

Cucurbit Genetics Cooperative

No. 6 June, 1983

Department of Horticulture
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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 Horticulturists, 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 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.

Further, 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 Germ Plasm 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	Journal of Economic Entomology
Euphytica	Journal of Heredity
HortScience	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

<u>Subscriber</u>	<u>Dues Biennial Membership</u>	<u>Back Issue Fee</u>
U. S.	\$ 6.00	\$3.50
Libraries	10.00	6.00
Foreign	10.00	6.00

REPORT OF SIXTH ANNUAL MEETING

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 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.

J. D. McCreight

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. Juvick (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. Juvick 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.

Source	df	Mean Squares		
		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.

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I. CUCUMBER

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

Delaney, D. E., R. L. Lower and M. D. Edwards, University of Wisconsin, Madison, WI 53706

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 GY14, 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 GY14 at all within row spacings (Table 1). Significant differences in fruit number per plant were not only found between the hardwickii derivatives and GY14, 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 GY14 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 GY14, 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.

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1. Horst, E. K. 1977. M.S. thesis. Department of Horticultural Science, North Carolina State University.
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.

Table 1. Mean mature fruit numbers per plant for three C. sativus var. hardwickii derivatives and GY14 at five different within row spacings.

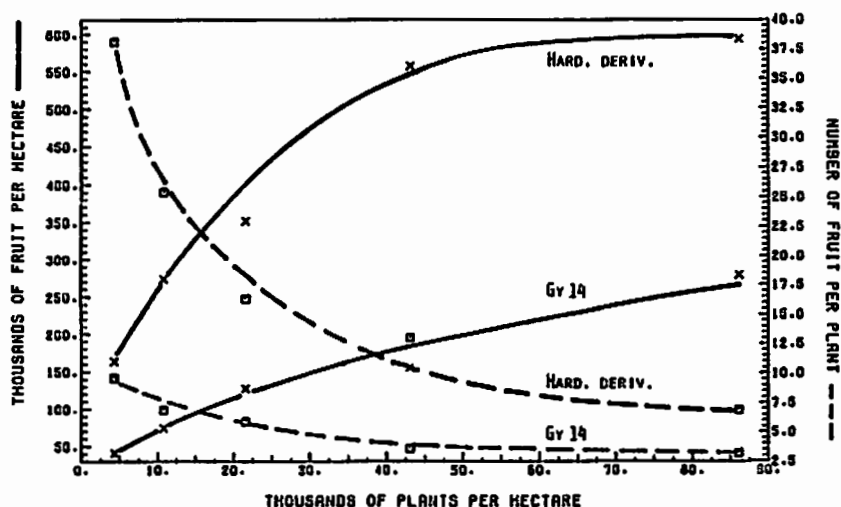
Line	Within Row Spacing				
	8 cm	15 cm	30 cm	61 cm	1.5 m
C. sat. var. hard. #1	8.19c	17.02c	17.25b	27.56b	39.32b
" #2	6.14b	9.24b	14.61b	22.45b	37.96b
" #3	6.37bc	12.54b	17.16b	26.32b	37.04b
GY14	3.24a	3.61a	5.94a	6.92a	9.63a
LSD (.05)	1.85	4.22	3.55	5.89	9.31

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
Lines	3	1298.2**
Within row spacings	4	1907.4**
Lines x within row spacings	12	123.8**
Error	80	17.9

**Significant at the 0.01 level.

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



2. Effect of Inbreeding on Seed Traits of Compact Cucumber

Edwards, M. D. and R. L. Lower, University of Wisconsin, Madison, WI 53706.

Previous reports have described seed quality problems associated with the compact plant type (cpcp) 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.

F₁ and F₂ seedlots 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 cpcp plants, all seedlots were produced on Cpcp plants which segregated cpcp individuals among the progeny. Parental, F₁ and F₂ 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 F₁ and F₂ generation values for seed weight exceeded the mid-parent value in all seven crosses. F₁ 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.

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.

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 (C.V.) 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 F₁ hybrids in this study is considerably poorer than values obtained for seedlots 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.

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
F₁'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
F₂'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.

Figure 1. EFFECT OF LEVEL OF INBREEDING ON SEED WEIGHT

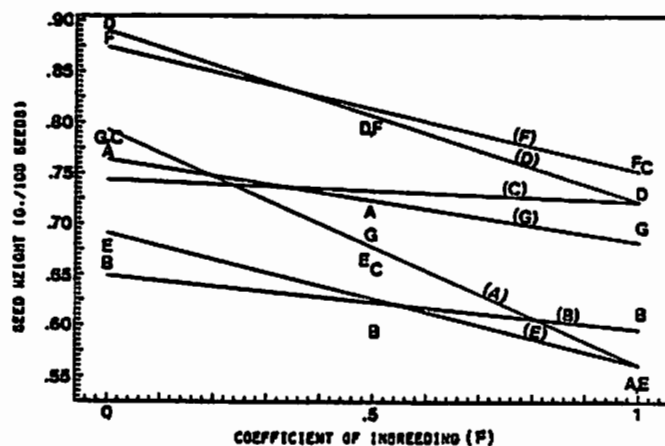
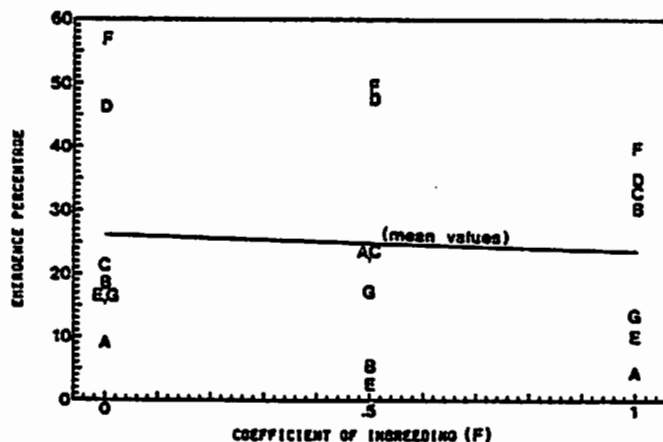


Fig. 2. EFFECT OF LEVEL OF INBREEDING ON EMERGENCE PERCENTAGE



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

El Jack, Ali and Henry M. Munger, Cornell University, Ithaca, NY 14853.

