

SEEDLESS STORY

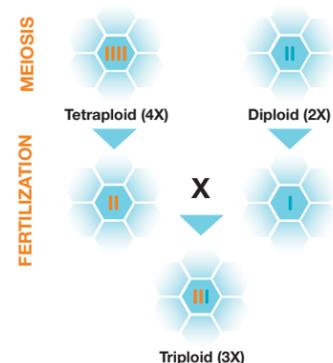
Although the breeding technology for seedless watermelon was developed in the late 1940s, only in the last quarter century have seedless watermelon crops been widely commercially grown. Standard seeded watermelon plants have 2 sets of 11 chromosomes (diploid), while seedless watermelon plants have 3 sets of 11 chromosomes (triploid).

SEEDLESS WATERMELON DEVELOPMENT TIMELINE



HOW TO MAKE A SEEDLESS WATERMELON

The chromosome number of a standard diploid (2X) watermelon is doubled using a chemical agent (like colchicine) to produce a tetraploid (4X) watermelon. This step is necessary to the production of triploid (3X) seedless watermelon varieties, which are hybrids developed by crossing tetraploid (4X) and diploid (2X) parent lines.



Because triploid seedless varieties do not contain developing seed, they require pollen to stimulate fruit growth. Triploid plants are essentially sterile and produce little, if any, viable pollen. To ensure fruit set initiation in the seedless crop, a pollenizer is interplanted in rows of triploid seedless variety plants.

BREEDING CONCEPT

SOURCES OF GENETIC VARIATION: related species, wild types, elite material from different parts of the world, etc.

SCREENING FOR TRAITS OF INTEREST: disease resistance screen, stress tolerance screen, trials in multiple environments

CROSSING AND SELECTION



Genetic diversity

Cross pollination

Powdery mildew screen

SEEDLESS WATERMELON TRAITS

GROWER TRAITS

- Marketable yield
- Maturity
- Plant vigor
- Disease resistance
- Field holdability

CONSUMER TRAITS

- Fruit uniformity
- Firmness/texture
- Flesh color/lycopene
- Low hollow heart sensitivity
- Low hard seed coat sensitivity
- Sugar/brix
- Shelf-life

UNDESIRABLE TRAITS



Poor flesh color/uniformity

Hollow heart

DESIRABLE TRAITS



Uniform fruit size

Ideal flesh color/texture for seedless watermelon

EXAMPLE DEVELOPMENT TIMELINE



YEAR 8

Commercial

YEAR 7

Pre-commercial testing

YEAR 6

Advanced hybrid testing

YEAR 5

Test hybrids

YEAR 1-4

Parent development

Watermelon Biology

Offering an industry-leading portfolio of watermelon varieties, growing methods and crop protection products, Syngenta provides its customers with modern agricultural solutions that help drive production of high-quality, nutritious watermelons with strong, diverse market appeal. In order to understand the intricacies of watermelon production, it is important to first know the basics of watermelon biology. This piece provides a top-line overview of key factors affecting watermelon production and marketing.

Seedless vs seeded: Total watermelon acreage in the United States is over 130,000 acres. More than 85 percent of U.S. watermelon production consists of seedless varieties. Florida, Georgia, Texas and California are the leading production states in the U.S.

Planting seed vs transplants: One hundred percent of the seedless acreage is transplanted. Nearly 50 percent of the seeded acreage is transplanted.

Plant populations: Normal plant populations for seedless crops are from 1,800 to 2,200 seedless plants per acre, plus the pollenizer plants.

Pollenizer ratios for seedless: Normal ratios are from 3:1 to 4:1 seedless plants for every pollenizer (also referred to as seeded, diploid or male). Pollenizer plants per acre range from 500 to 700 plants/A.

Bees/pollination: Bees are essential for pollination in a watermelon field. Growers will use at least 2 to 3 hives per acre. Bumblebees are now used in some areas as bumblebees can work under colder/windier conditions than honeybees. Sixteen to 24 bee visits per flower are required for seedless watermelon plants to achieve maximum fruit set and development. Seeded watermelon plants only require 8 to 12 bee visits per flower in order to achieve maximum fruit set and development.

Hard seed coats: "My seedless watermelon had seeds. Why?" Chances are these are not seeds, but hard seed coats that are empty and do not contain a seed. Immature white seed coats are commonly found in a seedless watermelon. Under certain stress/environmental conditions, some of these seed coats may become hard and black and look like a seed, but are empty inside. There is no harm in eating these hard seed coats.

Irrigation: As moderate users of water, watermelon plants require ample irrigation during fruit development for uniform, well-developed fruit. Water stress can cause misshapen fruit and poor internal quality. In comparison, potatoes and cabbage are heavy users of water.

Fertilizer: Watermelon plants are moderate to heavy users of fertilizer. Depending on soil test results, a crop will need from 100 to 150 lbs/A nitrogen, 50 to 150 lbs/A phosphate and 50 to 150 lbs/A potassium.

