

## **2003 FCGP Public Seed Initiative Variety Trial Results**

This fall marked the end of the second year of the Public Seed Initiative (PSI) Cornell variety trials in Oregon. Trial gardens were held in eight locations, and three workshops were held in the North, South and Middle of the state in September. In addition, a spring planning meeting was held in March. Cornell varieties of summer and winter squash, cucumbers, and melons all bred for powdery mildew resistance were compared to popular commercial varieties and evaluated for quality traits and disease resistance at the FCGP trial grounds in Junction City, Oregon. Seven cooperators held replicated trials throughout the state, with four returning meaningful results. The fall training workshops were held at cooperator sites. Finally, the trials included an open pollinated broccoli breeding project in collaboration with Oregon State University and an evaluation of disease resistant potatoes. The project results demonstrate notable quality traits and disease resistance in Cornell varieties that offer great promise for organic production systems.

### **Background**

The Public Seed Initiative is a collaborative effort to bring the innovations of public breeders directly to gardeners and farmers. The project is a partnership between Oregon Tilth's Farmer Cooperative Genome Project (FCGP), the Cornell University Vegetable Breeders Institute, the Plant Genetic Resources Unit (PGRU) in Geneva, and the Northeast Organic Farmer's Association (NOFA) of New York. PSI is a three year project funded through the USDA Initiative for Future Agricultural and Food Systems (IFAFS) program.

PSI was formed in response to consolidation of the seed industry, the increasing preference by seed companies for protected or patented varieties of plants, misunderstanding about the power of traditional breeding, and the neglected breeding needs of organic farmers. The goals of the project are to establish new relationships between university researchers and small producers, to distribute the public investment in plant breeding directly to organic farmers, to train growers in selection and breeding methods, and to better meet grower's regional plant breeding needs.

## Methods

The FCGP held an organizational meeting in March of 2003. Subsequently, participation was solicited through direct mailings, the publication in *In Good Tilt*, and follow-up phone calls. Seven growers throughout the state volunteered their time, materials, and space to the effort. Brian Thomas, Steve Florin, Christine Peralla, Jonathon and Jesse Spero, Baruch Bashan, Andy Parker, and Heather Coburn all made an effort to trial and evaluate varieties from either Cornell or Oregon State University. The FCGP provided organic transplants and helped install the experiments. Throughout the summer and fall the FCGP helped to collect data. Three workshops demonstrating the varieties, trialing methods, traditional breeding, and on-farm seed production were held throughout the state in the fall at cooperator sites.

An effort was made to find representative growers in each of the states major growing regions. A handful of varieties bred by the Cornell Vegetable Breeders Institute were trialed at each of the different locations to see how the varieties would perform in the different environments, climates, and production programs. Additionally, each site has a different history of pest and disease pressure that offered greater insight into the variety performance. Each of the cooperators grew the varieties under organic conditions. Three of the cooperators were certified organic.

At cooperator sites, Cornell varieties were trialed and compared to a standard variety. The blocks were randomized to ensure that field variations in fertility did not prejudice the results. Often there were only a few plants in each block, because of the limited quantities of seed available from the breeders, poor germination, or greenhouse pest pressure.

At the FCGP trial grounds in Junction City the Cornell varieties were compared to standard varieties and a composite variety which was a population cross from the previous year's trials, including the Cornell varieties and the standard. These trials were replicated in the field. In the first replication, the varieties were randomized within each block. In the second replication, the varieties were planted in blocks which were in turn randomized. Organic growing conditions were maintained, and all trials were fertilized

with composted chicken manure at a rate of two tons per acre. No additional amendments were applied during the growing season.

For all the trials records were kept for the planting date, transplanting date, date of first harvest, percentage germination, total numbers planted, total fruit harvest, total marketable fruit, and powder mildew resistance. Comments were recorded for the reason the fruits were unmarketable, environmental conditions, and general observations. Powdery mildew resistance was recorded using a numerical rating of 1 – 9 (with 1 representing very low resistance/severe infestation, and 9 representing high resistance/low or no PM present). Results include not only an evaluation of varieties, but also a comparison of on-farm research methods comparing randomized plots to randomized blocks.

