Greenhouse Production Technical Procedure for Pollution-free Food

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Abstract This procedure specifies production area environment, production technology, prevention and control of plant diseases and insect pests, and production files of pollution-free foods by taking tomato as an example. This procedure is applicable to greenhouse production of pollution-free food in Shandong Province.

Key words Pollution-free food, Tomato, Technical procedure

Daylight greenhouse tomato is sowed and seeded during the period from mid June to later August, and it is field planted during the period from later August to later September. Tomatoes are picked from December, and collection period extends more than 8 months for the tomato[1]. Regulatory documents cited for production of pollution-free tomato are the GB4285 *Standard for Safe Use of Pesticides*, GB/T8321 (all the parts) *Guidelines for Safe Use of Pesticides*, GB/8079 *Seed of Vegetables*, NY/T5005 -2001 *Pollution-free Solanaceous Fruit and Vegetables*, NY/T496 *Guidelines for Reasonable Use of Fertilizers - General Rules*, and NY/5294 *Environment Conditions for Growing Area of Pollution-free Food Facilities and Vegetables*. For dated references, only the dated edition applies to this document, and for undated references, the latest edition (including all amendments) applies to this document.

1 Environment of growing area

Environment of growing area shall comply with provisions of NY/5294, and the growing area should be within the daylight greenhouse located in the land with easy drainage and irrigation, and deep, loose and fertile soils.

2 Production technology

2.1 Preparations prior to sowing

2.1.1 Cleaning field. Clear remnant branches and rotten leaf of the preceding crops, as well as the pest residues.

2.1.2 Disinfection of greenhouse. Greenhouse without serious diseases and pests shall be disinfected as follows: burn piles of 2 to 3 kg sulfur powder, 0.25 kg dichlorvos and sawdust per 667 m^2, fumigate the house which must be enclosed round the clock, and then let the fresh air flow into the house. Farm tools to be used shall also be disinfected in the greenhouse.

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2.1.3 Disinfection of soils. For greenhouses with serious soil-borne diseases such as root-knot nematode, they shall be disinfected as follows: apply 50 -100 kg lime nitrogen (calcium cyanamide), and 600 to 1 300 kg and 4 to 6 cm long broken straw of wheat per 667 m^2 during the period from later June to later July. Turn up the soil or plough the soil over more than 20 cm. Make ridging with height of 30 cm, width of 40 -60 cm, clearance of 40 -50 cm, and the ridge shall be covered with soil film and sealed with soils. Inject water into the ridge until the water reaches the ridge shoulder. Temperature within 20 cm depth soil layer shall be more than 37 ℃ for 20 days. That can prevent root-knot nematode and other soil-borne diseases effectively.

2.2 Seedling

2.2.1 Seedling facilities. Make high ridge, use the pest-proof and rain-proof shelter to protect the greenhouse against sunshine, seedling is made in a rain-proof and anti-pest manner, or plug seedling may be used.

2.2.2 Seedling medium. Mix and then screen 6 pieces of fertile filed soil and 4 pieces of mild farm manure. Apply 15 kg crushed mild chicken manure, 2 kg calcium superphosphate, 10 kg plant ash, or (15 -15 -15) 3 kg NPK compound fertilizer, 80 g 50% carbendazol wettable powder per m^3 of nutritional soil, and then fully mix them. Place the prepared nutritional soil into the nutrition bowl or paper bag, and the bowls shall be arranged on the seed bed closely. Commercial seedling medium may be used[2].

2.2.3 Treatment of seeds. Select disease-resistant, stress-resistant, low-temperature-resistant, and poor-light variety with strong capability to continuous fruits, good quality, high yield, transportation resistance and high commercial property. Immerse seeds into the 55 ℃ hot water for 10 -15 minutes and keep mixing the seed, and when the water temperature decreases 30 ℃, stop mixing, immerse the seeds for another 3 -4 hours; or immerse the seeds into 500-fold 50% carbendazol wettable powder liquid for 30 minutes, clean the seeds with clean water and then immerse the seeds into the hot water[3].

2.2.4 Vernalization. After the seeds are immersed, place

them in an area with temperature 25 – 28 ℃ for vernilization.

2.2.5 Sowing. Vernilization is practicable once 60% of seeds bud. Capsuled seeds can be sowed directly.

2.2.6 Seedbed. In high-temperature whether, protect the seedbed against sunshine. In case of 2 true leafs, apply mepiquat chrolide once.

2.2.7 Reculturing seedling. It shall be conducted in case of 2 – 3 true leafs. Place the seedling into the reculturing bed for which seedling medium has been prepared with the 12 cm row spacing and 12 cm plant spacing. In addition, it is also allowed to place the seedling into the nutrition bowl with diameter of 10 – 12 cm.

2.2.8 Transplanting seedling. During the period from reculturing to transplanting, protect the seedling against sunshine properly, and in daytime, the bed temperature shall be kept at 25 – 30 ℃.

2.2.9 Criteria for seedling strengthening. The leaf shall be heavily green without pests, and the number is 6 – 8 with plant height of 20 cm or so, stem diameter of 0.4 cm. Age of seedling shall be 25 – 30 d.

