HEAT –TOLERANT TOMATO PRODUCTION UNDER IRRIGATION

EXTENSION BULLETIN No. 242

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ACKNOWLEDGEMENT

NAERLS wishes to acknowledge the financial support of Katsina State Government and FAO for the production of this bulletin. The bulletin has been updated with current information on the Production of Heat-Tolerant Tomato under Irrigation. Production and value addition of these perishable crops are of great importance to the well-being of our farmers.

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1.0 INTRODUCTION

Heat tolerance in tomato is defined as the ability of certain varieties of tomato to set fruits under high temperatures not lower than 21^0C. Some tomato plants continue to produce even during periods of extreme heat and humidity or heat and drought. Heat-tolerance is a phrase to look for when selecting the best varieties to grow during hot dry seasons. This is because most tomato varieties do not tolerate hot and humid weathers especially during fruit production and maturity. This is because such weather conditions cause fruit abortion, poor quality fruits and may also harbor pests and diseases due to high humidity with is accompanied by warm, humid nights that can lead to fungal diseases. Tomato (Lycopersicon esculentum Mill) is an important vegetable crop in many parts of the world including Nigeria. Tomato fruit is an essential component of the diet of man and also an important industrial commodity. Large scale tomato is grown in the Northern Guinea and Sudan savannah of Nigeria, where relatively high yield could be realized by planting between June and December. Planting between March and May results in low yields that cannot sustain demand. This low yield is due to the prevalence of temperatures considered too high (above 32^0C, day/night) for fruit set. The better night temperature for tomato production is between 15.6^0C and 21.1^0C. Only few tomato types have tolerance to high temperature fruit set, a character in great demand by growers. Efforts are still in progress to come out with varieties that would tolerate high temperature i.e heat tolerant varieties.

2.0 HEAT TOLERANCE

Heat tolerance in tomato is defined as the ability to set fruits under high temperatures not lower than 21^0C. This trait reportedly gives indications of genetic complexity, with variation exhibiting a continuous distribution and heutability values ranging from 5 –

19%, implying that the major part of the observable variation is environmental in nature.

3.0 Heat-Tolerant Tomato Varieties

These are tomato varieties that will continue to produce fruit when temperatures are high.

Faced with long bouts of daytime temperatures higher than 85 degrees Fahrenheit and nights above 72 degrees, tomatoes may fail to set fruit. The plants may look dark green and vigorous — evidence that all other growing conditions are favorable — but have blossoms that dry up and fall off.If the heat spell lasts no more than a week, the tomato plants will quickly recover. During

long stretches of warm nighttime temperatures, however, the plants will stop setting, causing a subsequent gap in tomato production.

In recent years, a flood of new varieties has been bred for greater heat tolerance. Known as “heat-set” tomatoes, or “hot-set” tomatoes, some commonly grown hybrids are ‘BHN 216,’ ‘Florasette,’ ‘Florida 91,’ ‘Heatwave II,’ ‘Solar Fire,’ ‘Summer Set,’ ‘Sunchaser,’ ‘Sun Leaper,’ ‘Sunmaster,’ ‘Sun Pride’ and ‘Talladega.’ According to the specialist in Extension System, many heat-set varieties also perform well in cool, rainy weather.

Florida 91 Heatwave II Solar Fire

Some heirloom tomato varieties are heat-tolerant as well, and these include ‘Arkansas Traveler,’ ‘Eva Purple Ball,’ ‘Hazelfield Farm,’ ‘Homestead 24,’ ‘Illinois Beauty,’ ‘Neptune,’ ‘Ozark Pink’ and

'Tropic.' Additionally, some "cold-set" varieties, such as 'Stupice,' are all-weather standouts because they're able to function in hot weather, too. A handful of cherry tomato varieties, such as 'Lollipop' and 'Yellow Pear,' also do well in prolonged stints of heat. Other varieties are T1 205 heat tolerant, T1 539 heat tolerant T1, 206 heat tolerant, and T1 204 heat tolerant

Tomato growers often choose heat-tolerant tomato varieties for summer and fall production — a strategy growers farther north may want to emulate now that climate change is causing hotter summers in most regions. When growing tomatoes in hot temperatures, you can boost your success rate by planting deeper (where the soil temperatures are lower), providing afternoon shade, watering in the morning and using thick organic mulch to keep soil cool.