## FCGP Trial Ground Variety Evaluation Results

Investigators: Heather Smith and J.J. Haapala

### Yellow Summer Squash

Three varieties of yellow straight-neck summer squash were organically grown at the FCGP Demonstration Garden in 2003. The varieties were evaluated for overall performance, yield, pest and disease resistance, and fruit characteristics. The experimental design was as described above with two replications in the field. All seeds were started in an unheated greenhouse on May 13, and transplanted into the field on June 14. All plots were grown organically, and the field was fertilized with composted chicken manure prior to planting. Plants were spaced 3 feet apart, one per row, in beds 5 feet wide. The trial received a weekly watering with overhead sprinkler irrigation. Squash were harvested between July 18 and August 21.

Varieties trialed were Cornell's PMR Yellow Straightneck, an FCGP yellow squash composite cross from 2002, and the standard Butterstick. The standard Butterstick variety outperformed each of the other varieties in all categories. Butterstick plants were vigorous, productive, and did not suffer from powder mildew. Butterstick

fruits were uniform, deep yellow in color, and straight. The composite variety displayed the next best PM resistance of the three varieties trialed, averaging a score of 6.5 between the two replications. The composite variety displayed very good vigor, and plants were larger. Yields of the composite were low, presumably due to a high number of off-types. Many composite variety plants had fruits that were a crookneck type with lighter skin color and a bulbous bottom. Cornell's PMR Yellow Straightneck had the worst PM resistance, and showed the least vigor. Yields of the Cornell variety were good, and only a slightly lower than the standard. Fruit color and shape characteristics of the Cornell variety do need improvement: fruits were a pale yellow, and many of the fruits had bulbous bottoms and crooknecks.

### Slicing Cucumbers

Six varieties of slicing cucumbers were organically grown at the FCGP Demonstration Garden in 2003. The varieties were evaluated for overall performance, yield, pest and disease resistance, and fruit characteristics. The experimental design was as described above with two replications in the field. All seeds were started in an unheated greenhouse on May 28, and transplanted into the field on June 19. All plots were grown organically, and the field was fertilized with composted chicken manure prior to planting. Plants were spaced 3 feet apart, one per row, in beds 5 feet wide. The trial received a weekly watering through overhead irrigation. Cucumbers were harvested between July 29 and September 4.

The cucumber trials included three Cornell varieties (M80Bw x P93F, M80Bw x M97F, and M97F x P97Bw), Marketmore 86 (standard), and two composite varieties saved from the 2002 trials at the FCGP garden. All the cucumbers displayed very good PMR compared to the standard, which succumbed first to the fungus. In the end, all varieties were heavily infested with powdery mildew. The Cornell varieties and the composites continued to produce for three weeks after the standard variety had ceased production.

Of the Cornell varieties, none performed as well as last year's trials, which may be indicative of the season more than the fitness of the varieties. The best all around

producer was M97F x P97Bw, which had the highest average of marketable yields per plant in both replications. All the Cornell varieties were vigorous, and showed good PMR resistance, except for M80Bw x P93F. M97F x P97Bw produced fruits that were of moderate length, with little to no ribbing, and had very smooth flesh with low spines. Cornell variety M80Bw x M97F had good PMR, but produced poorly, and germinated at only 31%. The fruits of M80Bw x M97F were shorter, lighter in color, with smooth flesh, low spines, and low mature seed content at harvest. M80Bw x P93F was the least promising of the three Cornell varieties. Although the variety was a good early yielder, vigor declined throughout the season, and average marketable yield was low in both replications. M80Bw x P93F showed moderate PMR in Replication II, but very little resistance to the fungus in the first replication. This is most likely due to the variety's close proximity to the irrigation pipe, as 40% of fruits produced in Replication I were bloaters. Other fruits of M80Bw x P93F were heavily damaged by cucumber beetles, and by the end of the season, 50% of the plants were dead. The composite varieties displayed good PMR, but the fruits were extremely varied, with many showing characteristics of a Soyu Long type Asian cucumber. The composite varieties had spineless and spiny fruits, long and short fruits, dark and light fruits, and high and low seed contents were expressed in both replications. In the composite varieties, the PMR trait appeared more heritable than any other trait.

### Green Zucchini Summer Squash Trials

Two varieties of green zucchini were organically grown at the FCGP Demonstration Garden in 2003. Cornell's 'PMR green zucchini' and the standard, 'Black Beauty' were evaluated for overall performance, yield, pest and disease resistance, and fruit characteristics. Due to poor germination rates, there was only one replication. All seeds were started in an unheated greenhouse on May 13, and transplanted into the field on June 14. Many of the starts were lost before the transplant date due to problems with root maggots in the greenhouse. A third bed was direct-seeded with the Cornell PMR green zucchini, but none germinated. Therefore, there was only one replication for the green zucchini trial. All plots were maintained organically, and the field was fertilized

with composted chicken manure prior to planting. Plants were spaced 3 feet apart, one per row, in beds 5 feet wide. The trial received a weekly watering through overhead sprinkler irrigation. Fruits were harvested between July 29 and September 11.