Grafting: Watermelon plants can be grafted onto a squash root stock to improve resistance to soil-borne diseases (like Fusarium) and to improve the performance of the plant under stressful conditions. Grafting is done in other parts of the world (Spain, Turkey, China, Mexico) but due to the high cost of grafting, which is a labor intensive process, it is not yet prevalent in the U.S. The USDA has funded a Specialty Crops Grant for grafting, which includes watermelon and other vegetable crops, in order to investigate ways to bring this technology into the U.S. market.

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Major Watermelon Diseases



Bacterial fruit blotch: Appears as dark, greasy blotches on nearly ripe fruit. Fruits become non-marketable. Can cause serious economic loss.



Gummy stem blight: Starts on the older plant leaves. Leaf spots are dark brown and begin on the edges of the leaves. If severe, it can nearly defoliate a plant. Increasing resistance to several fungicides.



Powdery mildew: Appears during dry spells as yellow or white powdery spots on the leaves. Leaves can yellow quickly. Some resistance to fungicides.



Fusarium: Vascular tissue in the root becomes discolored, which leads to plant collapse. Control by crop rotation, resistant varieties and grafting.

Additional diseases include: Pythium, anthracnose, downy mildew

Major Watermelon Insect Pests



Aphids: Reproduce rapidly and produce a sticky honeydew-like substance that covers the leaf. Can transmit viral diseases.



White flies: Reproduce quickly in hot weather. General feeding damage. Can transmit viral diseases.



Spider mites: Multiply rapidly during hot weather. Yellowing between the leaf veins, "webbing", develops on the underside of the leaf.



Rindworms: Insect larvae that feed on watermelon rinds are generically referred to as rindworms. Their feeding results in irregular trails over the rind surface.

(Source: Donald N. Maynard. University of Florida, Bradenton)

Disease and insect control:

There is genetic resistance available for Fusarium (now in commercial varieties) and powdery mildew (in some advanced experimental varieties). Watermelon growers utilize IPM (integrated pest management) programs and PCA (pest control advisor) services to monitor and appropriately control diseases and insects. Watermelon growers are careful to not over-apply pesticides because of environmental issues, added cost and pesticide resistance management.

HARVEST INFORMATION

- 1) Number of harvests:** On average, a field is harvested 3 times with approximately 5 to 7 days between harvests.
- 2) Seedless yield:** Yield will range from 40,000 to 90,000 lbs/A. Growers will average 1.5 to 2.5 harvestable fruits per plant for regular seedless watermelon.
- 3) Fruit size:** Size is based on the number of fruit that will fit in a standard bin that weighs 700 lbs. Standard fruit sizes are 36 count (18 to 22 lbs/fruit), 45 count (14 to 17 lbs/fruit) and 60 count (10 to 14 lbs/fruit). Mini seedless are packed in cartons of 6 to 8 fruit/carton and fruit weigh 4 to 6 lbs.
- 4) Postharvest handling:** Cooling is preferred, but not required. Most growers move the fruit into the market soon after harvest. Optimum storage temperature for whole fruit is 50 to 59°F. Storage life is typically 14 days at 59°F and up to 21 days at 45 to 50°F. Chilling injury (water-soaked areas on the rind, softening of the flesh) can develop if fruit are stored at less than 45°F.
- 5) Ethylene:** Watermelons produce very little ethylene, but are very ethylene sensitive at levels as low as 5 ppm. Do not ship/store watermelon with muskmelons, cantaloupes, honeydews, apples or other "ethylene producers".



ORIGIN

The scientific name for watermelon is *Citrullus lanatus*. Watermelon is a member of the Cucurbitaceae botanical family, which contains more than 800 different species, including watermelon, cucumber, melon, squash and various gourds. The center of origin for watermelon is the drier areas of tropical and subtropical Africa. Although originally domesticated in central and southern Africa, watermelons spread globally via emigration and trade routes. Early European colonists brought watermelon to the Americas and, by 1576, Spanish colonists were growing watermelon in Florida.

MORPHOLOGY



Watermelon roots uptake water and nutrients from the soil to the plant. Watermelon roots tend to be shallow and extensive.



Watermelon plants are typically monoecious, meaning distinct male and female flowers grow on the same plant. Typically, flowers are produced in a ratio of 5 to 7 male flowers for every 1 female flower. The male and female flowers are easily distinguished by the bulbous ovule beneath the petals of a female flower.



Watermelon is the only economically important cucurbit with lobed leaves. Watermelon plants grow as a trailing, highly branched vine.

Watermelon seeds come in a range of colors and sizes. On average, they take 3 to 6 days to germinate. Optimal germination conditions are 85 to 90° F and high humidity.



Watermelon fruit are 92 percent water. Red fleshed varieties are a good source of lycopene—averaging between 36 to 78 ug/g. There is significant variation in watermelon appearance (size, shape, skin), flavor (bitter vs. sweet) and flesh characteristics (seeded vs. seedless, flesh colors, flesh textures).

ADAPTATION

Watermelon is a warm season crop. Flowering and fruit development are promoted by intense sunlight and high temperatures. Watermelon crops are grown commercially throughout the world, with Asia being the most important production area (77 percent of the world's watermelon production). Watermelon plants perform best in soil with good drainage, high levels of organic matter and a neutral to slightly acidic pH.