In cucumber, nearly all crosses of powdery mildew resistant (PMR) x susceptible parents yield fully susceptible F₁'s. In a backcross program to transfer PMR from 'Spartan Salad' to 'Marketmore 70', Munger observed one F₁ 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 F₁ with uniformly low-intermediate PMR about equivalent to 'Tablegreen 65', while several others gave segregating F₁ progenies. He also found that PI 197088 produced a similar F₁ 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 F₁ 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 BC₃. In the F₂ of the BC₃ several plants with high-intermediate and high resistance were tested by crossing with 'Marketmore 70' and 'Tablegreen 65'.

Only the F₂ parents with high resistance produced F₁ 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 F₃ 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 F₁'s than previous PMR parents.

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4. Intermediary Inheritance of Glabrousness (gl) in Cucumber

Inggamer, H. and O.M.B. de Ponti, Institute for Horticultural Plant Breeding, P.O.B. 16, 6700 AA Wageningen, The Netherlands

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 (G1gl) 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 mm² 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 G1G1 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 mm² 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)	<u>G1G1</u>	3	42	41 - 44
B _{1.1A}	<u>G1G1</u>	5	45	39 - 49
	<u>G1g1</u>	5	23	18 - 29
B _{1.1B}	<u>G1G1</u>	5	47	39 - 51
	<u>G1g1</u>	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.
2. Inggamer, H. and O.M.B. de Ponti. 1980. The identity of genes for glabrousness in Cucumis sativus L. Cucurbit Genetics Coop. Rpt. 3:14.

5. A System for the Measurement of Foliar Diseases of Cucumber

Jenkins, S. F., Jr. and T. C. Wehner, North Carolina State University, Raleigh, NC 27650

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	<u>Colletotrichum lagenarium</u>
Angular leaf spot	<u>Pseudomonas lachrymans</u>
Downy mildew	<u>Pseudoperonospora cubensis</u>
Powdery mildew	<u>Erysiphe cichoracearum</u>
Scab	<u>Cladosporium cucumerinum</u>
Cucumber mosaic	Cucumber mosaic virus
Target spot	<u>Corynespora cassicola</u>
Gummy stem blight	<u>Didymella bryoniae</u>
Alternaria leaf spot	<u>Alternaria cucumerinum</u>
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.

Horsfall-Barratt Score	Redman et al. Score	% Disease	Mean % Conversion ^z	Jenkins-Wehner Method		
				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	-	-	-

^zConversion factor is used to convert the score to percent foliage damage.

^yVerbal 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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6. 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- γ source. That monogenic recessive mutant was found to be allelic to a similar mutant described by Robinson and Shail (4) as the F₁ 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 lh gene because they segregated independently from that gene in F₂ 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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7. 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 cassicola 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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8. 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-C₃ (hardwickii semi-exotic, cycle 3) and GS-C₃ (gynoecious synthetic, cycle 3), resulted from three cycles of S₁ selection (5).

Average fruit yield of 106 S₀ x S₀ (HSE-C₃ X GS-C₃) 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-S₁ and GS-S₁) 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.

	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	.89		

N.B. Number in parentheses indicates the number of crosses included in each average.

^a Selection intensity = 20%.

^b Check hybrids included three monoecious cultivars (Clinton, Liberty, and Wisc. SMR 18) and three F₁ gynoecious hybrids (Calico, Calypso, and Southern Belle).

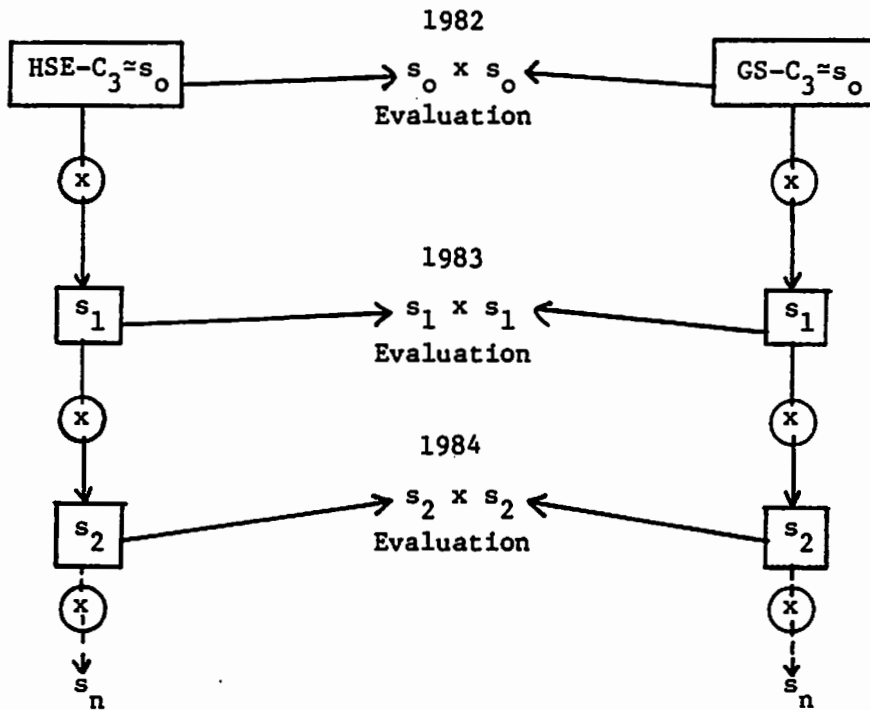


Figure 1. Outline of Full-sib Families Selection.

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9. 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) 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.

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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 gynococious F₁ hybrids (Calypso, Calico, and Southern Belle) and three monoecious cultivars (Clinton, Liberty and Wisc. SGR 18).

10. 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 gynocious standard line G6 (G1) (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 G1 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.

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

A. <u>glgl</u> x (2 <u>G1</u> + 1 <u>gl</u>)			
Fruit segment	Fruit locule / pollinated with		
	I / <u>G1</u>	II / <u>G1</u>	III / <u>gl</u>
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. <u>glgl</u> x (2 <u>gl</u> + 1 <u>G1</u>)			
Fruit segment	Fruit locule / pollinated with		
	I / <u>gl</u>	II / <u>gl</u>	III / <u>G1</u>
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)

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.

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11. 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.

Table 1. Recombination percentage (%), size of F₂-populations for linkage tests (N), and calculated chi-square ratios for the 9:3:3:1 ratios (X²) for four pairs of genes.

