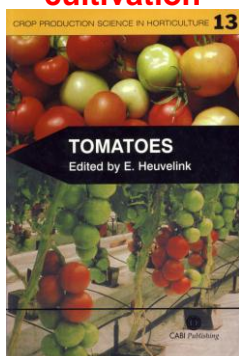


Solanaceous vegetables

- Solanaceae family - nearly 100 genera and 2700 species; the biggest diversity is in Latin-America
- Has great agricultural importance (vegetables, tobacco, chillies, ornamental crops, etc.)
- One of the most important plant family for vegetable production
- 23 species in the „World vegetables” book
- Potato is the No.1 tuber crops in the world
- As for the vegetables, tomato is No. 1, eggplant is No. 6, sweet pepper is No. 8
- Big importance in greenhouse vegetable production
- Some solanaceous vegetables are marketed as tropical fruits

Characteristics of tomato and its cultivation



Importance

- Number one vegetable crop in the world (processing, fresh; field, greenhouse)
- Most production is located in the temperate zone
- **World data:**
- 4,8 M ha, 177 M t, 37 t/ha
- China 32%, India 10%, USA 7.4%, Turkey 7.1%
- **EU data:**
- 265 th. ha, 18 M t, 68 t/ha
- Italy 36%, Spain 26%, Portugal 9.4%, Greece 5.8%, Netherlands 5.0%
- (subsidisation of processing tomato production has been stopped in the EU in 2008)

/FAOSTAT, 2016/

Taxonomy and origin

- *Solanum lycopersicum*
- native to the Andean region (Peru-Ecuador)
- probably domesticated in Mexico

Nutritive values and usage

- 4-7(-12)% dry mater content; soluble solids content = °Brix
- sugar:acid ratio (opt. 10:1) + volatile compounds → flavour
- bioactive compounds: lycopene, vitamin C, flavonoids, folate, doesn't contain alkaloids
- eaten fresh (all year round supply) and cooked,
- and in a multiple of processed form: whole peeled, juice, pulp, purée, paste, pickled, dried

Morphology

- Originally perennial, cultivated as an annual plant
- **Root system:** deep taproot (not so pronounced with transplanting); adventitious root formation
- **Stem:** a true sympodium; indeterminate, semi-determinate, determinate
- **Leaf:** compound pinnate, coarsely toothed
- **Flower:** yellow, hermaphroditic flowers (4-12-(30) pieces) in clusters (trust), self-pollinated with facultative bee pollination
- **Fruit:** fleshy berry, seeds in the fleshy pericarp, growth period is 35-60 days; changes colour during ripening; climacteric
- **Seed:** flattened ovoid, 2,5-3,5 g th. seed weight



Fig. 3.2. Sympodial nature of flowering in tomato. The initial axis terminates in the inflorescence. A, B, C: leaves initiated before flower initiation; D: first initiated leaf on axillary shoot. (Reprinted, with permission, from National Agricultural Advisory Board, London, 1967.)

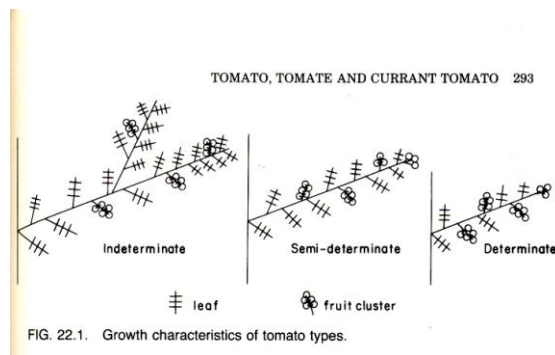


FIG. 22.1. Growth characteristics of tomato types.

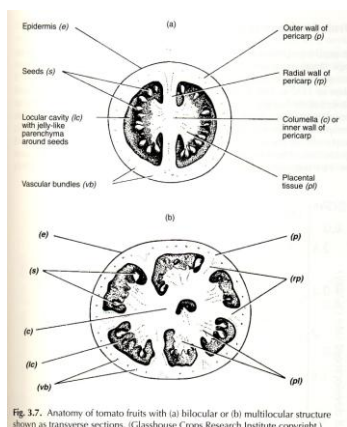


Fig. 3.7. Anatomy of tomato fruits with (a) bilocular or (b) multilocular structure shown as transverse sections. (Glasshouse Crops Research Institute copyright.)