4.0 ENVIRONMENTAL CONDITION

4.1 TEMPERATURE.

The optimum growing temperature for tomato is between 22 to 26^0C in the day time and 14 to 16^0C at night. It is difficult to locate production site with this temperature range in the low land tropics, which have a shorter cool season than subtropical areas. In addition the higher temperatures of the tropics cause more pests and disease problems and have often produced lesser quality fruits. Fall and a writer season areas are generally cool and dry, climatically, this is an ideal tomato producing area. Tomato grown under optimum temperatures are best for both flowering and fruit setting, Growth is not inhibited even if the night temperature drop to 13^0C. However the day temperature is should be above 15^0C for good pollination. Too high temperature causes the flowers to drop and there is poor fruit setting. Heat tolerant tomato varieties have the advantage of resisting the problem of too high temperature.

4.2 SOIL TYPE

Tomato can be grown in a wide range of soil types from sandy loams to clay loams and in soils high in organic matter. However, a well-drained fertile soil of medium texture and good depth is most suitable. It warms up quickly, possessed high available moisture holding capacity and provide an adequate rooting medium to carry the crop through the dry season.

5.0 SITE SELECTION

The site selected for the crop should be protected from wind blow especially north and east winds in the northern part of Nigeria. Temporary wind breaks should be established where natural shelter is absent. Shelter is needed most by the plants during the first month in the open field, It may be a disadvantage later in the season when freely circulating air is required to help check the spread of blight disease, Sometimes existing wall and buildings may be used for shelter, The site should be accessible to market,
Tomato has a vigorous root system, and can be grown successfully in either sandy or clay soils. However to obtain good fruits, it is best to select a field with deep fertile topsoil which has good drainage and water holding capacity. A fertile well drained (loamy) soil devoid to insects particularly nematode should be selected.

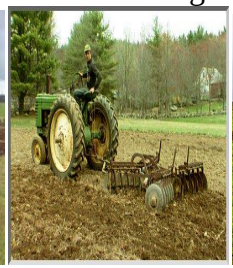
6.0 LAND PREPARATION

Once a perfect site for planting tomato is selected, a time is then allocated and spend on land preparation. Land clearing is the first thing to be done in land preparation; shrubs, grasses and other debris should be cut, gathered in heaps and burnt. Soil testing is next after land clearing. It is done to know the soil PH, its nutrients and chemical contents. Knowing the nutrients and chemical composition of the soil will provide a guide in selecting fertilizers to be used. Soil sample should be taken from selected points across the planting area for testing. Tomato grow best in slightly acidic soil with PH level between 6.0 and 7.0 – optimum level is between 6.5 and 7.0. If the soil's PH isn't within that range, some adjustments need to be made. To lower the soil's PH, put Sulfur

into the soil and mix thoroughly. To raise the soil's PH, put lime into the soil and mix thoroughly.

For better land preparation, the land should be pre-irrigated, then ploughed and harrowed thoroughly to obtain a fine tilth. Farm yard manure can be incorporated during land preparation. The land should be well pulverized by breaking up all clods manually or using any equipment for pulverization. Stones and weed should also be removed to give an area of fine tilth.

To prevent nematode infection, chemical called Nemagon-20 can be mixed with the soil during land preparation at the rate of 70kg/ha. The land can be made into ridges or basins as required.


7.0 NURSERY PROCEDURE

After preparing a well pulverized seed bed (Nursery bed) a very shallow grooves of about 1-2cm deep and 7-10cm apart could be drown out. The seeds are then thinly sown by hand to spread the seeds into the grooves and then covered tightly with soil, after which it is carefully watered and shaded by spreading dry grasses on top of the nursery bed. Irrigation of the nursery bed should be at 3 – 4 days interval depending on the soil type and the prevailing weather condition. The shade should be removed as soon as the


seeds germinate to allow sturdy growth of the seedlings. The seed rate of 0.25-0.5kg/ha is recommended (Anon., 1987).