Gene pair	%	N	X ²
<u>dv1</u> / <u>gl</u>	40	247	9.13*
<u>dv1</u> / <u>bi</u>	50	249	3.62
<u>dv1</u> / <u>Ccu</u>	46	223	6.56*
<u>gl</u> / <u>bi</u>	44	330	4.85

*Significant at P = 0.05

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.

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12. 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 F₂-populations, along with the reciprocal F₁'s and the sensitive and non-sensitive 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.

Generation	1981		1982		Ratio- Normal: Sensitive	X ² for 3:1
	Normal	Sensitive	Normal	Sensitive		
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}

13. Variation of Galactinol Synthase Activity in Cucumber Leaves

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



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', PI228238, 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.

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 by screening large populations.

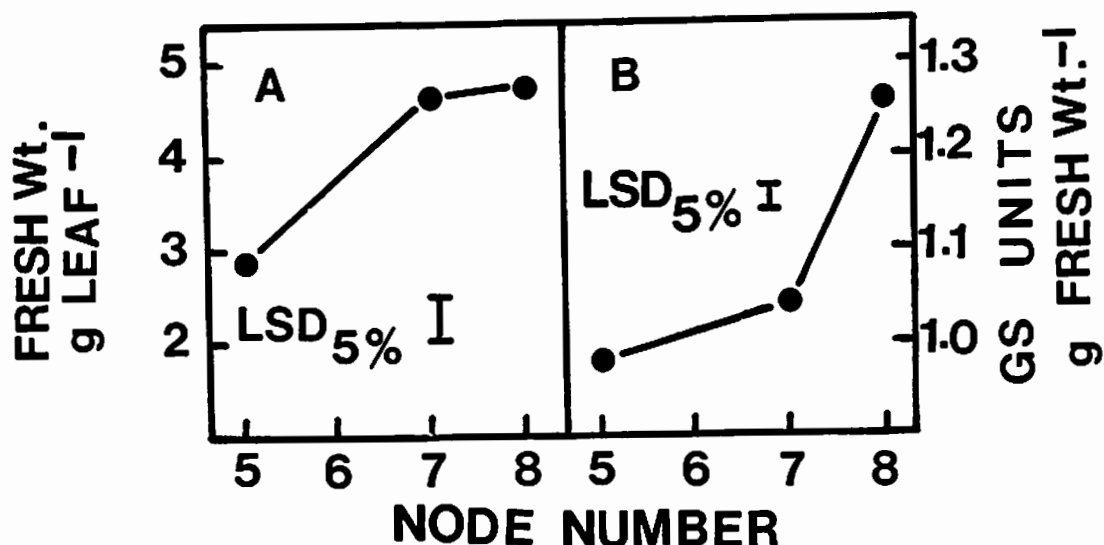


Figure 1. (A) Fresh weight of leaves from nodes 5, 7 and 8. (B) GS activity in leaves from 5, 7 and 8. Data are means of 3 replications and 5 lines of Cucumis sativus.

Table 1. Cucumis sativus lines in order by mean galactinol synthase (GS) activity in their leaf blades.²

Cultivar or Line	GS Activity ^y Units (grams fresh weight) ⁻¹
Windermoor Wonder	1.23
PI 233238	1.22
LJ 90430	1.07
Calypso	1.06
Sumter	0.90

LSD (10%) = 0.22

²Data are means over 3 node positions and 3 replications of 2 subsamples each. There was no line x node interaction.

^yA unit is that amount of enzyme which forms 1 mol of galactinol min⁻¹ at 30°C.

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14. 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).

Cultivar or line	Bitterness	Damage Rating		
		The Netherlands 1981	1982	USA 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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15. 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 cm² 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/m² (1 grain/in.²) of surface soil, was used for the 1981 study. All other studies used a rate of 3200 grains/m². 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.

Rank	Cultivar or Line	Origin	Percent of fruit surface infected in 3 separate tests			Fruit type ^z	Spine Color ^y
			Lab 1981	Lab 1982	Field 1982		
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
<u>LSD (5%)</u>			-	7.2	8.9		
<u>X (all lines)</u>			-	3.1	3.3		
<u>CV (%)</u>			-	11.5	12.6		

^zFruit type: P = pickle, S = slicer.

^ySpine 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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16. 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, Robinsin (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.

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.

C. sativus tissue

Enzyme	Abbreviation	Seed			Coty- ledons	
		Fruit	Sprouted	Imbibed	Green	Etoliated
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
Glutamic 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
Manitol 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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17. 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 cm², 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		Prefer- ence Test ^y	Line Class- ification ^x
			Clinton	Charleston		
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

^zLeaf damage scored 1 to 9 (1 = no damage, 9 = leaf tissue between veins completely eaten).

^yPercent of larvae on test line (remainder are on the check cultivar, Columbia).

^xR = resistant, S = susceptible.

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18. 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 <26 mm, 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.²

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
	Calypso	2118 ^{ns}	506 ^{ns}	557 ^{ns}	1073 ^{ns}	1444 ^{ns}	1803 ^{ns}	1929 ^{ns}
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
X̄ (all treatments)		2104	454	455	909	1323	1737	1858
CV (%)		11	13	15	14	12	11	10

²Vine 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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RESEARCH NOTES

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

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In the early 50's, Michelbacher *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 fruits (harvested over several dates) per plot were evaluated; the \bar{X} number of fruits 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 \bar{X} rating of 4.89; the most damaged was PI 222187 with a \bar{X} 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 \bar{X} of 46.06, followed by 'Topmark', 'Perlita', 'PMR5', 'PMR45', 'Gulfstream'. The least damaged was 17013 with a \bar{X} 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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20. 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.

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.

Table 1. Disease reaction ratings of 11 muskmelon entries.²

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		

²LSD 5% = 1.17

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21: A Long Internode Mutant in Muskmelon

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Abnormally long veined plants occurred in 7 of 10 F₂ 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 ($\chi^2=0.6095$, $P=0.3-0.5$). 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 ($\chi^2=0.2133$, $P=0.5-0.7$). 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.

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.

Table 1. Mean internode lengths (cm) of normal and long internode segregates of progeny 48763 at 30 days after planting.²

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

²Significant differences within columns at the $t_{0.005}$ (*) and $t_{0.001}$ (**) levels.

