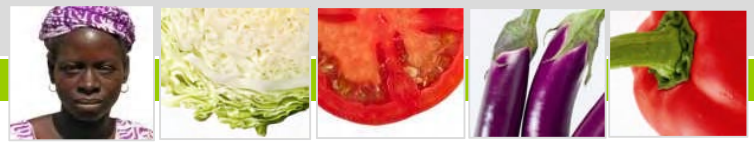
Certified Seed

This is the progeny of foundation seed (up to three generations) of a cultivar within a seed certification scheme.

The seeds are produced according to an officially approved and monitored program.

Certified seed produced from certified seed is not eligible for further seed increase.



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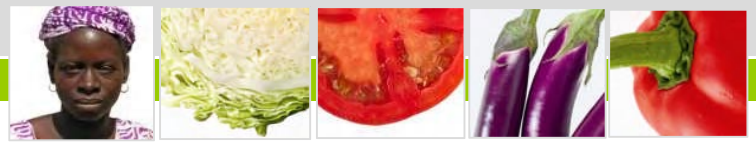
Commercial Seed

This is the stock of seed produced from foundation seed, but not within the framework of a seed certification scheme.

The majority of vegetable seeds used by farmers are in this category.



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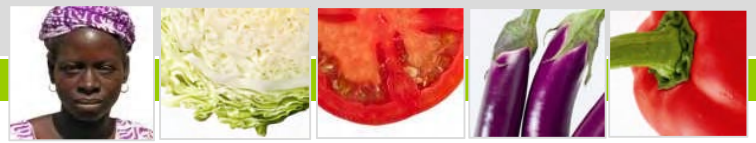
Botanical classification of vegetables

Monocotyledonae

Alliaceae
Allium cepa (onion)
Allium porrum (leek)
Allium sativum var. *sativum* (garlic)
Allium cepa var. *aggregatum* (shallot)

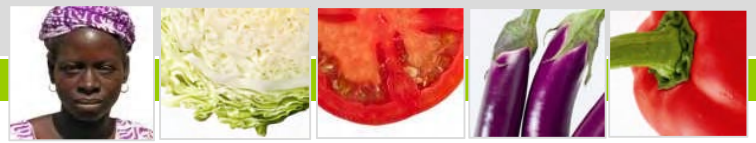
Dicotyledonae

Solanaceae
Solanum tuberosum (potato)
Solanum melongena (eggplant)
Solanum lycopersicum (tomato)
Capsicum annuum (bell pepper, chili)
Capsicum frutescens (tabasco)
Capsicum chinense (habanero)
Physalis peruviana (cape gooseberry)
Physalis philadelphica (Mexican husk tomato)
Cyphomandra betacea (tree tomato)
Solanum quitoense (naranjilla)
Solanum sessiliflorum (cocona)



Classification based on nature of pollination

Highly self-pollinated 90-100% selfing	Often cross-pollinated Cross poll. > 4%	Highly cross-pollinated Up to 100% CP
Asparagus bean (*V. unguiculata subsp. sesquipedalis*) Cluster bean (*Cyamopsis tetragonoloba*) French bean (*Phaseolus vulgaris*) Hyacinth bean (*Lablab purpureus*) Cowpea (*Vigna unguiculata* subsp. *unguiculata)* Garden pea *(Pisum sativum)* Lettuce *(Lactuca sativa)* Tomato *(S. lycopersicum)*	Lima bean (*P. lunatus*) Eggplant (*Solanum melongena*) Okra (*Abelmoschus esculentus*) Chili, sweet pepper (*Capsicum* spp.)	1. **Wind-pollinated**: amaranths, spinach (*Spinacia oleracea*), leaf, garden, sugar beet (*Beta vulgaris*) 2. **Insect-pollinated:** all cucurbits, all cole crops (*Brassica oleracea*), radish (*Raphanus sativus*), carrot (*Daucus carota)* onion (*Allium cepa*)



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Grouping based on planting response

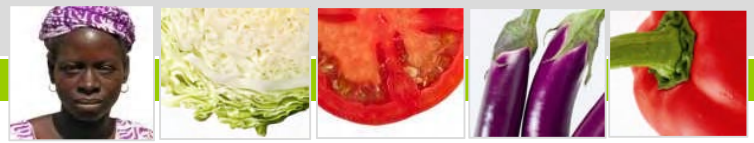
Survive transplanting easily:
all cole crops, Chinese cabbage, lettuce, tomato, eggplant, *Capsicum* spp.

