

African genes protect Syngenta's seedless watermelon business

by Edward Hammond

Switzerland-based Syngenta is on an intellectual property expedition into watermelon seed collections.¹ The company is looking for disease resistance genes to use in its patent-protected seedless watermelons. Since 2007, the company's "Super Pollenizer" varieties have incorporated disease resistance genes from watermelons originating in South Africa, Zimbabwe and Nigeria. These African genes have been bred into a variety that is of Chinese origin.

Melons and seeds

Watermelon (*Citrullus lanatus*) is an African native, thought to originate in the Kalahari Desert. By at least 4,000 years ago, its cultivation had spread as far north as Egypt, where it was used in ancient burials. As watermelons spread, they were enthusiastically adopted elsewhere – in China, by Native Americans, and by others. Watermelon is now cultivated across the world.

Syngenta's "Super Pollenizer" (SP) watermelon, and similar offerings from other companies, are bred to bear many male flowers. Pollen of these flowers stimulates a special kind of watermelon seed, called a triploid hybrid, to set fruit. The resulting melons are seedless due to the female parent's odd number of sets of chromosomes.

In farmers' fields, pollenizer watermelon plants are interspersed with the triploid hybrids in a pattern designed to insure that SP pollen reaches all the hybrid plants (see box for a more detailed explanation of seedless watermelon production).

Seedless watermelons date to the 1940s, but were comparatively rare in most places until recently. In the past decade, however, they have been widely commercialized. Syngenta and other companies, including Monsanto and Bayer, now sell seedless watermelons in North America, Europe, Africa, Australia and Asia.

TWN THIRD WORLD NETWORK is a network of groups and individuals involved in bringing about a greater articulation of the needs, aspirations and rights of the people in the Third World and in promoting a fair distribution of world resources and forms of development which are humane and are in harmony with nature.

Address: 131, Jalan Macalister, 10400 Penang, MALAYSIA
E-mail: twnet@po.jaring.my

Website: www.twn.my

Tel: 60-4-2266728/2266159 **Fax:** 60-4-2264505

How are seedless watermelons produced?²

1. A chemical is applied to watermelon seedlings that causes the plant's chromosomes to multiply from a normal state (diploid, one set) to a doubled state (tetraploid, two sets). Tetraploid plants are identified and seed produced from them.
2. Tetraploid plants are fertilized with pollen from diploid plants, resulting in seeds with three copies of each chromosome, termed triploid. These triploid hybrid seeds will germinate and mature; however, they are naturally infertile.
3. Because triploid hybrids can be finicky about germination and delicate as seedlings, in some regions they are grown in nurseries and delivered to farmers as small plants. In others, they are sold as seeds.
4. The triploid plants are delivered to farmers together with diploid varieties used to pollinate them. These pollenizer varieties are selected to produce many male flowers for an extended time and are typically planted at a ratio of 1:3 or 1:4 alongside or in row with triploids.
5. Bees carry pollen from the diploids to the triploids, stimulating the triploid plants to set fruit. The resulting watermelon is seedless because of chromosome incompatibility between the female flower and the pollen.
6. Pollenizer varieties also set fruit, but are bred to have easily recognized characteristics (e.g., foliage, rind colour and consistency) different than the triploids, ensuring that seeded melons are recognized in the field and not marketed as seedless.

Between 2003 and 2011 in the United States, the market share of seedless watermelons jumped from 51% to 83%. Although they are historically costlier to produce than seeded melons, the price premium that consumers will pay for seedless types, and consumer expectations, have made the difficulty and expense of growing seedless types worth it for many farmers. Seedless watermelons also offer advantages to seed companies, because the product cannot be replanted and therefore farmers must purchase seeds every year.

Syngenta's "Super Pollenizer" (SP)

Syngenta's SP varieties have incorporated several key traits from Africa, but they began as a cross between two Chinese watermelons. One is a commercial offering from Taiwan

("Tiny Orchid" from the Know-You Seed Company) and the other an edible seed variety from Xinjiang region of northwest China called "ESW1".³ This first cross, called SP-1, is covered by plant breeder's rights in the United States, Europe, New Zealand, Australia, Mexico and Turkey. It is also covered by patents as noted in Table 1.

After claiming SP-1, Syngenta began a programme to enhance it by adding a series of disease resistance genes. These were found in genebank collections of African watermelons.