Despite a very poor germination rate (16.67% compared to the standard's 72.22%), Cornell's PMR green zucchini grew vigorously in the field and proved superior in yield and marketability. Cornell's green zucchini demonstrated the greatest powdery mildew resistance. Even after the standard had succumbed to the disease, Cornell's PMR green zucchini showed no sign of infection. In addition, the Cornell variety had many notable traits that would be appreciated in a home or market garden. Leaves are compound, giving the plant an ornamental quality. Fruits are smooth, dark green and glossy, with very few spines. In addition, the fruits were set high on the plant, making harvest much easier. Cornell's PMR green zucchini had the highest yield and longest season of any of the summer squash, including the yellow summer squash varieties.

### Winter Squash Trials

Seven varieties of winter squash were organically grown at the FCGP Demonstration Garden in 2003. The varieties were evaluated for overall performance, yield, pest and disease resistance, and fruit characteristics. The experimental design was as described above with two replications. Seeds for trial varieties in replication one were started in an unheated greenhouse on May 13, and transplanted into the field June 15. Seeds for replication two were started on June 3, and transplanted into the field on July 9. All plots were grown organically, and the field was fertilized with composted chicken manure prior to planting. Plants were spaced 3 feet apart, one per row, in beds 5 feet wide. The trial received a weekly watering through overhead sprinkler irrigation. Squash were harvested on September 25 and October 17, respectively.

Cucurbita pepo varieties included the PMR Bush Delicata, PMR Bush Acorn, Harlequin, and the standard varieties (Celebration and Table Ace). C. moschata varieties included PMR Bugle and the standard (Waltham Butternut). C. moschata varieties were only evaluated in the second replication, and were grown side-by-side for ease of comparison. Bugle had best powdery mildew resistance of all the squash varieties, and

outperformed the Waltham butternut in yield, averaging 3.6 marketable fruits per plant (second highest of all squash in replication two), compared to 2.17 for the standard.

The most outstanding performer of all the squash and of *C. pepo* varieties in particular was the standard Celebration. Celebration rated second in powdery mildew resistance, first in average marketable yields per plant, and first in vigor. The range of variety types was wide, with all plants showing orange, green, and white to varying degrees. There were three distinct off-types: an elongated fruit type, a solid orange variety, and a type with very pronounced tip (see picture). Taste of Celebration was very good, more similar to the Delicata than to the acorn type.

Harlequin demonstrated the third best PM resistance, and had only slightly lower yields than Celebration. Fruits were very uniform, with white and green stripes and orange spots where they sat on the field. As the squash cured in the greenhouse, yellow and orange colors became more apparent. Cooked fruits had very good flavor, color, and texture. Many of the fruits had a very hard, inedible skin after curing.

PMR Bush Acorn ranked fourth in PM resistance, with 40% of plants dead at harvest, and most others severely stunted. The PMR Bush Acorn ranked last in yields in both replications.

PMR Bush Delicata ranked worst in PM resistance, and showed the least vigor. Many plants of the PMR Bush Delicata were dead at harvest, and all plants were stunted by powdery mildew throughout the season.

### Melon Variety Trials

Six melon varieties were organically grown at the FCGP Demonstration Garden in 2003. Melon entries were evaluated for yield, fruit and quality characteristics, and disease resistance. The experimental design was a randomized block with two replications. Data collected included yield, fruit characteristics, flavor, and sugar content. All seeds were started in an unheated greenhouse. Seeds for the first replication were started between April 30 and May 2, and transplanted into the field on June 14. All flowers were removed from transplants before they were planted. Seeds for replication two were started on May 30 and transplanted on July 1. All plots were grown

organically, and the field was fertilized with composted chicken manure prior to planting. Plants were spaced 3 feet apart, one per row, in beds 5 feet wide. The trials received a weekly watering through overhead sprinkler irrigation. Melons were harvested between August 19 and September 16.

Replication I contained the following varieties: Cornell's 339 Series, NY 01-907, and PMR Delicious 51, an FCGP composite from 2002, and two standards ('Earligold' from Territorial Seeds, and 'Harvest Queen', an heirloom from Seeds of Change).

Replication II did not contain the FCGP composite from 2002 or the 'Earligold' standard.