Need care in transplanting:
onion, leek, celery, parsley (*Petroselinum crispum*), amaranths, cardamom

Not suited for transplanting:
garden pea, radish, carrot, spinach, gourds, garden beet

Suits both transplanting and direct seeding:
Chinese cabbage, chili, amaranths

Polypack planting:
most cucurbits, cucumber, bitter gourd, squashes, melons, pumpkins, tomato hybrids



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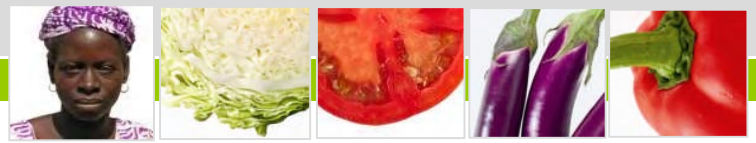
Grouping based on growth cycle

Annual:
tomato, eggplant, Capsicum spp., garden pea, amaranth, all cucurbits, celery, parsley, taro, cocoyam (*Colocasia*)

Biennial:
Cole crops, Chinese cabbage, onion, carrot garden beet, leek, radish, spinach

Perennial:
Asparagus, chayote (*Sechium edule*), ginger, cardamom, turmeric (*Curcuma longa*)

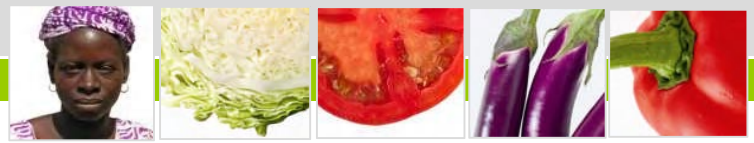


Grouping based on climate

Temperate:
Cabbage, kale, Brussels sprout, broccoli, sugar beet, chicory, potato, amaranths, temperate varieties of radish, carrot, garden pea, tomato

Sub-temperate/sub-tropical:
late cauliflower, spinach, celery, parsley, asparagus, chayote, sub-temperate varieties of radish, carrot

Tropical:
eggplant, okra, *Capsicum* spp., all cucurbits, ginger, turmeric, cardamom, sweet potato, Colocasia, tomato



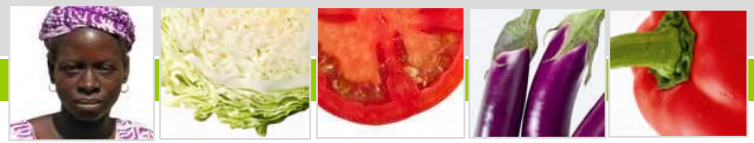
Factors affecting seed quality

During seed production

- Climate
- Cultural practices
- Isolation distance and rogueing
- Seed maturity
- Fruit and seed position on mother plant
- Insect pests and diseases

During seed storage

- Seed moisture
- Storage temperature
- Relative Humidity
- Oxygen
- Storage insect pests and diseases



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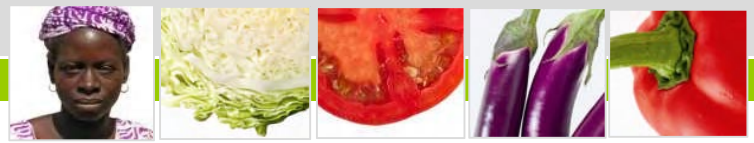
Effect of climate on seed quality

- **Temperature**
- **Relative humidity**
- **Rainfall**
- **Sunshine hours**
- **Wind velocity**

Determine growth, development and health of plants

Excess rain or drought during flowering affect seed set and result in low seed yields. Seed quality is also affected by environmental stress during seed filling stages



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Effect of climate on seed quality…..cont.

