 weeks. The inoculum is prepared by shortly grinding galled cucumber or tomato roots containing mature egg masses in a blender and depositing the suspension on a nematode filter with tap water. Very large numbers of active larvae can easily be gathered in a few days. The prehatched larvae can be stored for some time in a refrigerator. Before inoculation the suspension is diluted to the desired concentration. Preliminary tests pointed to 50 larvae per plant as the best concentration in our system. Thus far we have mainly used one well-defined Dutch population of *M. incognita* for inoculum.

Seedlings are inoculated, as soon as the cotyledons have expanded, by injecting 1 ml of suspension into the top 2 cm of each tube with a veterinary syringe. Delaying the inoculation yielded root systems with only root knots in the lower part, illustrating the insensitivity of grown roots to infection. After 4–5 weeks, plants are carefully removed from the tubes, put on a screen, and the sand is simply rinsed off the roots with tap water. The plants are best examined on the screen, immersed in water, against a black background. Well-developed root knots are frequent on susceptible checks, containing egg masses which are visible to the naked eye. No secondary infection is evident at this time.

The repeatability of the results obtained with this procedure is illustrated by the mean number of rootgalls per plant of several representative accessions which were tested 3 times (Table 1). Each population was usually tested in 3 randomized replicates of 8 plants. Accessions behaved fairly consistently, but a large variation in number of galls occurred within many accessions. Resistant species not only possessed few galls, but these were small and only rarely contained egg masses.

Table 1. Mean number of root galls per plant of several species of *Cucumis*.

		Root galls per plant in 3 screening tests		
Species	**Accession**	**81-1**	**82-1**	**82-3**
C. anguria L.	1761	19	17	17
C. ficifolius A. Rich	1729	13	7	9
C. metuliferus Naud.	1768	8	4	8
	1822	2	2	2
	1994	9	5	2

C. prophetarum L.	1752	13	6	5
	2016	6	4	2
C. zeyheri Sond. 2x	0181	5	4	4
C. zeyheri Sond. 4x	1807	13	8	11
C. sativus L.	1745	20	17	28
(primitive)	1759	14	23	16

None of over 70 cucumber cvs. tested so far exhibited appreciable resistance. Cucumber cv. Sakata Kohaifushinari from Japan was reported as having 24% (2) or 4% (3) resistant plants. In our tests the numbers of galls of 140 plants of this cv. averaged 22, and that of the susceptible check cv. G6, 24. The percentage of plants with less than 5 galls were 1 and 3, and with less than 10 galls were 7 and 14, respectively, for the two cultivars. Our nematode population may differ from that used by Udalova.

In conclusion, the described method appears to be efficient in space and time (ca. 10 work days per test of 2700 plants). The reliability of the results derives in part from the uniform inoculum and the minimal damage to the roots for observation.

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Cucurbit Genetics Cooperative Report 6:99 (article 50) 1983

The Occurrence of Zucchini Yellow Mosaic Virus in the United States

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A new viral disease occurred in 1982 in a field of 'Multipik', a cultivar of yellow summer squash *(Cucurbita pepo)* situated near Warehouse Point, Connecticut. Plants were severely affected by a prominent foliar yellow mosaic, distortion, necrosis and stunting. Fruits were small, malformed, and green mottled.

Electron microscopy of leaf extracts revealed the presence of long flexuous virus particles similar in size to those usually associated with infection of watermelon mosaic virus 1 (WMV-1) or watermelon mosaic virus 2 (WMV-2) in the Northeast (3). However, serological tests with antisera to these two viruses were negative. This new virus strongly reacted with an antiserum to zucchini yellow mosaic virus (ZYMV), kindly supplied by Vittoria Lisa, of the Instituto di Fitovirologia Applicata, of Turin, Italy.

The American isolate of ZYMV incited similar symptoms in cultivars of *C. pepo*, *C. maxima*, *C. moschata*, *Cucumis sativus*, *C. melo*, *Citrullus lanatus*, *Lagenaria siceraria* and other cultivated and wild cucurbit species to those described for ZYMV in Italy (1) and for muskmelon yellow stunt virus (MYSV) in France (2).

This virus, which appears to be present in other European, North African and Middle Eastern countries, is very destructive and poses a new challenge to plant pathologists and cucurbit breeders of four continents.

None of the genes for resistance to WMV-1 or WMV-2 appear to be able to control this virus, thus an extensive search is under way for sources of resistance in cultivated and wild species of the genus *Cucurbita*. *Cucumis* and *Citrullus*. A few sources of resistance have already been found.