Ecological requirements

- **Light:** day neutral, sets fruits above 5.000 lux; too much sunlight can cause sunscald
- **Temperature:** can be grown above 16°C average T; frost sensitive; threshold T for germination is 10°C; optimum T for germination is 30°C, for growth is 20-25°C; below 12°C chilling injury occurs; above 32-38°C growth is retarded
- **Water:** has some drought tolerance; sensitive to waterlogging, PET is 3-10 mm/day; requires 25-30 mm/day in average
- **Soil:** not so sensitive to soil type and quality; pH = 5,5-7,0, relatively salt tolerant
- **Nutrients:** likes manure; too much N results in excessive vegetative growth; has a high potassium (and calcium) requirement ↔ °Brix;

Classification of cultivars

- **Based on the usage:** industrial, fresh market
- **Processing t.** – determinate growth, dwarf habit – small vines, uniform and concentrated fruit set and ripening, good vine storage, fruits should break easily from the stem (jointless), tough skins, high °Brix
- **Fresh market t.** – indeterminate or semi-determinate, shelf-life and disease resistance have bigger importance, earliness, state of calyx
- **Based on the growth habit:** determinate, semi-determinate, indeterminate
- **Based on the berry size:** cherry and cocktail (10-20 g, 16-25 mm), classic (70-100 g 47-67 mm), beefsteak (180-250 g)
- **Based on the berry shape:** round, lobed, oval (plum), cylindrical
- **Based on the picking method:** single fruits; truss or vine t.
- **Based on the berry colour:** red, pink, yellow, orange, blackish, multiple coloured
- **Based on shelf life:** normal, semi-LSL, LSL ((? GM tomato))

Field production of fresh market (F) and processing (P) tomatoes I

- **Crop rotation:** strongly recommended
- **Tillage:** ploughing or discing, (chiselling), bed formation, pressing with land roller
- bare ground or plastic mulch culture
- **Propagation:**
 - **direct seeding (P)** – 1,5-4 cm depth, 100-200 thousand seeds/ha, thinning at 3-4 true-leaf stage
 - **transplanting** – (P) plug transplants (20-30 cm³/cell), 4-5 weeks raising period, (F) soil block or pot transplants; 30-40.000 plants/ha; transplanted to the depth of the first true leaves

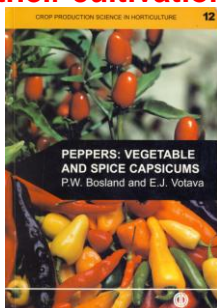
Field production of fresh market (F) and processing (P) tomatoes II

- **Irrigation:** overhaed sprinkler, furrow or drip; 5-7 days interval on good soils; (P) cut off irrigation 2-4 weeks before harvest
- **Crop management:** (F) rarely row tunnels; (F) pruning – removal of side shoots, staking and trellising; weed control
- **Harvest:** (F) multiple hand harvests at various stages of ripeness; (P) once-over destructive mechanical harvest at the red-ripe stage (70-125 DAP), etephon spraying 2-3 weeks prior harvest
- **Post-harvest (F):** size and colour grading
- **Storage (F):** 85-95% rh, 13-18°C for green (4-7 weeks) and 8-10°C for red (1-3 weeks) fruits

Greenhouse production of tomatoes

- The exact technology depends on the type of the greenhouse and on the locality; 1-2 cultures/year
- Duration of cultivation varies from 4-5 to 11.5 months after planting; indeterminate cultivars
- **Propagation:** always by transplants, 1.25 – 5 plants/m² → 3-5 stems/m²
- **Irrigation, fertilization:** usually by fertigation; soilless cultivation is very common
- **Crop management:** usually trellised – high-wire system; removal of side shoots and older leaves, removal of growing point 4-6 weeks prior the end of the cultivation
- **Harvest:** hand harvests at one week interval, stage of ripeness depends on transportation distance; yield varies from 20 to 80 (100) kg/m²

Characteristics of capsicums (vegetable and spice peppers) and their cultivation



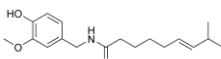
Taxonomy and origin

- Solanaceae family
- Capsicum genus
- With one exception every Capsicum species originated from America
- 25 wild species
- and 5 domesticated species:
 - *C. annuum* (domesticated in Mexico)
 - *C. frutescens*, *C. chinense*, *C. baccatum*, *C. pubescens*

Nutritive values and usage

- vitamin C
- carotenoids
- vitamin E
- capsaicin
- used as vegetable in salads, cooked, fried, and as pickles
- used as spice in dehydrated form or as a paste
- used in folk, traditional and even in modern medicine
- used as a pot plant

antioxidants



Importance (chillies and peppers)

- **World data:**
 - 'green' 1.9 M ha, 34.5 M t, 18 t/ha
 - China 50%, Mexico 8%, Turkey 7%, Indonesia 5.7%
 - 'dry' 1.8 M ha, 3.9 M t, 2.2 t/ha
 - India 35%, Thailand 9.7%, Ethiopia 8.4%, China 7.8%
- **EU data:**
 - 'green' 62 th. ha; 2,4 M t; 38 t/ha
 - Spain 45%, Netherlands 15%, Italy 11%
 - 'dry' 55 th. ha, 73 th. t, 1,3 t/ha
 - Romania 63%, Hungary 22%, Spain 5.5%

/FAOSTAT, 2016/

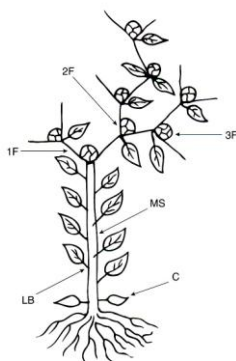


Fig. 3.9. Schematic diagram of *Capsicum annum* plant development: C, cotyledons; MS, main stem; 1F, first terminal flower; 2F and 3F, second and third node flower; LB, nodes.