Cole crops (cabbage, cauliflower, kohlrabi, Brussels sprout) need vernalization for bolting (, 10 ^{o}C for six weeks)

Onions need cool weather during initial stages of crop growth, but require warm and dry conditions for seed maturation and harvesting. Plants grown at 15-16 ^{o}C yielded more high quality seed than those grown at 22-23 ^{o}C.

Tomato plants grow well at temperatures of 18-27 ^{o}C; fruit and seed setting is affected by high temperature and low humidity. Temperatures above 38 ^{o}C affect fruit set.

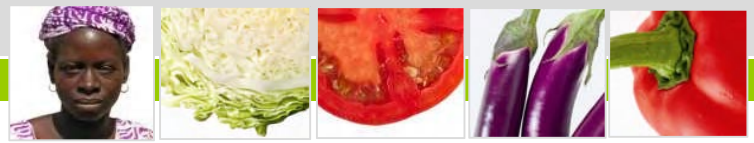
Small radishes grow better under cooler climate, large ones withstand fluctuations of temperature

Carrot seeds are produced at higher altitudes and in cooler regions

French bean and peas produce quality seeds under cooler conditions

Cucumber, melon and gourds prefer hot and dry or humid climate for growth

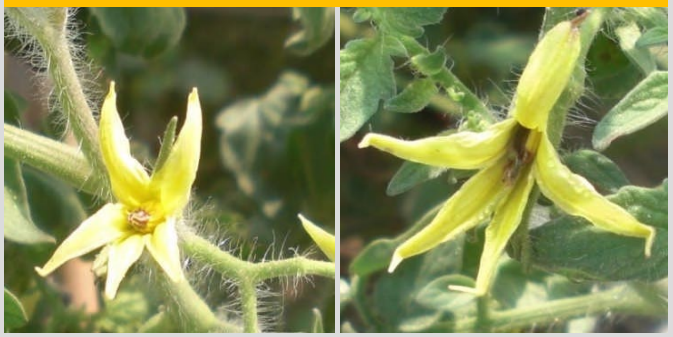
Muskmelon seeds produced in humid conditions are of inferior quality.



Searching for Heat Tolerance

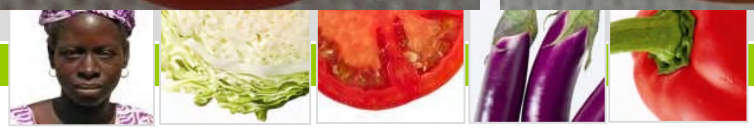
normal flower

damaged flowers of CA4



parthenocarpic fruits of CLN2498E

no fruit set in CA4



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Effect of cultural practices on seed quality

Seeds are either sown directly in the field or seedlings are raised in a nursery and transplanted after 4-6 weeks at appropriate spacing in the field.

Well drained humus-rich and fertile soils are most suited for vegetable cultivation

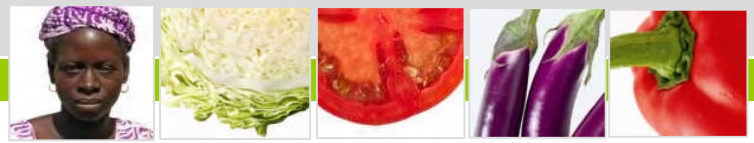
Support is provided to the young plant if needed (tomato, eggplant, beans)

Timely weeding, irrigation (fruit set and seed filling are critical stages), and adequate fertilizers must be provided

N+P applications improve seed vigor (constituents of proteins and phospholipids for cell membrane integrity)

Deficiency of calcium affects seed quality in muskmelon

Plants must be protected against insects and pathogens



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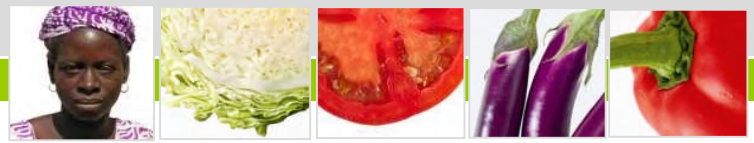
Effect of cultural practices … cont.

Crop rotation

Crop rotation ensures the maintenance of good soil structure and fertility.