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Cucurbit Genetics Cooperative Report 6:100-101 (article 51) 1983

Variation for Interspecific Crossability of *Cucumis anguria* L. and *C. zeyheri* Sond.

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Cucumis anguria L. and *C. zeyheri* Sond. are both resistant to cucumber green mottle mosaic virus, a serious disease of glasshouse cucumbers. The resistance of *C. anguria* is due to a single dominant gene, *Cgm* (3), but the inheritance in *C. zeyheri* is as yet uncertain. Crosses between both species were made to find out if the resistances are genetically identical.

Although pollen tubes of *C. zeyheri* 2x penetrate into the ovules of *C. anguria* (2) and fruits set, no viable seeds were obtained (1, 2). The reciprocal cross (*C. zeyheri* 2x x *C. anguria*) yielded viable seeds, and F_1 plants were reported by Dane, et al (1). We also obtained viable seeds, but the F_1 plants died (4). Differences in occurrence of seedling death appeared to depend on the combination of accessions of both species. Therefore, more crosses were made involving 8 accessions of *C. anguria* (4 of which belong to var. *longipes* A. Meeuse), and 6 accessions of *C. zeyheri* (5 diploid, and one tetraploid). The latter species has erroneously been referred to as *C. africanus* L.f. in earlier reports (5). Five plants per accessions were cultivated and pollinated in an insect-proof glasshouse in the summer of 1981. Progenies were screened for occurrence of seedling death in 1982.

C. anguria and *C. anguria* var. *longipes* gave different results in the crosses with *C. zeyheri* 2x. In the combination *C. anguria* x *C. zeyheri* 2x, none out of 216 seeds from 6 fruits (10% fruit set) germinated. Fruit set was generally high in the reciprocal cross and many seeds were obtained, but seedling death. of the F_1 plants prevailed. One exceptional accession of *C. zeyheri*, however, yielded in combination with 3 out of 4 accessions of *C. anguria* a small number of weak seedlings which developed into fairly fertile hybrids (Table 1).

Table 1. Percentage of fruit set following pollinations of *C. zeyheri* by *C. anguria* and *C. anguria* var. *longipes*, and occurrence of seedling death in the F_1 (5 pollinations per cross).

Ploidy of Female Parent *(C. zeyheri)*		**Male Parent**							
		C. anguria				***C. anguria* var. *longipes***			
	Gbn	0307	0310	1970	2067	0198	1784	1736	1827
2x	0162	100 D	80 D	60 D	60 D	80 D	20 D	100 +	20 +
	0181	80 D	100 D	100 D	60 D	100 D	60 D	60 +	20 +
	0330	80 D	40 D	0	0	60 D	20 D	100 D	40 +
	2065	100 D	60 D	100 +	60	100 D	100 D	60 +	60 +
	1787	20 +	30 +	70 S	60 +	0	0	0	0
4x	1457	20 +	100 +	80 +	100 +	80 +	40 +	100 +	100 +

S = no germination; D = seedling death of F_1 plants; + = normal F_1 plants.
Note: Gbn (Gene bank no.) 0307 = PI 196477; 0310 = PI 233646; 1787 = PI 299569; 1457 = PI 299570.

The crosses of *C. anguria* var. *longipes* x *C. zeyheri* 2x yielded 7 fruits with 182 seeds out of 135 pollinations. Seed of only one combination of accessions germinated and gave rise to weak, sparingly fertile hybrids. The reciprocal combinations were more successful; 2 of the 4 accessions of *C. anguria* var. *longipes* produced many vigorous and fertile hybrids with all but one of the accessions of *C. zeyheri* 2x. All hybrids made with the other two accessions exhibited seedling death. The behavior of *C. zeyheri* Gbn. 1787 in this combination is also remarkably different. It distinguishes *C. anguria* from *C. anguria* var. *longipes* (Table 1).

All diploid haploids were characterized by fully intermediate fruit shape. Fruits of both reciprocal crosses of *C. anguria* var. *longipes* and *C. zeyheri*, were indistinguishable.

The cross *C. zeyheri* 4x x *C. anguria* and *C. anguria* var. *longipes* yielded many vigorous, but sterile, F_1 plants. The reciprocal cross, with the tetraploid species as pollen parent, gave 2 fruits out of 25 pollinations, and several sterile hybrids were raised.

We conclude that there is sufficient variation within *C. anguria* (notably in var. *longipes*) and within *C. zeyheri* 2x to overcome the crossability barrier between the two species. Analysis of the inheritance of the virus-resistance is in progress.