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22. 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 F₂ progenies scored in the greenhouse segregated 176 fertile:56 male sterile, a close fit to the expected 3:1 monogenic ratio ($\chi^2 = 0.0919$, $P = 0.80-0.90$). Three testcross families segregated 100 fertile:76 male sterile, a loose fit to the expected 1:1 ratio ($\chi^2 = 3.2727$, $P = 0.05-0.10$).

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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23. 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.

Generation	Phenotype				Single Factor χ^2		Linkage χ^2
	Normal		Yellow green		\underline{r}	$\underline{y\bar{g}}$	
	Normal	Red stem	Normal	Red stem			
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 $\chi^2=0.2760$ which confirmed the F_2 data. Thus, these two loci are not linked.

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24. 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 F₂ families segregated 559 green, fertile:195 green, male sterile:221 red stem, fertile:2 red stem, male sterile, X²=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				Single Factor X ²		Linkage X ²
	Normal		red stem		r	ms-1	
	male fertile	male sterile	male fertile	male sterile			
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 X²=711.5384 which strongly supported the F₂ data. The recombination fraction, p (2) between these loci was 0.2556±0.0081.

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25. 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 F₁ hybrids of PI 125861 and breeding line 61090, F₁ 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 F₁ 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.

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

^zWilting 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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26. An Improved Method of BA Application for the Promotion of Fruit Set in Muskmelon

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The artificial cytokinin N⁶-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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27. 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.

F₂ 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 F₂ 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-1¹ from PI 180280, Wmv-1² from PI 180283, and Wmv-1⁺ (susceptible). The order of dominance is Wmv-1¹ > Wmv-1² > Wmv-1⁺.

From a practical point of view, Wmv-1¹ should be used instead of Wmv-1² which conditions for top necrosis and death of the plants with isolates such as E2 or E115.

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Table 1. Segregation in F₂ progenies after inoculation of E2 strain of Watermelon Mosaic Virus 1.

F ₂ Progeny	Test	Number of plants with the same symptoms as:			X ² (3:1)	Probability (%)
		72025	B66-5	Charentais		
(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

28. Chiasma Frequency in Different Sex Forms of Muskmelon

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The pairing behaviour 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 gynomoecious, 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 gynomoecious, 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.

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Table 1. Chiasma frequency in sex forms of muskmelon.

Variety	Sex ^z form	Number of bivalents per PMC				Chiasmata per PMC			Chiasmata per bivalent
		Ring		Rod		Mean	±	SE	
		Range	Mean	Range	Mean				
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 (<i>C. melo</i> var. <i>utilissimus</i>)	M	8-12	9.60	0-4	2.40	21.92	0.21	1.83	
Phut (<i>C. melo</i> var. <i>momordica</i>)	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	

^zAM = andromonoecious; H = hermaphrodite; M = monoecious; GM = gynomonoecious; G = gynoecious; A = androecious.

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29. 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 disinfested 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 subcultures
<u>Seeds</u>				
Oliver's Pearl Cluster	10	1	2.2 X	4 X
Takii's Honey	10	2	2.5 X	4 X
<u>Shoot tips</u>				
Harper Hybrid	85	1	2 X	4 X

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RESEARCH NOTES

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30. 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 Neve 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 Neve 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.

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

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

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

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.

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31. 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.

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.

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

<u>Biotype</u>	<u>Days after Inoculation^{a/}</u>					
	<u>25</u>	<u>31</u>	<u>39</u>	<u>73</u>	<u>81</u>	<u>98</u>
	<u>Dead leaves</u>			<u>Per Cent Defoliation</u>		
189225	1.64	1.64	8.60	41	55	53
271775	0.79	1.54	8.80	44	30	47
271778	1.21	2.29	6.80	48	60	74
271779	1.33	1.64	6.50	39	33	58
299379	1.14	1.21	8.40	36	38	44
C. 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.

<u>Biotype</u>	<u>Per cent Defoliation</u>	<u>Lesions per Fruit (range)</u>	<u>Spores (10⁷)^{a/}</u>
189225	53	3.0 (0-8)	1.43
271775	47	2.5 (0-8)	----
271778	74	15.1 (0-50+)	1.84
271779	58	10.0 (0-50+)	4.34
299379	44	1.4 (0-7)	0.34
C. 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.

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32. 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 F1 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.

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 F1 generation. However, germination was nil for 'R309' as a pollen parent in the F1 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 F1 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 F1, F2 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
<u>R309 x 299379</u>					
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
<u>R309 x New Hampshire Midget</u>					
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
<u>R309 x 189225</u>					
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

CGC 6:65 (1983)

ID	Parents		Seed	
	Female	Male	Plant.	Germ. ^a
<u>299379 x New Hampshire Midget</u>				
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
<u>299379 x 189225</u>				
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
<u>New Hampshire Midget x 189225</u>				
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

^aNumber of seed germinating after 8 days.

33. 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, notably 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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34. The Inheritance of the 'Moon and Stars' Variegation in Citrullus lanatus

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Seed 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 F1 progeny were all spotted, the F2 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, F1, F2, 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
F1	All	None	1:0	0	1.0
F2	130	46	3:1	0.49	0.50-0.75
	51	17	3:1	0.00	>0.99
F1 x ps	54	88	1:1	8.14	0.001-0.01
	77	93	1:1	1.52	0.20-0.30
F1 x 'M&S'	181	0	1:0	0	1.0
ps x F1	84	74	1:1	1.38	0.20-0.30

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35. Overcoming the Silvering Disorder of Cucurbita

Burger, Y., H.S. Paris, H. Nerson, Z. Karchi and M. Edelstein, Division of Vegetable Crops, Agricultural Research Organization, Neve Ya'ar Experiment Station, P. O. Haifa, Israel.

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 seedling 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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36. Effect of Fruit Thinning on Dry Matter Accumulation and Variability in Cucurbita maxima winter squash

Evans, Deborah and Brent Loy, University of New Hampshire, Durham, N. H. 03824

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.

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

	Ave. fruit size (kg.)	Ave. fruit fr. wt. per plant (kg.)	Ave. fruit dry wt. per plant (kg.)	% dry matter pericarp
<u>Gold Nugget</u>				
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
<u>Buttercup</u>				
Natural set (8.4)	2.0 ± 0.2	16.7 ± 3.1	4.1 ± 0.7	24.9 ± 1.4

^aUnder low density spacing: 3' x 6' (within x between row) for 'Gold Nugget', and 6' within row with no guard rows for 'Buttercup'.

