Survey of Cucumber Breeding Methods in the U.S.A.

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In 1987, I surveyed public (state university and U. S. Dept. Agric.) and private (seed or processing companies) plant breeders assigned to the improvement of cucumber. The survey included questions on breeding objectives, selection methods, type of germplasm released, and traits of interest in the breeding program. See (1) for definitions of breeding methods and germplasm types. The traits of interest was an expanded version of a survey run in 1985. The information is summarized here in order that plant breeders can determine what resources need to be developed in the future for germplasm collections, and what research is needed to support efforts to improve cucumbers for the consumer.

Of the surveys sent out, 6 public and 11 private cucumber breeders responded. The public breeders were from New York, North Carolina, South Carolina, Texas, and Wisconsin. The private breeders represented Abbott & Cobb, Asgrow Seed, Campbell Inst. Res. Tech., Ferry-Morse, Harris-Moran, Musser Seed, Nickerson-Zwaan, Northrup King, PetoSeed, and SunSeeds.

As expected, most cucumber breeders were using the pedigree and backcross methods (Table 1). Inbred-backcross and single-seed descent were also used in breeding programs. Methods such as recurrent selection and pure-line family (bulk breeding) were rarely used, especially among private breeders. Breeding objectives for public researchers were to develop inbred lines (germplasm or cultivar) or hybrid cultivars, and for private breeders were to develop hybrid or inbred cultivars. There was some confusion about the definition of inbred vs. open-pollinated cultivars, since inbred cultivars are sib-mated in isolation to produce certified seed, often referred to as open pollination. Generally, open-pollinated cultivars are developed by mass selection from an open-pollinated population, and have an inbreeding coefficient (F) near 0 (vs. F near 1 for inbred cultivars).

Most public cucumber breeders in the U.S.A. were involved in the improvement of pickling types or on more basic research in genetics and population improvement (Table 2). Private breeders emphasized pickling and slicing types about equally. Secondary emphasis included work on Middle-Eastern slicers (so called Beit Alpha types), and a small emphasis on trellis (Japanese burpless) slicers.

Most programs emphasized disease resistance, fruit yield, and fruit quality as primary considerations in selection, with earliness and sex expression nearly as important (Table 2). The traits that cucumber breeders wanted evaluated most in the U. S. germplasm collection were resistance to gummy stem blight (caused by *Didymella bryoniae*), root-knot nematode (caused by *Meloidogyne* spp.), *Alternaria cucumerina*, and fruit rot (caused by *Rhizoctonia solani*). Heat tolerance, combining ability for yield, and seedcell size were the only traits in the top 10 that did not involve disease resistance (Table 3). Most of the traits of high interest are being evaluated currently.

Literature Cited

1. Fehr, W.R. 1987. Principles of cultivar development, volume 1. Macmillan Pub. Co, New York, N. Y.

Table 1. Survey responses of 6 public and 11 private cucumber breeders working in the U.S.A. in 1987 for importance of breeding methods and germplasm types[z].

Question /Answer	Ranking of responses	
	Public	Private
Average ranking of breeding methods:		
Pedigree(cross,select,self)	1.2	1.4
Backcross(cross,select,backcross)	1.3	1.6
Inbred-backcross(cross,BC,self,sel.)	2.0	2.0
Single-seed descent(cross,self,self,sel.)	2.3	2.4
Recurrent selection (RS) - half-sib	2.7	3.3
- full sib	3.2	3.1
- S1 line	2.5	3.3
- S2 line	3.0	3.5
Mass selection (single-plant RS)	2.8	3.1
Pure-line family(cross,bulk,self,sel.)	3.3	3.3
Reciprocal recurrent selection	3.5	3.6
Objective for release of germplasm types:		
Inbred line (germplasm)	2.0	2.8
Population (germplasm)	2.7	3.6
Hybrid cultivar (2-4 inbreds crossed)	2.0	1.1
Inbred or line cultivar (from selfing)	2.5	2.6
Open-pollinated cultivar (from mass sel.)	3.5	3.3
Multiline cultivar (mixture of isolines)	3.5	3.7
Synthetic cultivar (>3 inbreds intercrossed)	3.8	3.6

[z]Importance was rated 1 to 4 (1=frequent, 2=occasional, 3=rare, 4=never).