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Cucurbit Genetics Cooperative Report 6:102 (article 52) 1983

Special Invitation

National Muskmelon Research Group - Statement of Purpose and Invitation to Cooperate

Muskmelon research and breeding during the last 60 years have produced numerous sources of disease and insect resistance. Relatively few of these have been used in commercially grown cultivars. The National Muskmelon Research Group (NMRG) was formed in 1978 with the goal of combining these sources of pest resistance into populations which would serve as sources of germplasm for breeding programs.

Two populations were formed initially: the domestic source nursery (DSN) formed from horticulturally acceptable resistant lines; and the exotic source nursery (ESN) formed from crosses of resistant plant introductions and lines from the DSN.

Lines chosen for the DSN were selectively and sequentially cross pollinated yearly from 1979–1981 to maximize recombination of complementary resistance genes. To assess progress in recombination of resistance genes, crosses made in 1979, 1980, and 1981 DSN were evaluated for resistance to powdery mildew, downy mildew, fusarium wilt, gummy stem blight, watermelon mosaic virus, bacterial wilt, melon aphid, pickleworm, striped cucumber beetle and sulfur. In the absence of selection, numerous lines have been found with resistance to powdery mildew and fusarium wilt. DSN lines were selected for population improvement via mass selection and recurrent selection.

The ESN will be selectively and sequentially cross pollinated during the next four years with the objective of recombining exotic resistant genes with those resistant genes in horticulturally acceptable lines.

There are currently 25 horticulturists, pathologists, breeders, entomologists, and a chemist and a statistician in 10 states with nearly equal representation of State and Federal agencies in the NMRG. The group meets yearly to review results and plan for the following year. Membership in the NMRG is open to scientists involved in developing pest resistant muskmelon cultivars.

For further information contact P. E. Nugent, G. L. Reed or J. D. McCreight

Cucurbit Genetics Cooperative Report 6:103-106 (article 53) 1983

Covenant and By-Laws of the Cucurbit Genetics Cooperative

ARTICLE I. Organization and Purposes

The Cucurbit Genetics Cooperative is an informal, unincorporated scientific society (hereinafter designated "CGC") organized without capital stock and intended not for business or profit but for the advancement of science and education in the field of genetics of cucurbits (Family: Cucurbitaceae). Its purposes include the following: to serve as a clearing house for scientists of the world interested in the genetics and breeding of cucurbits, to serve as a medium of exchange for information and materials of mutual interest, to assist in the publication of studies in the aforementioned field, and to accept and administer funds for the purposes indicated.

ARTICLE II. Membership and Dues

The membership of the CGC shall consist solely of active members; an active member is defined as any person who is actively interested in genetics and breeding of cucurbits and who pays biennial dues. Memberships are arranged by correspondence with the Chairman of the Coordinating Committee.

The amount of biennial dues shall be proposed by the Coordinating Committee and fixed, subject to approval at the Annual Meeting of the CGC. The amount of biennial dues shall remain constant until such time that the Coordinating Committee estimates that a change is necessary in order to compensate for a fund balance deemed excessive or inadequate to meet costs of the CGC.

Members who fail to pay their current biennial dues within the first six months of the biennium are dropped from active membership. Such members may be reinstated upon payment of the respective dues.

ARTICLE III. Committees

1. The Coordinating Committee shall govern policies and activities of the CGC. It shall consist of six members elected in order to represent areas of interest and importance in the field. The Coordinating Committee shall select its Chairman, who shall serve as a spokesman of the CGC, as well as its Secretary and Treasurer.
2. The Gene List Committee, consisting of five members, shall be responsible for formulating rules regulating the naming and symbolizing of genes, chromosomal alterations, or other hereditary modifications of the cucurbits. It shall record all newly reported mutations and periodically report lists of them in the Report of the CGC. It shall keep a record of all information pertaining to cucurbit linkages and periodically issue revised linkage maps in the Report of the CGC. Each committee member shall be responsible for genes and linkages of one of the following groups: cucumber, *Cucurbita*sp., muskmelon, watermelon, and other genera and species.
3. Other committees may be selected by the Coordinating Committee as the need for fulfilling other functions arises.

ARTICLE IV. Election and Appointment of Committees

1. The Chairman will serve an indefinite term while other members of the Coordinating Committee shall be elected for ten-year terms, replacement of a single retiring member taking place every other year. Election of a new member shall take place as follows: A Nominating Committee of three members shall be appointed by the Coordinating Committee. The aforesaid Nominating Committee shall nominate candidates for an anticipated opening on the Coordinating Committee, the number of nominees being at their discretion. The nominations shall be announced and election held by open-ballot at the Annual Meeting of the CGC. The nominee receiving the highest number of votes shall be declared elected. The newly elected member shall take office immediately.