It will affect the incidence of soil-borne pests and diseases which will affect growth of plants and seed yield.

It also affects the occurrence of volunteer plants which reduce the quality of the seeds produced.



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Effect of isolation (by distance, time, barriers) & rogueing

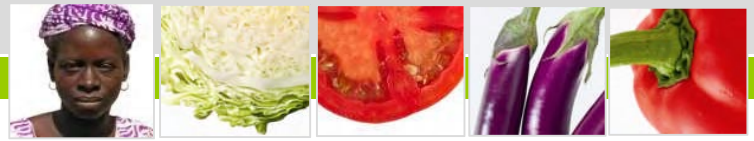
Genetic purity is an important parameter of seed quality. It is affected by genetic contaminations and genetic drift in the field.

Pollen contamination is prevented by removing weeds or related plants and by providing isolation distance.

The isolation distance is about 50 m for self-pollinated crops (tomato, garden peas, French bean) and 1,000 to 1,600 m for cross-pollinated crops (cole crops, onion, cucurbits).

Contamination is relevant during flowering: frequent inspection and removal of off-types can help maintain genetic purity.

Rogueing can be done at vegetative, flowering and mautrity stage of plants.



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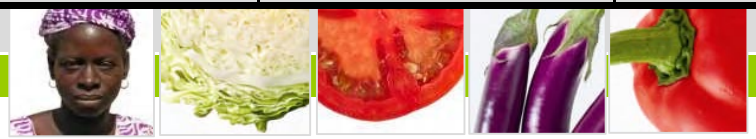
Pollination behavior of some vegetable crops

Crop	Species	Pollinat. type	Pollination mechanism	Method used
Amaranth	*Amaranthus* spp.	CP	Wind	Isolation 1000 m; bagging; net cage
Beet	*Beta vulgaris*	CP	Wind	Isolation 2000 m
Black gram	*Vigna mungo*	SP		
Bottle gourd	*Lagenaria siceraria*	CP, monoecious	Insects	Bagging & hand pollination; net c.
Brown mustard	*Brassica juncea*	Mainly SP; 4-14% CP	Insects	Isolation 1000 m; bagging; net cage
Cabbage	*Brassica oleracea* var. *capitata*	CP	Insects	Isolation 1000 m; Net cage w/ pollinator
Carrot	*Daucus carota*	CP; protandrous	Insects	Isolation 1000 m; Net cage w/ pollinator
Cauliflower	*Brassica oleracea* var. *botrytis*	Mainly CP	Insects	Isolation 1000 m; bagging; net cage
Chickpea	*Cicer arietinum*	SP		
Common bean	*Phaseolus vulgaris*	Mainly SP	Insects	Isolation 100 m; bagging; net cage



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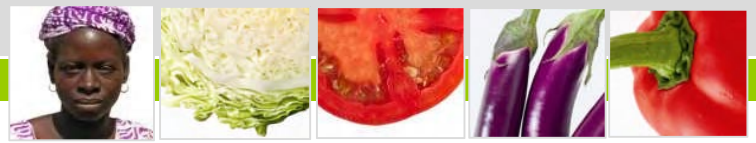
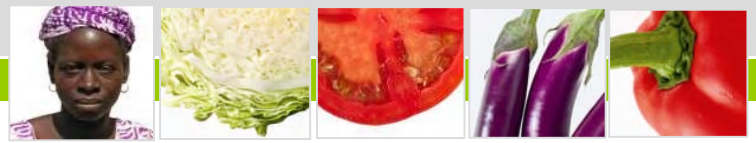
Pollination behavior of some vegetable crops