2.3 Soil preparation and fertilization Turn up, plough soils after fertilization and 10 – 15 d prior to field planting, and then level the soils with rake. The fertilization amount and method shall be determined in accordance with fertility of soils, and soil testing and formulated fertilization may be used, or it is allowable to use the recommended fertilization amount. Recommended fertilization amount per 667 m^2: stack the 7 to 8 m^3 mild farm fertilizer or 5 to 6 m^3 chicken manure with crop straw of the same amount for ferment and application and then apply 50 to 60 kg NPT (15 – 15 – 15) compound fertilizer, and 80 kg calcium superphosphate. Lower limit is used in case of high fertility, and the upper limit is used in case of low fertility.

2.4 Field planting Plant the tomato in large and small rows and small high ridge. Large row spacing is 100 cm, and small row spacing is 60 cm. Level ridge shall be made firstly. Two rows are planed on each ridge with plant spacing of 38 – 40 cm, and plant 2 000 – 2 200 rows every 667 m^2 area. after seedling is planted, water it thoroughly. After the ground is dried, intertill the ground for 2 – 3 times from the shallow points to the deep points, and after 7 – 10 d, fill soils around the plants so as to form the ridge, while soil film is not covered.

2.5 Management prior to and during winter

2.5.1 Management of humidity and temperature. Before the seedling is transplanted, the greenhouse temperature shall be 28 to 30 ℃ in daytime, and 17 to 20 ℃ at night, while the ground temperature shall not be less than 20 ℃. Its purpose is to seedling transplanting. After the seedling is transplanted, reduce the greenhouse temperature properly so that the temperature is 22 to 26 ℃ in daytime, and 15 to 18 ℃ at night. In sunny days, the skylight may be opened for air if the greenhouse temperature is 30 ℃ at noon. If the temperature is lower than 30 ℃, ventilation shall not be done, while it is required to "cultivate the fruits at high temperature". In case of high house humidity in sunny days, ventilate for 30 – 40 minutes after the mats are uncovered, and then close the vent.

2.5.2 Management of non-transparent coverage. In the morning, the appropriate time for uncovering the mat shall be such that no remarkable reduction in greenhouse temperature is found after the mat is uncovered. In sunny days, mats shall be uncovered promptly if the lighting roof is subject to direct sunshine. Pay attention to cleaning film so as to maintain high light transmittance. In the afternoon, cover the mats after the greenhouse temperature decreases to 20 ℃ or so. In severe winter, mats can be uncovered in later time and covered in earlier time properly. In case of general rainy days, mats shall be uncovered as long as the greenhouse temperature does not decrease. In case of snow, mats may be uncovered for a short time or uncovered while being covered after snow is eliminated. In case of continuous cloudy days, mats may be uncovered prior to noon and covered after noon. In case of sunny days immediately long-term cloudy days, mats shall be uncovered one after another but not uncovered abruptly for fear of burning leaf. Mats shall be covered after plant leaf wilt after mats are uncovered. Mats are uncovered in an interval manner after the plants are restored to normal status.

2.5.3 Adjustment of plants. Trim branches of a plant, and promptly wipe the branches and tie the seedlings.

2.5.4 Management of fertilizer water. After the seedling transplanting and before fruit setting, control watering and conduct several times of intertillage to promote control of seedlings at root, thus preventing strong growth of plants. When the fruit of the first inflorescence is as large as walnut, open trench on side of the ridge, and apply NPT compound fertilizer (15 – 15 – 15) of 30 – 40 kg every 667m^3, and then cover with the soil film. Water beneath film. Under the film shall be watered as thorough as possible, and mitigating watering as many as possible in severe winter. During the winter, if a plant reflects insufficient water, water under the middle film in the high ridge in a sunny days, and apply 15 kg of urea and 10 kg of potassium sulfate or apply fertilizer with water every 667 m^2. Use of fertilizer shall comply with requirements of NY/T496.

2.5.5 Flowers and fruits retention. When the fruit setting of first inflorescence is around the corner, spray 30 to 40 mg/kg of PCPA on the flowers to prevent flowers and fruits from falling due to low temperature. After the fruits are set, properly perform flower and fruit thinning so that 3 – 4 fruits are maintained on each of ears.

2.6 Post-winter management

2.6.1 Management of temperature and light. Since mid February, as the hours of sunshine increase, properly uncover mats in earlier time and cover it in later time so as to extend the hour of plants subject to sunshine as long as possible. Prompt ventilation is required, and in sunny day, greenhouse temperature shall be 25 to 28 ℃ in morning, in 5 to 20 ℃ afternoon and 20 to 15 ℃ at night. In rainy or cloudy days, greenhouse temperature shall be 25 to 20 ℃ in daytime and 15 to 10 ℃ at night.

2.6.2 Management of fertilizer water. During the period from mid February to mid March, water once every 15 d with application of fertilizer, and 20 kg of NPT compound fertilizer (15 –

15 –15) is applied every 667 m^2. After mid March, water once every 7 –10 d. Apply additional 15 to 20 kg of DAP every 667 m^2 every two times of watering. Use of fertilizer shall comply with requirements of NY/T496.