From South Africa, Syngenta obtained *Fusarium* wilt resistance in a watermelon collected in the Kalahari in 1964. It is unclear if this melon, denominated PI 296341 and noted

Table 1: Syngenta's "Super Pollenizer" Intellectual Property		
Variety	Plant Breeder's Rights⁴	Patent⁵
SP-1	US PVP 200300006 CPVO 20040523 (Europe) New Zealand VEM008 Australia 2004016 Mexico 542-SAN-002-101003 Turkey 4618	US 6759576 US 7071374 US 7528298 CN 1738529 (China patent) EA 009946 (Eurasia patent) AU 2003216413 (Australia patent)
SP-4	US PVP 200700023 CPVO 20072975 (Europe) 218060001302011 (Brazil) Australia 2007233 Turkey 4619	US 7550652
SP-5	US PVP 201000008 Australia 2011164 Mexico 1272-SAN-015-011011	US 8173873 (Patent) AU 2011200211 (Australia application)
SP-6	US PVP 201200091 South Africa PT6888 (Application)	US 8212118 (Patent) AU2012202642 (Australia application)

as a "Tsamma" in genebank collections, is a wild watermelon or a farmers' variety. It is unsurprising that Syngenta used PI 296341, however, because its *Fusarium* resistance was identified as early as 1989.⁶ Syngenta added the gene to SP-1, calling the "new" variety SP-4.⁷

PI 296341 was already a well-known source of *Fusarium* resistance from South Africa, but this was not an obstacle for Syngenta to obtain plant breeder's rights over SP-4 in the United States, Europe, Brazil, Australia and Turkey. In addition, a utility patent was issued for SP-4 in the United States. There is no public indication that Syngenta entered into any relevant benefit-sharing agreements.

In 2010, Syngenta took mildew resistance from a Zimbabwean seed originally collected in April 1982. This it bred into SP-4. Denominated TGR 309 (PI 482270), this watermelon had been collected by the International Board for Plant Genetic Resources (the predecessor to Bioversity International, part of the Consultative Group on International Agricultural Research) from a farmer's field 30 kilometres north of the city of Masvingo (then called Fort Victoria). The collectors' notes indicate that it is a sweet, red-fleshed variety.⁸

Syngenta called the resulting pollenizer variety SP-5. To date, plant breeder's rights have been issued in the United States, Australia and Mexico. At the time of writing, a utility

patent has been issued in the United States, and is pending in Australia.

Syngenta then sought resistance to zucchini yellow mosaic virus (ZYMV), a widespread disease of watermelons and other cucurbits.⁹ It found ZYMV resistance in a watermelon from Nigeria whose collection date is unclear. This melon, whose local name is “Egun”, was placed in the United States Department of Agriculture (USDA) collection in 1990 by researchers from Auburn University in Alabama, USA. It is an “egusi” watermelon type, grown for its nutritious seeds of the same name, which are used in egusi soup and other Nigerian recipes.

Syngenta added ZYMV resistance from the Nigerian melon to SP-5, calling the resulting variety SP-6. This melon has been patented in the United States and an application is pending in Australia. Plant breeder’s rights have been issued in the United States and are pending in South Africa.

Seedless melon markets

There is a significant market for seedless watermelons in many regions of the world. In 2012, Americans spent over \$520 million on watermelons.¹⁰ With seedless types commanding a price premium and accounting for over 80% of the market, this suggests that seedless watermelons are worth more than \$415 million per year in the United States alone.

But according to UN Food and Agriculture Organization (FAO) statistics as seen in Table 2, the United States is only the 9th largest watermelon producer in the world in terms of acreage sown. China is far and away the largest producer, planting 1.8 million hectares. Syngenta’s SP-1 variety is patented in China, and its seedless watermelons, whose pollenizer genetic base is composed of two Chinese melon varieties, are sold there.

A Eurasian patent¹¹ on SP-1 covers world #2 watermelon producer Russia and #10 producer Kazakhstan. Some of Syngenta’s SP types

Table 2: Top Watermelon Producers by Area Harvested
(2011 – Source: FAOSTAT)

Country	Hectares Harvested
China	1.8 million
Russia	160,000
Turkey	146,000
Iran	132,000
Brazil	98,000
Ukraine	62,000
Egypt	51,000
Algeria	51,000
United States	49,000
Kazakhstan	48,000
Uzbekistan	46,000
Thailand	41,000
Mexico	41,000
Indonesia	33,000
Pakistan	32,000

are covered under plant breeder’s rights in #3 producer Turkey and #5 producer Brazil.