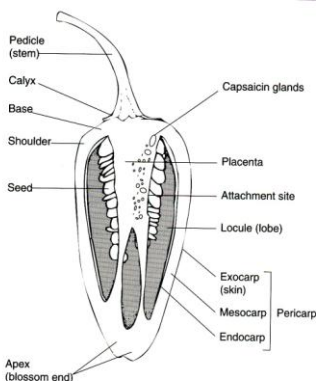
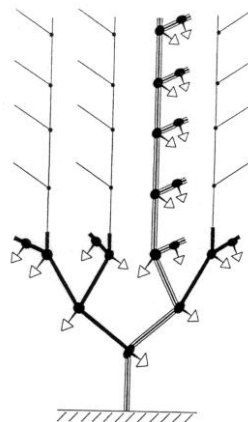


Fig. 3.11. Pepper fruit illustrating the vein on the placenta where the capsaicinoids are concentrated (pungency).

Morphology

- Annual plant at our climate
- **Root system:** usually without a taproot, as a consequence of transplanting; shallow rooted (max. 30-60 cm depth), tassel-like
- **Stem:** indeterminate, semi-indeterminate, determinate
- **Leaf:** simple, entire, symmetrical
- **Flower:** usually solitary; hermaphroditic, pentamerous (5-7 petals), usually white; flowers for less than one day; self-compatible with facultative bee pollination
- **Fruit:** diverse in shape, size and colour; a pod with two or more locules; needs 35-50 days until mature green stage; changes colour during ripening; non-climacteric
- **Seed:** straw yellow; thousand seed weight is 5-7 g

Classification of cultivars

- **Based on the usage** – vegetable (immature full size or mature), spice
- **Based on the level of pungency** – hot (pungent), sweet (non-pungent)
- **Based on the cultivation method** – field, greenhouse
- **Based on the growth habit** – determinate; indeterminate: vegetative and generative types
- **Based on the pod type** (50-75 groups) - bell, pimiento, tomato, yellow wax, cherry, paprika, chiltepin, ancho, cayenne, pepperoncini, costeno, mirasol, cascabel, de Arbol, jalapeno, serrano, new Mexican, santaka, habanero, scotch bonet, datil, charapita, aji, amarillo, etc. /Bosland & Votava,2000/

Ecological requirements

- **Light:** fruit set is above 5.000 lux; flowers with a daylength of 10 hours or more; too much sunlight can cause sunscald
- **Temperature:** warm season crop; highly susceptible to frost; threshold T for growth is 10-(18)°C; sets fruit between (16)-18-32°C
- **Water:** has high water need, WUE is about 10 kg/m³
- **Soil:** needs good quality soils (deep, well-drained, good aeration and water holding); moderately sensitive to soil salinity
- **Nutrients:** high nutrient requirement; likes manuring; vegetative/generative balance ↔ N:K ratio; too much N overstimulate growth; blossom-end-rot

Field production I

- **Crop rotation:** once in every 3-4 years, with no other solanaceous crops in the rotation; wheat, cole crops, maize, lucerne, legumes are favourable
- **Tillage:** ploughing, deep chiselling, discing, smoothing, listing; laser levelling
- in a flat field or on raised beds – plastic mulch covering
- **Propagation:** 30-100 thousand plants/ha with 25-30 cm within row spacing
- **direct seeding** – thinning at 3-4 true leaves stage
- **transplanting** – 6(-8)-week raising period, usually in greenhouse; bare root transplants, tray transplants (soil block transplants)

Greenhouse production

- The exact technology depends on the characteristics of the greenhouse and on the locality
- Duration of cultivation varies from 5 to 11 months after planting; indeterminate cultivars
- **Propagation:** always by transplants, (2)-3-6 plants/m² → 3-6 stems/m²
- **Irrigation, fertilization:** usually by fertigation; soilless cultivation is very common
- **Crop management:** staked (for shorter period of cultivation) or trellised (high-wire system); pruning: removal of unnecessary shoots
- **Harvest:** hand picked at 7-10 days interval, stage of ripeness depends on the type of the cultivar; yield varies from 8 to 30 kg/m²

Field production II

- **Irrigation:** essential in arid and semi-arid regions; drip, sprinkler or furrow irrigation; water applied on a 5-7-day schedule
- **Weed control:** crucial; with mulching, with herbicides and with shallow cultivation
- **Fertilization:** manure, 70-200-(300) kg N/ha
- **Row tunnels:** for altering microclimate, results 2-3-week earliness
- **Harvest:** fruit stage for harvest is dependent on the final use; mainly by hand with multiple picks; rarely machine harvested (followed by trash removal) for processing purposes
- **Storage:** max. 2-3 weeks; 7-10°C, 85-90% rh
- **Red pepper:** drying (sun- or artificial), dicing, drying (4-6%), grounding, rehydrating (8-11%), cold storage (3°C)