In the event of death or retirement of a member of the Coordinating Committee before the expiration of his/her term, he/she shall be replaced by an appointee of the Coordinating Committee.

Members of other committees shall be appointed by the Coordinating Committee.

ARTICLE V. Publications

1. One of the primary functions of the CGC shall be to issue an Annual Report each year. The Annual Report shall contain sections in which research results and information concerning the exchange of stocks can be published. It shall also contain the annual financial statement. Revised membership lists and other useful information shall be issued periodically. The Editor shall be appointed by the Coordinating Committee and shall retain office for as many years as the Coordinating Committee deems appropriate.
2. Payment of biennial dues shall entitle each member to a copy of the Annual Report, newsletters, and any other duplicated information intended for distribution to the membership. The aforementioned publications shall not be sent to members who are in arrears in the payment of dues. Back numbers of the Annual Report, available indefinitely, shall be sold to active members at a rate determined by the Coordinating Committee.

ARTICLE VI. Meetings

An Annual Meeting shall be held at such time and place as determined by the Coordinating Committee. Members shall be notified of time and place of meetings by notices in the Annual Report or by notices mailed not less than one month prior to the meeting. A financial report and information on enrollment of members shall be presented at the Annual Meeting. Other business of the Annual Meeting may include topics of agenda selected by the Coordinating Committee or any items that members may wish to present.

ARTICLE VII. Fiscal Year

The fiscal year of the CGC shall end on December 31.

ARTICLE VIII. Amendments

These By-Laws may be amended by simple majority of members voting by mail ballot, provided a copy of the proposed amendments has been mailed to all the active members of the CGC at least one month previous to the balloting deadline.

ARTICLE IX. General Prohibitions

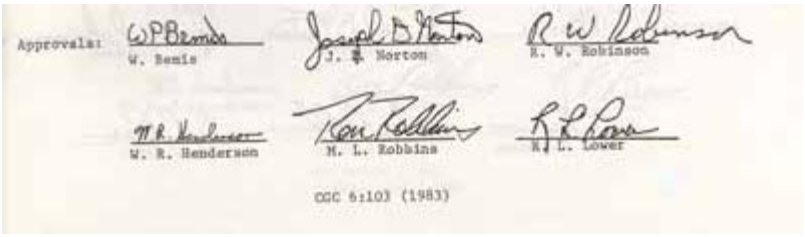
Notwithstanding any provision of the By-Laws or any other document that might be susceptible to a contrary interpretation:

1. The CGC shall be organized and operated exclusively for scientific and educational purposes.
2. No part of the net earnings of the CGC shall or may under any circumstances inure to the benefit of any individual.
3. No part of the activities of the CGC shall consist of carrying on propaganda or otherwise attempting to influence legislation of any political unit.
4. The CGC shall not participate in, or intervene in (including the publishing or distribution of statements), any political campaign on behalf of a candidate for public office.
5. The CGC shall not be organized or operated for profit.
6. The CGC shall not:
    a. lend any part of its income or corpus without the receipt of adequate security and a reasonable rate of interest to;
    b. pay any compensation in excess of a reasonable allowance for salaries or other compensation for personal services rendered to;
    c. make any part of its services available on a preferential basis to;
    d. make any purchase of securities or any other property, for more than adequate consideration in money's worth from;
    e. sell any securities or other property for less than adequate consideration in money or money's worth; or
    f. engage in any other transactions which result in a substantial diversion of income or corpus to any officer, member of the
    Coordinating Committee, or substantial contributor to the CGC.

The prohibitions contained in this subsection (6) do not mean to imply that the CGC may make such loans, payments, sales, or purchases to anyone else, unless authority be given or implied by other provisions of the By-laws.

ARTICLE X. Distribution on Dissolution

Upon dissolution of the CGC, the Coordinating Committee shall distribute the assets and accrued income to one or more scientific organizations as determined by the Committee, but which organization or organizations shall meet the limitations prescribed in sections 1-6 of Article IX.



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Cucurbit Genetics Cooperative Report 6:107-115 (article 54) 1983

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- **Muskmelon**
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- **Watermelon**
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- **Cucurbita spp.:**
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- **Other Genera:**
  - R.W. Robinson, Department of Seed and Vegetable Sciences
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In order to prevent using the same symbol for two different genes, researchers are urged to consult the previous gene lists before publishing a symbol for a new gene. Any questions concerning correct gene nomenclature may be directed to the gene list committee.

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