Crop	Species	Pollinat. type	Pollination mechanism	Method used
Cowpea	*Vigna unguiculata*	Mainly SP		
Cucumber	*Cucumis sativus*	CP; monoecious	Insects	Isolation 1000 m; bagging & hand pollination; net cage
Eggplant	*Solanum melongena*	Partial SP; 0-8% nat. outcrossing (AVRDC)	Insects	Net cage; supple-mentary hand pollination
Endive	*Cichorium endiva*	SP		Isolation 600 m
Faba bean	*Vicia faba*	Mainly SP; 4-8% outcrossing	Insects	Isolation 1000 m; bagging; net cage
Grass pea	*Lathyrus sativus*	SP; significant levels of CP		Bagging; Net cage
Hyacinth bean	*Dolichos lablab*	Partially CP;	Insects	Isolation 500 m;
Lentil	*Lens culinaris*	SP		
Lettuce	*Lactuca sativa*	Mainly SP; 1-6% outcrossing	Insects	Isolation 100 m; bagging; net cage



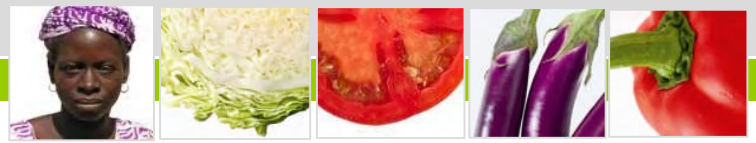
Pollination behavior of some vegetable crops

Crop	Species	Pollinat. type	Pollination mechanism	Method used
Lima bean	*Phaseolus lunatus*	Mainly SP; up to 18% outcrossing	Insects	Isolation; net cage
Melon	*Cucumis melo*	CP	Insects	Isolation 1000 m
Mungbean	*Vigna radiata*	SP		
Okra	*Abelmoschus esculentus*	Partial SP; out-crossing 4-19%	Insects	Isolation 500 m; bagging; net cage
Onion	*Allium cepa*	Mainly CP; protandrous	Insects	Isolation 600 m; net cage w/ pollinator
Garden pea	*Pisum sativum*	Mainly SP		Isolation 100 m
Chili, sweet pepper	*Capsicum annuum*	Often CP	Insects	Isolation 500 m; bagging; net cage
Pigeonpea	*Cajanus cajan*	Normally SP; nat. outcrossing 5-40%	Insects	Isolation 500 m; bagging, net cage
Pumpkin	*Cucurbita moschata*	CP; monoecious	Insects	Isolation 1000 m; bagging & hand pollination; net cage



Pollination behavior of some vegetable crops

Crop	Species	Pollinat. type	Pollination mechanism	Method used
Radish	*Raphanus sativus*	CP; self-incompatible	Insects	Isolation 600 m; net cage w/ pollinator
Safflower	*Carthamus tinctorius*	SP		
Sesame	*Sesamum indicum*	Mainly SP; up to 5% CP	Insects	
Soybean	*Glycine max*	SP		
Spinach	*Spinacea oleracea*	CP; dioecious	Wind	Isolation 2000 m; net cage
Sword bean	*Canavalia gladiata*	Mainly SP		Isolation 100 m
Tomato	*Solanum lycopersicum*	Normally SP; some species self-incompatible		Isolation 50 m; net cage w/ suppl. pollination, if necessary
Watermelon	*Citrullus lanatus*	CP; monoecious	Insects	Isolation 1000 m; bagging & hand pollination; net cage



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Factors affecting seed quality

During seed production

- Climate
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- Fruit and seed position on mother plant
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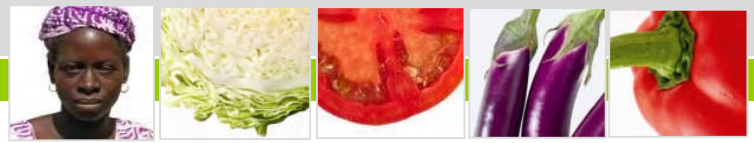
During seed storage

- Seed moisture
- Storage temperature
- Relative Humidity
- Oxygen
- Storage insect pests and diseases



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Seed maturity affects seed quality

Seed viability and vigor are highest at the mature fruit stage and are lower with early or late harvest of the crop

In onion, seed maturity is associated with rapid reduction in chlorophyll and water content, increase in dry weight, as well as germination

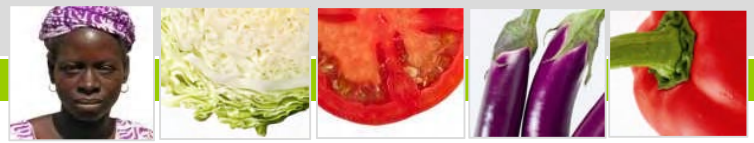
Pepper seeds are allowed to mature for up to one week within red fruits after harvest for maxim germination

Fruit cracks in okra indicate maximum seed germination and vigor

Tomato and pepper: fruits must be fully red

In cucurbits (watermelon), fruits are kept on the vine for some time to allow for complete maturity of the seeds

Seed maturity can be estimated by measuring chlorophyll fluorescence: the amount of chlorophyll is directly related to the degreening process and maturity.