8.0 SPACING AND TRANSPLANTING

Seedlings are considered to be ready for transplanting when they are about 10 to 13 cm high, or when 4-5 leaves emerged. While uprooting the seedlings, care should be taken that roots are not broken. For this reason it is advisable that seedbed be thoroughly watered or irrigated before uprooting. The seedlings could then be uprooted separately either by hand or with a garden fork. Transplanting is better done in the late afternoon or early morning or on cloudily day and immediately after uprooting the seedlings.

Spacing of 45cm is appropriate between plants on ridges of 75cm apart. In case of sunken beds or when a flat border is used, the spacing is 45 x 45 cm. A uniform stand and spacing is necessary for achieving uniform maturity and maximum yield of marketable fruits.


9.0 IRRIGATION

Due to its succulent nature, tomato has high water requirements and yields better when grown under irrigation. Optimum production is favoured by high level of moisture throughout the vegetative and early flowering period followed by reduction during fruits development and lower level during ripening.

Tomato needs to be irrigated 15-20 times during the growing period at the frequency of five to seven (5 –to 7) days depending on the soil type and prevailing weather condition. The amount of

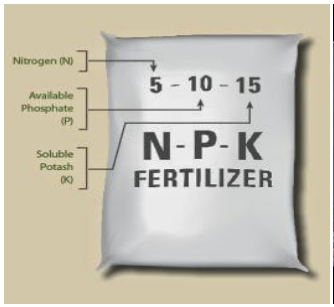
water required for optimum growth ranges from 400-600mm. Critical stages of growth of tomato that are sensitive to water stress are: flowering fruit formation and vegetative period particularly during or prior to start of flowering. Therefore framers should endeavor to supply adequate irrigation water during these periods. Irrigation methods suitable for tomato production are: furrow and basin irrigation methods. Furrows are small channels which carry water down the land slope between crop rows, while basins are flat areas of land surrounded by low bunds which prevents water from flowing to the adjacent fields. The basin sizes could be either 2 x2m, or 3x3m depending on the slope of the land. Whatever irrigation method used, it should not encourage water logging.

TOMATO STACKING

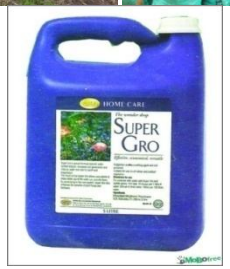
This is usually required for vegetables with climbing growth habit. Staking is done to provide support for the tomato plant to climb and display the leaves for photosynthesis to take place. The support allows the plant to carry more load without touching the soil thus enhancing the quality of the fruit. Stake can be made from bamboo or other available wood.

10.0 FERTILIZER RECOMMENDATION AND APPLICATION METHOD.

To maintain the fertility of any soil under cultivation for guaranteed continuous high productivity, fertilizer and organic manure should be applied. One of the various recommendations and application methods is to apply compost, lime and NPK fertilizer at the rate of 125:50:50kg NPK/ha. All compost, lime and P_2 O_5 and one –third of the N and K_2O should be applied as a basal application. The remaining two –thirds of the N and K_2 O should be splited into two equal parts, the first to be applied as a top dressing 25 –30days after transplanting, and the second part to be applied 10 –15 days later (Anon., 1989).







11.0 WEED CONTROL

11.1 CULTURAL WEED CONTROL

Weed is controlled in Nigeria by hand weeding using hoe, which is always tedious on large-scale farms. It should be carefully done to avoid damage to the crop. Weeding should be promptly done at 2, 4 and 6 Weeks after transplanting (WAT) to prevent competition between the crops and weeds for nutrients, light and space.

Any cultural practice that increases the density and vigor of desirable turfgrasses will discourage competition from weeds. Weeds can only exist if there is space for them. Thus, cultural practices for weed control in turf are aimed at shading and crowding the young weed seedlings by producing a dense sod. Effective cultural control measures include the proper selection and establishment of turfgrasses, adequate liming and fertilization, proper mowing practices, judicious watering, and insect and disease control.