Of the Cornell varieties, the NY 01-907 melon expressed the best PMV resistance in both replications. NY 01-907 fruits were uniform in size and shape, slightly larger and more oval than the 339 Series, with more pronounced ribs. Flesh was bright orange, with a small seed cavity. Netting was uniform, and averaged 7 (out of a scale of 1 – 9 with 1 being no netting).

The PMR Delicious 51 variety had the second best powdery mildew resistance. The predominant types had moderate netting, shallow ribs, and bright orange flesh. Fruits were variable in size and shape, and netting ranged from 2 to 7 on a scale 1-9. Plant vigor was low throughout the season, and germination was sporadic, at 55%. This variety displayed the most off types. The off types were similar to the Charentais type French melon, and had a notable sweet flavor.

The 339 Series x ZBC5TUF11 melons had the lowest rate of mildew resistance, with most foliage damaged by the mildew. The fruits have moderate netting and moderate ribs, with bright orange flesh, and a sweet flavor. The size of the fruit was varied, but other fruit characteristics were highly uniform.

For the second year in a row, the Earligold standard displayed the lowest PMR, with a score of only 2 out of 9 (with 1 being no resistance/high susceptibility). Two out of seven plants died before producing mature fruit, and all plants were dead well before any of the other varieties. The few fruits produced were uniform: round, with no ribs, and heavy netting. Yield was very low, averaging less than one marketable fruit per plant.

The Harvest Queen standard displayed moderate PMR, and had good yields in comparison to the other varieties. Fruits, though, were much larger than the other varieties trialed. Ribs were very pronounced, and the fruits had a tendency to crack in the

field before reaching maturity. This particular variety of Harvest Queen does not appear to be a stable variety, as there was significant variation of fruit types.

The FCGP composite variety derived from the 2002 evaluations expressed the most resistance to powdery mildew, and had the highest yields, averaging 2.67 marketable fruits per plant. Netting on the fruits varied greatly, ranging in score from 2 to 8. Most fruits had moderate ribs. The Charentais characteristic was strong in a third of the fruits (producing a smaller, rounded fruit with little to no netting). Many of the fruits were the most flavorful of any of the varieties trialed. Like the cucumbers, the PMR trait appeared more heritable than other characteristics.

### Pickling Cucumber Trial

Six varieties of pickling cucumbers were organically grown at the FCGP Demonstration Garden in 2003. The varieties were evaluated for overall performance, yield, pest and disease resistance, and fruit characteristics. The experimental design was a randomized block with only one replication. All seeds were started in an unheated greenhouse on June 1, and transplanted into the field on July 7. Many of the starts were lost before the transplant date to problems with root maggots in the greenhouse. All plots were grown organically, and the field was fertilized with composted chicken manure prior to planting. Plants were spaced 3 feet apart, one per row, in beds 5 feet wide. The trial received a weekly watering through overhead sprinkler irrigation. Cucumbers were harvested between August 18 and September 11.

The varieties trialed were NY 99 531 N, NY 99 527 N, Dryden OP 94, NY 99 522 X 530, NY 99 530B N, NY 99 528N, and the standard (Clinton). NY 99 527 N had the highest yields, with an average of 15 fruits per plant over the course of the month. NY 99 522 x 530 had yields only slightly lower, averaging 14 fruits per plant, and Dryden OP 94 came in third averaging 12.5 fruits per plant. The earliest varieties were NY 99 531 N, NY 99 527 N, NY 99 522 x 530, and the standard Clinton.

In terms of fruit characteristics, NY 99 531N was most promising. Fruits were slender and dark green with good PMR, high uniformity, with moderate spines and ribs.

The low yields could have been due to its position in the field, which was partially shaded by neighboring corn.

NY 99 527N had greater color variation, longer fruits, and smoother flesh, but good PMR. Dryden 94 OP had good PMR, slender fruits, moderately dark color, deep ribs, and spiny flesh. NY 99 522 x 530 had poor coloring, medium spines, but good PMR. NY 99 530B had longer fruits that were darker and smoother. NY 99 530B also expressed good resistance to powdery mildew, but was a larger variety generally.

### Cooperator Pickling Cucumber Trial

Investigator: Brian Thomas

Location: Cottage Grove, Oregon

The varieties trialed included NY 99-527 N, NY 99-522 x 530, NY 99-531 N, Dryden 94 OP, and a standard (Northern Pickling Cucumber). Two replications were grown. Replication I was transplanted on 6/14 in mounds containing 3 plants per variety. Replication II was transplanted on 6/22 in mounds containing one plant per variety. All varieties were grown organically in raised beds amended with lime and compost. The trials were watered by hand once a week. Plants were trellised. Plants were harvested twice a week from August 1 to October 13, and picked at marketable pickle size. Data was collected on PMV resistance and yield.