Fruit and seed position on mother plant

In muskmelon, fruit position on mother plant influences seed quality

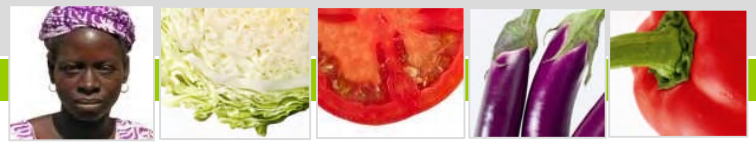
With increasing fruit numbers per plant, there is a reduction in fruit weight, seed weight and viability

Seeds from early pickings of tomatoes show higher seed quality

Pepper seeds from fruits formed on main stem, first and sec. branches have high seed weight and germination; plants from these seeds are more productive and have better disease resistance than plants from seeds on 3rd or 4th order branches appearing later.

Okra, eggplant: best quality seeds obtained from fruits borne at lower nodes

Seed position in fruit: In pepper and eggplant, seed from the basal portion showed higher viability and vigor than those from middle and tip portion of fruit (**source-sink relationship**)



Insect pests and diseases

Seed carry pathogens internally or externally; these multiply on sowing, affecting crop productivity and seed quality

Insects and pathogens on seeds cause shriveling, discoloration, decay, low germination and vigor

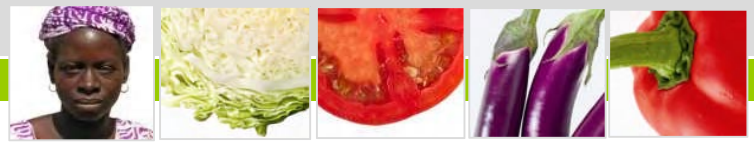
Pathogens thrive on injured seed, with high seed moisture content, high storage temperature, and with good aeration in field or storage

Insects are often found in seeds of pod vegetables such as cowpea, French bean, and pea.

Seeds extracted from infected, rotten fruits are of inferior quality

The microorganisms produce heat and toxins during storage, and induce biochemical changes

Fungal pathogens (*Alternaria, Aspergillus, Penicellium, Cladosporium*) are mainly responsible for seed deterioration and reduced viability.



Caging of shallot before flowering

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Seed regeneration of onion in net cage

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Regeneration of amaranth

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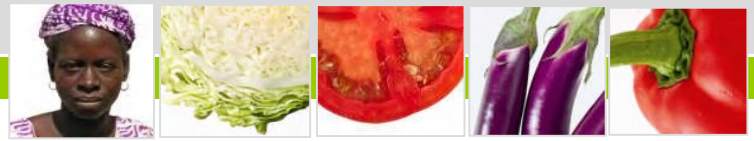
Land preparation for snow pea regeneration

Drill hole, 75- 80 cm deep, for the installation of the iron support pipes

Prepare raised transplanting beds

The bed is covered with 1.5m wide black polyethylene mulch



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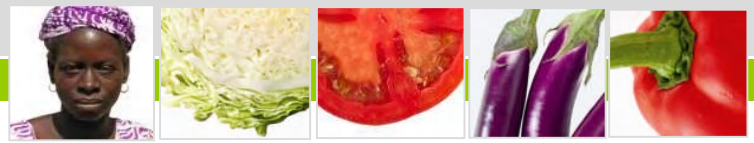
Harvest and post-harvest of yardlong beans

Harvesting of mature pods

Pre-drying of mature pods in the screenhouse



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Thank you for your attention!
Quality vegetables from quality seed