11.2 CHEMICAL WEED CONTROL

For chemical weed control, the herbicide mostly preferred is metribuzin. Apply metribuzin (sencor) at the rate 15-20kg a.i./ha at the time of transplanting (Anon., 1997)

12.0 PESTS AND DISEASES CONTROL

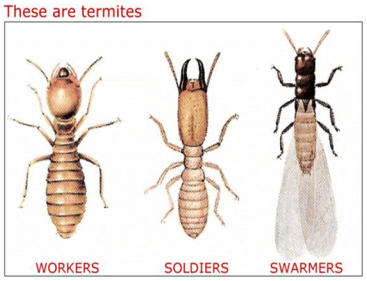
Brief descriptions of the chief symptoms and routine method of control for the commoner diseases and pest of tomatoes are given in the following paragraph. It is essential that the field problem should be correctly diagnosed and when in doubt growers are advised to consult the nearest horticultural advisory officers in the ADP offices located in their area.

12.1 PEST OF TOMATO

The tomato plant is subject to attack by a number of pests, and although some are of minor importance, few can cause very serious losses unless care is taken to control/them. Because tomatoes are an intensively grown crop, pests can multiply very rapidly, control measures should therefore, be adopted immediately symptoms of attack are observed.

A ROOT ATTACKING PESTS

i. **Termite** –may eat up seeds in the soil resulting in poor germination or eat up the young roots of the tomato. These results in premature wilting and lodging of stands. Termites can also tunnel into the conducting tissues of the crop thereby cutting off water and nutrient supply.



ii **White grubs**. These are the family of the Melolonthidae. These larvae feed underground on roots and other underground parts of the plant.
Feeding may result in the death of the plant or the plant may wither or come stunted.

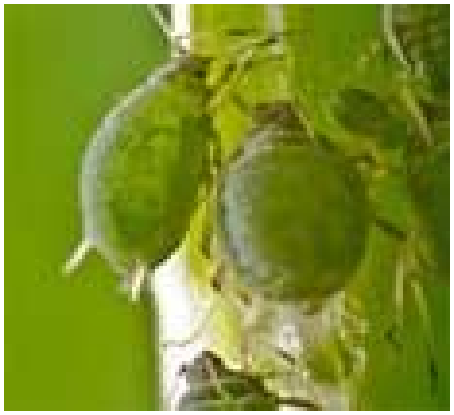
iii **Cutworms**: They are caterpillars of several species of noctuid Moth. They inhibit the soil surface and are veracious eaters. Early in their life, they feed on the leaves, later they migrate to the ground where they hide

by day and appear at night to attach the seedlings to near ground level, biting holes in stems or cutting them off completely.

iv. Crickets: These burrow into the soil and damage crops by eating roots and destroying stems.

B FOLIAGE AND STEM PESTS.

i. Aphides: Several species of aphids infest tomato plants. Aphids and their
Nymphs cause damage to plants by sucking the plant sap and by transmitting the virus diseases e.g. tomato mosaic disease



ii Stink bugs: The green stunk bugs are the most common stunk bug that sucks sap from the young growing points leaves, buds and fruit. The sucking may result in malformation of fruits or leaves. Their feeding point also serve as entry point to disease organisms. Tomato may rot away when attacked.

Adults and young ones found clustered on leaf surfaces and stems. They Suck plant nutrients resulting in Malnutrition of the leaves and stunted growth. There sugary, sticky excrements called honey due, accumulate on stems and leaf surfaces and softy mould fungus develop on them thereby reducing the market value of tomato crop.

i. Thrips: These are small slender insects with piecing – sucking mouth parts.
A characteristic symptom of attack is the appearance of white blotches on infested tissue. Tips of the leaves wither and turn brown. Their attack can also cause distortion and malformation of plants.

ii. White flies: Nymphs and adults feed on the undersurface of leaves
sucking plant juice and indirectly transmitting viruses. Leaf curl virus disease of tomato are transmitted by these flies.

iii. Grass hoppers: About five species are important pests in Nigeria Zonocerus variegates is very common on tomato and could be destructive if they occur in large number.

iv Other important pests of tomato includes: Cotton leaf worm (Spodoptera litorallis), Blister beetles (mylabris spp), They cause damage by devouring the flowers and fruits of tomato.