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.

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.

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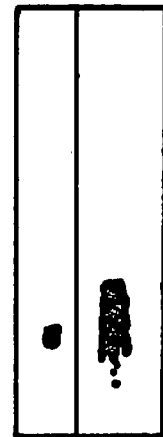
37. A Report of Cucurbitacin Poisonings in Humans

Ferguson, J. E., D. C. Fischer, and R. L. Metcalf, Departments of Entomology and Horticulture, University of Illinois, Urbana-Champaign, IL 61801

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. africanis 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 Diabrotica 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.



E-gly bitter
std. cv.

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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38. Intense Bitterness in Commercial Zucchini

Herrington, Mark E., Redlands Horticultural Research Station, Ormiston, Qld. 4163, Australia.

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 diarrhoea 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 diarrhoea 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 cv. 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) ($\chi^2 = 0.44$, $P = 0.52$). 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 F₂ 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.

39. Overview - The Cucurbita Species

Holle, Miguel. CIAT, Cali, Columbia.

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).

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 m² 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, c/o CIAT, Apartado 6713, Cali, Colombia.

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. Laborde	<u>C. pepo</u> , <u>C. moschata</u> <u>C. mixta</u> , <u>C. ficifolia</u>
Guatemala	ICTA - O. Orozco?	"
Other Central America	CATIE - H. Heinze?	"
Venezuela	U.C.V. - C. Linares	<u>C. moschata</u> , <u>C. maxima</u>
Colombia	ICA (Palmira) - J. Jaramillo	Low altitude types (<u>C. moschata</u>)
	ICA (Tibaitata) - F. Higueta	High altitude types (<u>C. maxima</u>)
Ecuador	INIAP	
Peru	UNA-La Molina - F. Delgado	<u>C. maxima</u> , <u>C. moschata</u> <u>C. ficifolia</u>
Brasil	ESALQ-Piracicaba - Rochelle?	<u>C. moschata</u> , <u>C. maxima</u>

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

40. Controlling Cucumber Beetles and Corn Rootworm Beetles with Baits of Bitter Cucurbit Fruits and Root

Metcalf, R. L., J. E. Ferguson, Dan Fischer, Richard Lampman and John Andersen, Departments of Entomology and Horticulture, University of Illinois, Urbana-Champaign, Illinois 61801

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 (F₁ fruit) or 3.0 mg/g (F₂ 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			No. beetles dead or dying on ground			Percent control
		WCR	SCR	NCR	WCR	SCR	NCR	
A.	<u>C. andreae x C. maxima</u> 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.	<u>C. foetidissima</u> 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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41. 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. martinizii 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. martinizii 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:

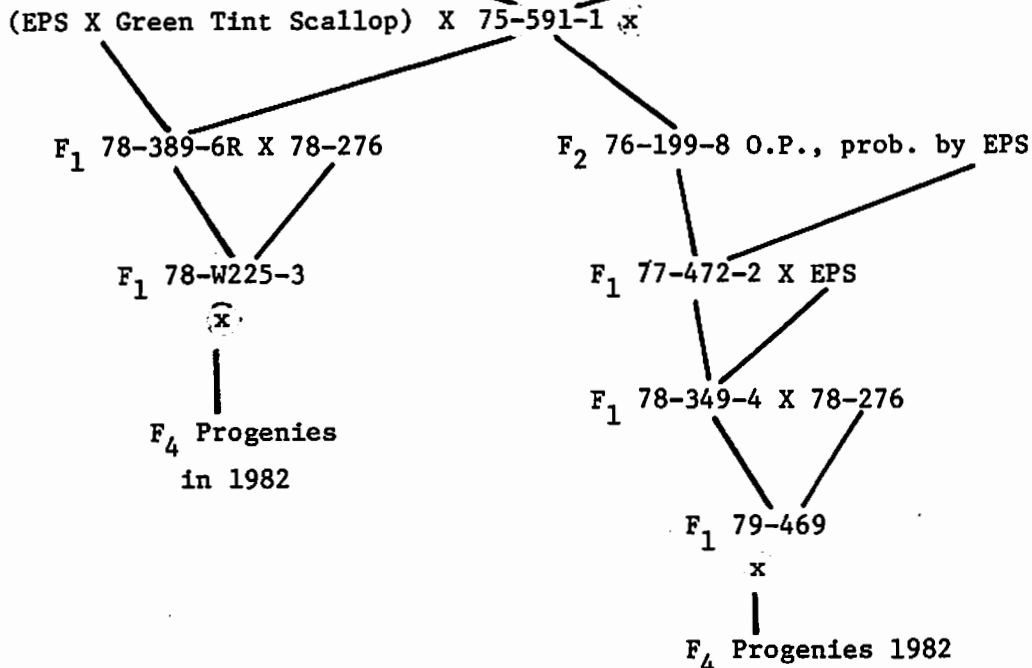
1. 'Early Prolific Straightneck' (EPS). Uniformly susceptible in all tests. Highly stunted or killed when inoculated at any age. Usually severely affected from natural infection in field at Ithaca, NY.
2. 'Zucchini' and 'Caserta'. Usually as badly stunted as EPS when inoculated at cotyledon stage, especially 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. F₅ progenies from [(PI 176959 x Yankee Hybrid)F₅ 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. F₈ 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. martinizii and 78-276 (listed under 3 above) and constitute our most advanced material with a uniformly high level of CMV resistance. Numerous F₄ 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.

[(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)



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42. Growth of Parthenocarpic and Seed-bearing Fruits 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 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 fruits per plant	Yield (gr) per plant	Percentage class 1 fruits
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.