Due to the limitations of online patent and plant breeder’s rights databases, it is quite possible that Syngenta’s intellectual property claims have been made or granted in more places than indicated here.

Benefit sharing and disclosure of origin questions

Syngenta accessed all three of the African varieties that have yielded intellectual property-protected disease-resistant watermelons from genebanks rather than doing the collecting itself. In all likelihood, these genebanks were not located in the country of origin of the resistant seeds. The South African and Nigerian melons both appear to have entered the international genebank system via the United States, while the third melon, from Zimbabwe, was collected by the institution now named Bioversity International (see Table 3).

Table 3: Syngenta's Disease Resistance Gene Sources		
Accession	Use by Syngenta	Collection Details
"Tsamma" (South Africa), USDA PI 296341	Source of <i>Fusarium</i> wilt resistance	Collected in or before 1964 in Cape Province, South Africa. Provided to international collections in 1964 by the Plant Introduction Office, Pretoria. Possibly uncultivated.
TGR 309 (Zimbabwe), local name unrecorded, USDA PI 482270	Source of mildew resistance	Local variety collected in April 1982 by the International Board for Plant Genetic Resources (now Bioversity International) near Masvingo. Local cultivar.
"Egun" (Nigeria), USDA PI 595203	Source of zucchini yellow mosaic virus (ZYMV) resistance	Donated to USDA collection in 1990 by Auburn University, Alabama, USA. An egusi-type melon.

Watermelons are not among the crops covered by the Multilateral System of the International Treaty on Plant Genetic Resources for Food and Agriculture; thus, access and benefit sharing (ABS) for the materials claimed by Syngenta is internationally governed by the Convention on Biological Diversity (CBD) and, upon its entry into force, the Nagoya Protocol on access and benefit sharing. Because each of the watermelon accessions appears to have been collected prior to the entry into force of the CBD, to address the legal aspects of access and benefit sharing, governments (particularly in the country of origin) need to take appropriate measures in national ABS laws as well as require the disclosure of country of origin, prior informed consent and evidence of benefit sharing in patent applications.

Syngenta's patent application on SP-1 divulges the Chinese origin of both parents of that variety, although it uses what appears to be an internal designation for one of the par-

ents that does not facilitate its identification in international databases.

Syngenta's patent applications on the three varieties with African disease resistance do not disclose the country of origin of the resistance traits, nor do they even identify them as being from Africa at all. Thus, unless readers of the patent applications consult genebank databases to identify the origin of these seeds, they cannot even be identified as being African, much less more specific details.

Edward Hammond directs Prickly Research (www.pricklyresearch.com), a research and writing consultancy based in Austin, Texas, USA. He has worked on biodiversity and infectious disease issues since 1994. From 1999 to 2008 Hammond directed the Sunshine Project, an international non-governmental organization specializing in biological weapons control. Hammond was Programme Officer for the Rural Advancement Foundation International (now the ETC Group) from 1995 to 1999. He holds

MS and MA degrees from the University of Texas at Austin, where he was an Inter-American Foundation Masters Fellow.

Endnotes

1. Watermelons are not among the crops in the Multilateral System of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), and their exchange as genetic resources is thus governed by the Convention on Biological Diversity and its Nagoya Protocol.
2. For more information see: McCuistion F and TC Wehner. Seedless Watermelon Breeding (web page). North Carolina State University. URL: <http://cuke.hort.ncsu.edu/cucurbit/wmelon/seedless.html>
3. "ESW1" is likely Syngenta's designation for this variety, making it difficult to trace this watermelon back to its Chinese origin.
4. Search conducted on the UPOV PLUTO Database. URL: <http://www.upov.int/pluto/en/>
5. Search limited to those countries or regional patent offices with data reported in the INPADOC database. URL: <http://www.epo.org/searching/essentials/patent-families/inpadoc.html>
6. Netzer D and RD Martyn. 1989. PI 296341, a Source of Resistance in Watermelon to Race 2 of *Fusarium oxysporum* f. sp. *Niveum*. *Plant Dis.* 73:518.
7. SP-2 and SP-3, if they exist, appear to have never been publicly described.
8. USDA. 1994. Plant Inventory No. 191. p. 191.
9. Cucurbits are the plant family that includes watermelons and many other melons, cucumbers, squash, zucchini (courgette), pumpkins, luffa and many gourds.
10. USDA ERS. 2013. U.S. Watermelon Industry (89029) (online statistics). URL: <http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1399>
11. See <http://www.eapo.org/>