C. FRUIT ATTACKING PESTS.

i. Heliothis armigera: American bollworm caterpillars cause heavy damage to flowers and fruits of tomato. They bore into the fruits and one caterpillar can bore into as many fruits as possible.

12.2 TOMATO PEST MANAGEMENT

A. CULTIURAL METHOD

1. Crop rotation with non-susceptible crops that are not solaanacea
2. Use of resistant varieties
3. Dress your seeds before planting
4. For termite on soil surface or in to soil, apply water by watering can.

B. CHEMICAL METHOD

In controlling insect pest of tomato, care must be taken to select an effective but relatively non persistent insecticide because of the problem of residue since tomato matures within a short period.

The following insecticides have been suggested for the control of leaf, stem and fruit feeding insect pests of tomato.

Table 1: SUGGESTED INSECTICIDES AND THEIR RECOMMENDED USE ON TOMATO.

CHEMICAL	USE	RATE
1. Dimethoate	Most sucking pests	125m1 in 10 litres of (Rogor)Aphids, thups etc Water
2. Decamethrin (Decis)	Fast knockdown	50ml in 10 litres of insecticide on fruit water crops
3. Dichlorvous (Nogos)	Low residual insecticide	1.5-3 litres per hectare on vegetables in 180 –400 litres of water. 1-1.5 lires per
4. Nuvacron	hectare in 150 –200	lires of water.
5. Carebary (85 wp) (vetox 85,sevin 85)	Effective on grasshoopers armyworms and other insects. Some crops may be sensitive To it.	5 gms in 4.5 lires of Water
6. Femitrothion	A broad spectrurr insecticide	10-15 mls in 4-5 litres water
7. Furadan 3G	Useful on soil pests in nurseries of field. Can also control of nematodes.	30-40kg/ha granules.

13.0 DISEASES OF TOMATO

a) Fungal Diseases

i) Damping off

Caused by several fungi like phytophthora spp. They cause rotting of germinating seeds before reaching the soil surface. Seedlings are killed by an attack on the roots and basal parts. In some cases affected plants do not die but becomes girdled at the base and remained unthrifty.

Control

i) Seed dressing with protective fungicides e.g. Apron star, at the rate of 10gms/2.5kg of tomato seed.

ii) Since the disease is favoured by excessive wet soil, care should be taken in choosing site for seed bed and the frequency of watering the bed.

iii) Provide better drainage by improving the soil texture.

iv) Avoid thick planting and longer shading periods.

Leaf Spots and Blight

Some species of fungi, namely, Alternaria solani, A. brassicae, A. brassicicola A. raphoani and some species of cercospora and colletotrichum, cause important leaf blight/leaf spot diseases of tomato and other vegetables. These pathogens are widespread throughout the country and attack leaf, pot, and stem of the crops. These diseases become severe with abundant

atmospheric humidity or frequent rains, followed by warm weather (Ishaque and Talaledar 1967); Talukadar 1974; and Ashrafuzzaman 1977. The pathogens can survive in seed or infected plants for years in soil and act as a primary source of infection. Secondary spread of the disease occurs through conidia disseminated by air, wind, water and insects. A perennial weed (Solanum nigrum) also serves as a perpetual source of Alternaria spp.

Control

1. practice crop rotation and field sanitation
2. adopt good agronomical practice for better plant growth
3. treat seed with vitavax-200 before sowing
4. spray with 0.2% Rovral 50WP against Alternaria spp. And 0.2% Bavishtin 50 WP against cercospora spp. At 12-day interval.
5. Spray with Bavistin 50WP (0.1%) or Tilt 250EC (0.05%) at 12-day intervals.

Wilt and Foot Rot Disease

Fursarium wilt (fusarium oxysporum) and root rot (sclerotium rolfsii and Rhuzoctonia solani) are two devastating diseases of tomato and other vegetables causing 90% or more damage. These fungi are strictly siil borne and attack various vegetable crops such as tomato, potato, brinjal, cabbage, caulifloever etc.