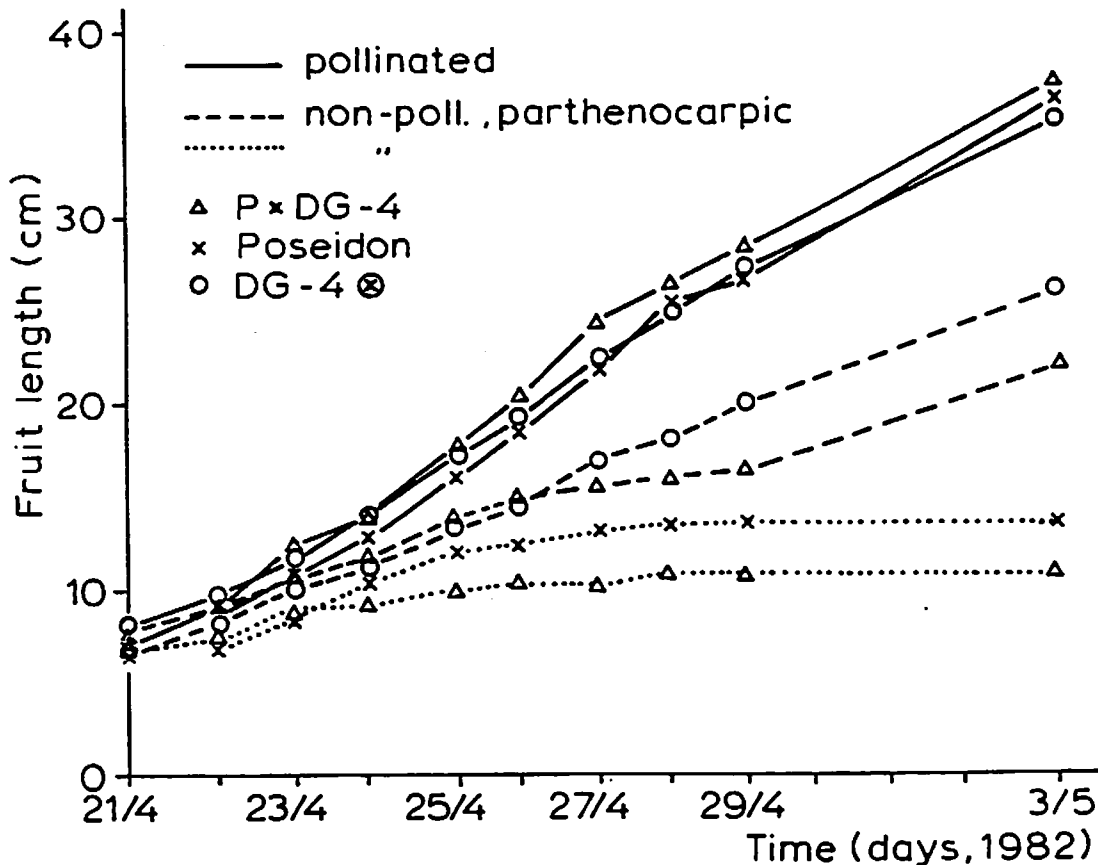


Figure 1. Mean length growth of pollinated and non-pollinated flowers of squash.

Figure 1 presents preliminary data on the length growth of pollinated and non-pollinated 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 didn't 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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43. On Regreening of Cucurbita pepo L. Fruits

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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

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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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44. On Spotting of Cucurbita pepo L. Fruits

Schaffer, A.¹ and C. D. Boyer², Rutgers University, New Brunswick, NJ 08903.

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 F₂ segregants had dark green fruit with conspicuous light green-cream spots. After 50 days past antheses, 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 F₂ 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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45. Reflected Light Spectra from Silvery and Nonsilvery Leaves of Cucurbita pepo¹

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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 33×10^3 lu/m² 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.

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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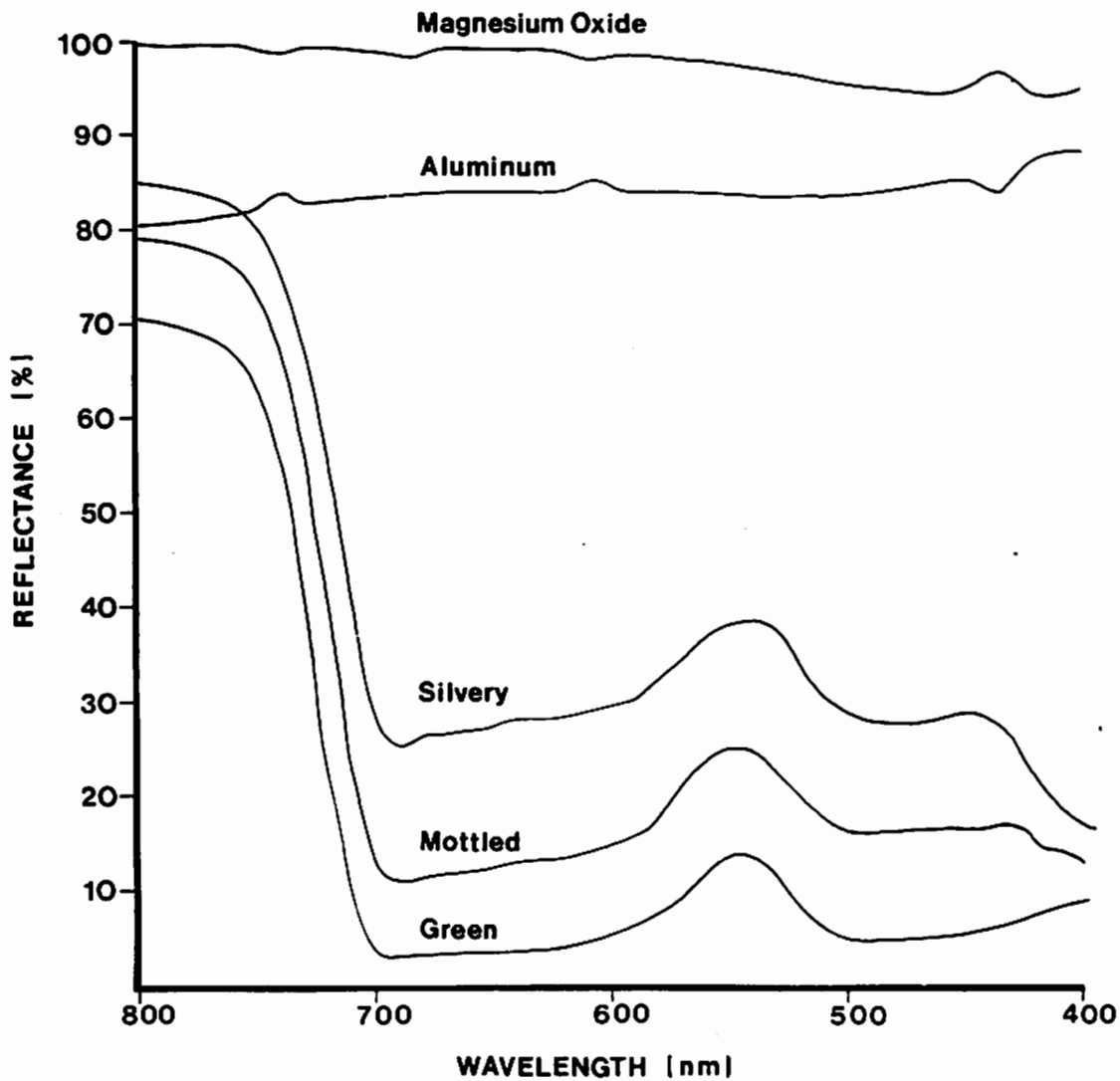


Fig. 1. Reflected light spectra of green, mottled, and silvery leaves. Aluminum foil was used for comparison.