Table 2. Survey responses of 6 public and 11 private cucumber breeders working in the U.S.A. in 1987[z].

Question /Answer	Number of responses		
	Public	Private	Total
What are your primary research/breeding objectives?			
Breeding pickles	3	7	10
Breeding slicers	1	6	7
Breeding Middle-Eastern slicers	0	1	1
Population development	1	0	1
Genetics research	1	0	1
What are your secondary research/breeding objectives?			
Breeding pickles	3	2	5
Breeding slicers	1	2	3
Breeding other slicers	0	4	4
Population development	1	0	1
Genetics research	1	0	1
What are your minor research/breeding objectives?			
Breeding slicers	2	1	3
Breeding other types	1	4	5
Quality research	1	0	1
What traits are of primary concern?			
Disease resistance	5	9	14
Yield	3	11	14
Fruit quality	4	7	11
Earliness/Sex expression	3	5	8
What breeding method do you use most?			
Pedigree(cross,select,self)	5	7	12
Backcross(cross,select,backcross)	4	6	10
Inbred-backcross(cross,BC,self,sel.)	2	5	7
Single-seed descent(cross,self,self,sel.)	3	3	6
Recurrent selection (RS) - half-sib	1	0	1
- full sib	0	1	1
- S1 line	0	1	1
- S2 line	0	0	0
Mass selection (single-plant RS)	0	1	1
Pure-line family(cross,bulk,self,sel.)	0	1	1
Reciprocal recurrent selection	0	0	0

[z]Number of answers are greater than number of people answering where several first-choice responses were given.

Table 3. Traits in the plant introduction collection of cucumber that cucumber breeders would like evaluated (listed in order from a 1987 survey).

Rank in survey 1987	Rank in survey 1985	Trait
1	7	Gummy stem blight resistance*
2	5	Root knot nematode resistance*
3	15	Alternaria leaf blight resistance
4	3	Rhizoctonia fruit rot resistance*
5	12	Heat tolerance
6	2	Anthracnose resistance*
7	26	Pythium cottony leak resistance
8	1	Fruits/plant (combining ability in gynoecious hybrid)*
9	8	Downy mildew resistance*
10	6	Fruit seedcell size
11	14	Cold shock resistance
12	11	Pickleworm resistance*
13	17	CMV resistance
14	18	WMV1 resistance
15	19	WMV2 resistance
16	16	ZYMV resistance
17	23	Drought resistance
18	25	Earliness (no. oversized fruits in single-harvest trial)*
19	20	Angular leafspot resistance
20	22	Cold germination
21	21	Target leafspot resistance
22	13	Salt tolerance*
23	4	Fruit shape (appearance, not length/diameter ratio)
24	9	Powdery mildew resistance
25	10	Fruits/plant (actual)
26	28	Days to first flower
27	24	Branching habit
28	27	Cucumber beetle resistance
29	29	Daylength response
30	-	Unique character (character not previously documented)*
31	33	Scab resistance
32	-	Spider mite resistance
33	31	Fusarium wilt resistance
34	32	Bacterial wilt resistance
35	30	Verticillium wilt resistance
36	-	Nutritional value
37	-	Parthenocarpic tendency
38	-	Cold vigor
39	-	Brinestock quality
40	-	Sex expression
41	-	Cold vigor
-	-	Beet Pseudo-yellows virus (cucumber yellows)
-	-	Rhizoctonia seedling damping-off resistance
-	-	Air pollution resistance

*Trait currently being evaluated, or evaluation completed.
-Not on trait list for survey.