The highest producer in both trials was NY 99-522 x 530, followed by the standard. It had almost twice the production of the other trialed Cornell varieties. The next best producer was NY 99-527, followed by Dryden 94 OP, NY 99-531 N, and NY 99-527 N respectively. The only variety affected by PMV was NY 99-531 N.

(Other Cooperator Results (Florin, Spero, and Parker) will be included on the disc to be sent on 3.17, which also includes photos from all the trials and workshops.)

### Summary

The Cornell varieties in general were characterized by good tolerance to powdery mildew, and demonstrate how traditional breeding can confer disease resistance and

improve organic production systems. However, in some instances the standard varieties did outperform the Cornell varieties.

Of the squashes the standard Butterstick yellow summer squash outperformed the Cornell variety, and had better PMV resistance. The Celebration winter squash (a standard developed by Cornell) outperformed all other winter squash varieties. While the other standard (Table Ace) was the poorest performer. Bugle winter squash (*C. moschata*) had the best PMV resistance of all the winter squash along with Celebration, and the other squash had variable resistance. The Cornell PMR Green Zucchini not only had the most marketable fruits per plant and had outstanding PMV resistance, but it also had a very attractive leaf type and growth habit with few spines on the plant.

All the Cornell slicing cucumbers had better PMV resistance than the standard Marketmore (an older Cornell variety). The best producing slicing cucumber in replication I was M97F x M80B2w, while the best producing cucumber in replication II was the M97F x P97Bw. The best PMV resistance in either trial was the composite variety (composite 2) saved from the previous years trials (representing a population cross of the Cornell varieties and the standard). The pickling cucumber NY 99-522 x 530 had the highest yields by far for the cooperator, while NY 99 527 N had the highest yield at the FCGP demonstration garden. The standard pickling cucumber (Clinton) outperformed NY 99 531 N, and NY 99 530B N in yield of marketable fruits per plant.

The melon trials were more variable, and the standard (Harvest Queen) was more productive and had better PMV resistance than many of the Cornell varieties (while the fruit was much more variable). Of the Cornell varieties and the standard, the best producer in replication I was 339 Series x ZBC5TUF11, while it was the poorest producer in replication II. The best producer in replication II was PMR Delicious 51. Overall the most outstanding producer in yield was the composite variety representing a population cross from the 2002 Cornell varieties and the standard, though the percentage of off-types was high. The Best resistance to PMV was NY 01 907. The poorest resistance to PMV was demonstrated by the standard (Earligold) and composite 2, while composite 1 shared the highest resistance rating.

In comparing trialing methods, it was interesting to note that there were no significant correlations between the two replications in regards to yield or disease

resistance. Furthermore, cooperator results did not significantly correlate with the results at the demonstration garden. There was wide variation between the replications and with cooperator trials. Many more plots with consistent growing practices and trialing methods would be required to determine definitive trends. Of the two randomizing methods used at the demonstration site (randomizing plants within a block vs. randomizing blocks) there was an insufficient correlation to determine if one method was statistically more accurate than another. However, in regards to appeal and ease of demonstration, workshop participants found the randomizing blocks method to be superior.

Western participant interest in the Public Seed Initiative is strong, and those that have trialed Cornell varieties have been impressed with the disease tolerance and quality traits of Cornell cultivars. Of note is that many participants who would have participated declined to sign Material Transfer Agreement forms. This concern has not abated, and continues to be a topic of correspondence. Those growers are concerned that the MTA is a binding personal contract protecting a trade secret. They fear that they would be liable for breach of contract and conversion of Cornell property if Cornell germplasm were to cross-pollinate with other varieties that they save seed from. Unlike the Plant Variety Protection Act which preserves a breeder's right to use protected varieties in the production of new varieties, the MTA has no exemption for using a variety for further development (7 USC § 2544). What is needed is for the Public Seed Initiative or some organic grower consortium to license the Cornell varieties so that they may be distributed without the MTA, but with acknowledgment of their origin. Otherwise organic growers will be left to purchase the varieties from a commercial source if they choose to use the Cornell germplasm in their regional breeding programs. That would be an unfortunate option, because there would be no way to trace crop improvements back to their source – the Cornell Vegetable Breeders Institute.