¹I thank Ron Prokopy for use of his spectrophotometer and Frank Durmand for his help.

46. 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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47. Hybridization of Cucurbita pepo with Disease Resistant Cucurbita Species

Washek, Richard L. and Henry M. Munger, Cornell University, Ithaca, NY 14853.

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 F₁ plants of C. martinezii x C. pepo were obtained by making 206 pollinations and using embryo culture. These F₁ plants were self-fertile and produced a large amount of F₂ seed. Reciprocal backcrosses of F₁ and F₂ plants have produced only a few viable seeds. The backcross plants obtained show adequate self-fertility. In a population of over 100 F₂ 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 F₂ 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 F₂ 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 F₁ plants through embryo culture, all from one fruit of Foodhook Zucchini. F₂ seed was not obtained; the F₁ produced few male flowers and these not at the same time as females. The F₁ 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 F₁ plants were also grown in the field and from numerous pollinations with C. pepo, several dozen plump seeds have been obtained. The F₁ 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 F₁ 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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48. Mentor Pollen in an Interspecific Cross in Cucumis: Effects of Irradiation Dose and of Order of Application of the Two Types of Pollen

Custers, J. B. M. and A. P. M. den Nijs, Institute for Horticultural Plant Breeding, P. O. Box 16, 6700 AA Wageningen, The Netherlands.

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 studied 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 l 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.

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.

Table 1. Effects of irradiation doses 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

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

Nijs, A. P. M. den and K. Hofman. Institute for Horticultural Plant Breeding, P. O. Box 16, Wageningen, The Netherlands.

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/m² 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 m² 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.

None of over 70 cucumber cvs. tested so far exhibited appreciable resistance. Cucumber cv. Sakatakohaifushinari 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.

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

Species	Accession	Root galls per plant in 3 screening tests		
		81-1	82-1	82-3
<u>C. anguria</u> L.	1761	19	17	17
<u>C. ficifolius</u> A. Rich	1729	13	7	9
<u>C. metuliferus</u> Naud.	1768	8	4	8
	1822	2	2	2
	1994	9	5	2
<u>C. prophetarum</u> L.	1752	13	6	5
	2016	6	4	2
<u>C. zeyheri</u> Sond. 2x	0181	5	4	4
<u>C. zeyheri</u> Sond. 4x	1807	13	8	11
<u>C. sativus</u> L.	1745	20	17	28
(primitive)	1759	14	23	16

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50. The Occurrence of Zucchini Yellow Mosaic Virus in the United States

Provvidenti, R. and D. Gonsalves, New York State Agricultural Experiment Station, Geneva, New York 14456, and H. S. Humaydan, Joseph Harris Company, Inc., Rochester, New York 14624.

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 Istituto di Fitoviologia 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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51. Variation for Interspecific Crossability of Cucumis anguria L. and C. zeyheri Sond.

Visser, D. L. and A. P. M. den Nijs, Institute for Horticultural Plant Breeding, P. O. Box 16, Wageningen, The Netherlands.

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 F₁ plants were reported by Dane, et al (1). We also obtained viable seeds, but the F₁ 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 F₁ 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).

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, F₁ 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.

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 F₁ (5 pollinations per cross).

Ploidy of Female Parent (<u>C. zeyheri</u>)	Male Parent								
		<u>C. anguria</u>				<u>C. anguria</u> var. <u>longipes</u>			
	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 F₁ plants; + = normal F₁ plants.

Note: Gbn (Gene bank no.) 0307 = PI 196477; 0310 = PI 233646; 1787 = PI 299569;
1457 = PI 299570.

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VI. 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. Mc Creight.

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.

Approvals:

W.P. Bemis
W. Bemis

Joseph D. Norton
J. D. Norton

R. W. Robinson
R. W. Robinson

W. R. Henderson
W. R. Henderson

M. L. Robbins
M. L. Robbins

R. L. Lower
R. L. Lower

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.

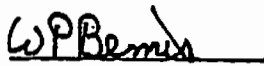
In the event of death or retirement of a member of the Coordinating Committee before the expiration of his/her term, he/she shall be replaced by an appointee of the Coordinating Committee.

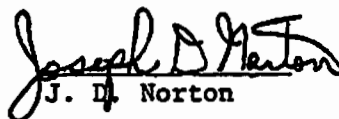
Members of other committees shall be appointed by the Coordinating Committee.

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.

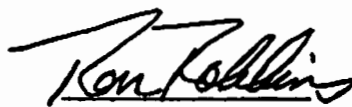
Approvals:


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W. R. Henderson


M. L. Robbins


R. L. Lower

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.

Approvals:

W.P. Bemis
W. Bemis

Joseph D. Norton
J. D. Norton

R. W. Robinson
R. W. Robinson

W. R. Henderson
W. R. Henderson

M. L. Robbins
M. L. Robbins

R. L. Lower
R. L. Lower

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.