2.6.3 Adjustment of plants. Promptly remove old leafs, and fall tendril in due time. Topping shall be conducted as soon as possible after sufficient eras are reserved. In addition, branches may also be trimmed in pruning method of continuous decapitation.

3 Prevention and control of pests

3.1 Principle of prevention and control Abide by the plant protection policy of " prevention primary and comprehensive prevention and control" , and take agricultural physical and biological measures for prevention and control with priority, as well as the chemical prevention and control is used as an auxiliary means.

3.2 Main diseases and pests They include cataplexy, virosis, gray mold, leaf mold disease, late blight, aphid, bemisia tabaci and blanchard.

3.3 Agricultural prevention and control Select multiple-disease-resistance verities; practice crop rotation for more than 3 years; clear field after harvest; foster strong seedling, reasonably water, and apply mild organic fertilizer fully.

3.4 Physical prevention and control

3.4.1 Preventing pest with insect-proof net. Vent of the daylight greenhouse is sealed with 40-mesh nylon gauze to mitigate occurrence of pests.

3.4.2 Yellow sticky traps. Hang 30 –40 yellow sticky traps of 25 cm × 40 cm every 667 m^2 to kill aphid, bemisia tabaci and blanchard. Hanging height shall be identical or more than 5 –10 cm to the top.

3.4.3 Avoiding aphid with silver gray film. The silver gray soil film is installed or hanged in the greenhouse to protect the house against pests.

3.5 Biological prevention and control At early stage of disease, use 200 –250 fold 2% Ningnanmycin spray to prevent and control viruses; use 150 –200 fold 2% Wuyi antimicrobial agent spray to respond to gray mold; use 500 –800 fold propamocarb hydrochloride to cure leaf mold disease; use 2 000 –3 000 fold 1.8% Abamectin EC or 800 –1 000 fold green mature seal, or 1 000 –1 500 fold Azadirachtin , 600 fold 1% matrine mix, 500 –800 fold 1.2% alkali solution spray to prevent and control aphid, bemisia tabaci and blanchard.

3.6 Chemical prevention and control

3.6.1 Principle of using pesticide: Chemical agents shall be used in accordance with GB4285 and GB/T8321 (all parts). Hypertoxic, high-toxicity and residual pesticides are not allowable, and it should be noted that all agents are used alternately. Interval of safe period for pesticides shall be controlled strictly, and before harvesting, it is forbidden to use chemical agents 7 d in advance.

3.6.2 Cataplexy. At early stage of this disease, spray 1 000 fold 72% Cymoxanil wet powder, 450 fold hymexazol (Tachigaren) or apply them around the root.

3.6.3 Virosis. At earlier stage of this disease, use the mixed 1 000 fold 1.5% TS agent, or 500 fold 20% virus A wet powder agent, or 200 –300-fold 5% dioctyl divinyltriamino glycine, or 1 000 fold potassium permanganate solution and 6 000-fold 1.8% sodium nitrophenolate solution spray to prevent and control.

3.6.4 Gray mold. At earlier stage of this disease, spray 3 000-fold 50% Azoxystrobin wettable powder, or 1 000 –1 500-fold 50% Rovral wettable powder, or 800 fold 50% Diethofencarb wettable powder to prevent and control. To dip the flowers into hormone, add 0.1% of 50% Procymidone wettable powder to the agent.

3.6.5 Leaf mold disease. At earlier stage of this disease, select 1 500 –2 000-fold 10% Difenoconazole wettable dispensable granule, or 800 fold 47% kasumin + Bordeaux wettable powder.

3.6.6 Late blight. At earlier stage of this disease, use the spray of 600 –800 fold 72% Cymoxanil Mn –Zn wettable powder, or 800 fold 69% dimetho-morph Mn –Zn wettable powder, or 800 –1 000 fold 58% Metalaxyl Mn –Zn wettable powder.

3.6.7 Aphid, whitefly and blanchard. Use 1 000 fold 10% Imidacloprid wettable powder, 2 500 fold 2.5% Deltamethrin EC, or 2 000-fold 4.5% efficient Cypermethrin EC, which can also be used to prevent and control earworm and Laphygma exigua.

3.6.8 Bemisia tabaci. Select 1 500-fold 20% Buprofezin wettable powder, 2 000 –3 000-fold 2.5% Bifenthrin EC, 2 000 –3 000-fold 10% efficient Cypermethrin EC, 2 000-fold 20% Fenpropathrin EC, and 1 500-fold 10% Imidacloprid wettable powder, and prevent and control tomato yellow leaf curl disease for 2 –3 times in a row every 10 days or so.

4 Collection

Fruits for long-distance transportation shall be collected from version to rare period, and the transportation-resistant varieties may also be transported from rare period to firm-ripe stage.

5 Production files

Keep detailed record of production area environment conditions, input articles for production, production management, prevention and control of pests and diseases, product quality inspection and the relevant traceability materials for more than 3 years.

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