W. P. Bemis

W. Bemis
(Cucurbits sp.)

W. R. Henderson

W. R. Henderson
(Watermelon)

Joseph D. Norton

J. D. Norton
(Muskmelon)

Ken Robbins

M. L. Robbins
(Cucumber)

R. W. Robinson

R. W. Robinson
(Other genes and species)

R. L. Lower

R. L. Lower, Chairman

1983 MEMBERSHIP DIRECTORY
CUCURBIT GENETICS COOPERATIVE

1. Adams, Howard. Northrup, King and Co., Box 1406, Woodland, CA 95695
2. Adeniji, Adeoye A. P. O. Box 12465, Ibadan, Nigeria, West Africa
3. Baggett, J. R. Dept. of Horticulture, Oregon State University, Corvallis, OR 97331
4. Baker, L. R. Director, Vegetable Research, Asgrow Seed Co., 7171 Portage Avenue, Kalamazoo, MI 49001
5. Balgooyen, Bruce. Northrup, King and Co., P. O. Box 959, Minneapolis, MN 55440
6. Bemis, W. P. Dept. of Plant Science, University of Arizona, Tucson, AZ 85711
7. Biblioteca de Crida 07. INIA, Apartado Oficial, Moncada, Valencia, Spain
8. Bohn, G. W. Imperial Valley Cons. Research Center, 1094 Klish Way, Del Mar, CA 92014
9. Bowman, Richard. Vlastic Foods, Inc., West Bloomfield, MI 48033
10. Boyer, Charles. Plant Breeding & Genetics, The Pennsylvania State University, 101 Tyson Building, University Park, PA 16802
11. Burkett, Al. PetoSeed Company, Inc., Route 4, Box 1255, Woodland, CA 95695
12. Carey, Edward. 1103 West Dorner Drive, Urbana, IL 61801
13. Central Library of Agricultural Science. Attn: A. Guratski, Periodicals Dept., P. O. Box 12, Rehovot, 76 100, Israel
14. Chambliss, O. L. Dept. of Horticulture, Auburn University, Auburn, AL 36830
15. Chermat, M. C. Vilmorin Documentation Center, La Menitre 49250 Beaufort en Vallee, France
16. Chung, Paul. PetoSeed Company, Inc., Route 4, Box 1255, Woodland, CA 95695
17. Clayberg, C. D. Dept. of Horticulture & Forestry, Kansas State University, Manhattan, KS 66506

18. Cohen, Yigal. Dept. of Life Sciences, Bar-ilan University, 52 100 Ramat Gan, Israel
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20. Coyne, Dermot. Dept. of Horticulture, University of Nebraska, Lincoln, NE 68583
21. Crall, J. C. University of Florida, Agricultural Research Center, P. O. Box 388, Leesburg, FL 32748
22. Cuartero, J. Estacion Experimental "La Mayora", Algarrobo (Malaga), Spain
23. Custers, J. B. M. Institute for Horticultural Plant Breeding, P. O. Box 16, Wageningen, The Netherlands
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28. de Ruiter, A. C. Deruiterzonen Seed Company, Postbus 4, Bleiswijk, The Netherlands
29. Della Vecchia, Paulo. Embrapa, Centro Nacional de Pesquisa de Horticas - CNPN, BR 060 Km 09, Caixa Postal 11-1316, CEP 70.000 Brasilia-DF, Brazil
30. Del Monte Corporation. Attn: Ms. Dorothy Arthur, Librarian, P. O. Box 36, San Leandro, CA 94577
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32. Dumas de Vault, Roger. Centre de Recherches Agronomiques, Station d'Amelioration des Plantes Maraicheres, Domaine Saint Maurice-84140 Montfavet, France
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43. Gabert, August C. Dessert Seed Company, Box 9008, Brooks, OR 97305
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47. George, B. F. Heinz, U.S.A., P. O. Box 57, Tracy, CA 95376
48. Gnoux, J. P. Graines Gautier, Selectionneurs Producteurs Grainiers, B. P. No. 1 - 13630, Eyragues, France
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122. Ruttencutter, Glen. Agway Inc. Vegetable Seed Farm, P. O. Box 356, Prospect, PA 16052
123. Schroeder, R. H. Moran Seeds, Inc., Agricultural Chemical Division, P. O. Box 2508, El Macero, CA 95618
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125. Sekioka, Terry T. University of Hawaii, College of Tropical Agriculture, Kauai Branch Station, Kapaa, HI 96746
126. Seshadri, V. S. Indian Agricultural Research Institute, Division of Vegetable Crops & Floriculture, New Delhi-110012, India
127. Sharma, Govind C. Dept. of Natural Resources, Alabama A & M University, Normal, AL 35762

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147. Vinals, Fernando Nuez. Departamento de Genetica, E.T.S. Ingenieros Agronomos, Universidad Politecnica, Cno. de Vera, 14, Valencia - 22 (Espana)
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153. Wyatt, Colen. PetoSeed Company, Inc., Route 4, Box 1255, Woodland, CA 95695
154. Yorty, Paul. Musser Seed Company, Box 1406, Twin Falls, ID 83301
155. Yu, Albert. Known-U Seed & Nursery Company, 26 Chung-cheng, 2nd Road, Kao-hsiung, Taiwan, Republic of China
156. Yukura, Yasuo. 46-7, 3-Chome, Miyasaka, Setagaya-Ku, Tokyo, Japan
157. Zuta, Zeev. Hazera Seed Company, Oe Yehuda Post, Israel

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NAGAI, Hiroshi

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HOLLE, Miguel
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GRANQVIST, Britt

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RICHENS, R.H.

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DUMAS DE VAULX, Roger
GNOUX, J.P.
GONON, Yves
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IGNART, Frederic
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PITRAT, Michael
RISSER, Georgette
SOCIETE Clause

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ZUTA, Zeev

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KOSAKA, Yashiro
TAKAHASHI, Osamu
YUKURA, Yasuo

MEXICO

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PERSSON, Arnulf

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DE PONTI, O.M.B.
DE RUITER, A.C.
EENHUIZEN, P.
MEIJSING, Wilbert D.
NIJS, A.P.M. den
TJEERTES, P.
VAN BLOKLAND, G.D.
VAN DER AREND, Wim
VERHOFF, Ruud

ROUMANIA

POLI, Virgil

SPAIN

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HUNG, Lih
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YUGOSLAVIA

INSTITUT Za Ratarstvo

Cucurbit Gene List Committee

Cucumber:

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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.

FINANCIAL STATEMENT

June, 1983

(Prior to publication of Report No. 6)

<u>Balance</u> - June, 1982		\$1,609.21
<u>Receipts</u> - June, 1982 to June, 1983*		
Dues and Back Issues	\$452.00	
Interest	<u>110.78</u>	562.78
TOTAL		\$2,171.99
<u>Expenditures</u>		
Cost of publication and mailing of CGC #5		<u>441.07</u>
Balance		\$1,730.92

* One complimentary membership to Plant Breeding Abstracts