Clearing of veinlets and drop of petioles leading to wilt of the entire plant are the characteristic symptoms of Fusarium wilt. Browining of the vascular system can also be seen in a cross-section of the lower stem. In root rot disease, the lower portion of the stem near the base is attacked, resulting in rotting of stem base or root system.

Control

1. Collect healthy planting materials from disease free areas.
2. Destroy weeds and crop residue.
3. Strictly follow crop rotation.
4. Use resistant varieties/cultivars
5. Provide drainage facilities.

Leaf Mould

Caused by fungus called cladosporium fulvus. Leaves of affected plants show duster of grayish-green fungal growth on the lower surface, while the upper surface appear yellowish. Large number of spoils are produced from those fungal growth on the leaves and are spread by air currents and rain or irrigation water splash.

Control

1. Crop rotation
2. Field sanitation
3. Burn plant residue
4. Application of fungicides.

Table 2: Suggested Fungicides and their rates.

Chemical	Use	Rate
1. Benlate (50% WP)	Fungicide effective for most fungal attack on tomato.	15gms in 10 litres of water. 62.5gms in 10 litres of water.
2. Dithane M45	"	15gns in 10 litres of water i.e. 45gms/ha.
3. Baylaton 50% WP)	"	

b) Bacterial Diseases

i) Bacterial Wilt of Tomato

Bacterial wilt incited by Pseudomonas solanacearum is the most destructive disease of tomato, potato and Brinijal. Sudden welting of the entire plant or parts of the plant leading to death are characteristic symptoms. Ambient temperature ranging from 25 to 35ºC, high humidity and soil moisture are the most favourable conditions for disease development.

The crops are vulnerable at both seedling and maturity stages. The pathogen can spread through water, planting materials, tillage equipment, man, animals and other avenues. Infection always occurs through wounds made during crop cultivation.

Control

1. Use resistant varieties
2. Raise seedlings in disease free seedbed

3. Use crop rotation with non-host crops like cereals for at least five years.
4. Apply adequate nitrogen and manure
5. Use minimum irrigation, particularly avoiding flood irrigation
6. Remove diseased plant.

Soft Rot

Soft rot caused by Erwinia caratovera appears sporadically in the field at any stage of plant growth. Affected tissues show a soft, slimy bad smelling rot, which, under favourable conditions, rapidly spreads throughout the entire plant.

Control

1. Use disease free planting materials
2. Provide drainage and avoid damage during cultivation
3. Wash harvested materials in 1% bleaching powder solution

C) Nematode Diseases

Root-Knot

The most important nematode is Moloidogyne spp. Causing root-knot disease. Crop loss due to root knot nematodes has been estimated to vary from 10 to 40%, resulting in substantial yield reduction (Ahmed 1985; Zahid et al 1986; and Mian and Ali 1986).

A large number of crops are susceptible to root-knot nematodes, but vegetables are the most vulnerable. Most of the popular winter vegetables like tomato, lettuce, chili etc are susceptible to the disease. Stunted growth, wilting at day time and formation of knots or galls on the root system are the characteristic symptoms of root-knot nematode disease. The pathogen may infect plants at any stage of growth. Early infection causes severe yield reduction.

Infected agricultural equipment and planting materials can disseminate the disease, since the organisms can survive in a wide temperature range, over wintering or over summering is very easy.

Control

1. Use nematode-free planting materials
2. Collect and destroy crop residues
3. Practice crop rotation with wheat, maize and mustard for at least three years
4. Apply Furadan (Carbofuran) 3G or Curator (Carbofuran) 3G or Sunfuran 3G, 40kg/ha or mustard oil cake 75g/plant (must be decomposed for a minimum of 20 days before seedling/planting) to the soil.

Virus Diseases

i) Leaf Curl Virus Disease

It is the most serious virus disease in the dry season production of tomato. The leaves become coarse, curled and twisted, the veins and the mid-rib also become thickened. The plants are severely stunted. The virus is known as tobacco leaf curl virus, transmitted in the field by the vector Bemisia tabaci (white fly).

Control

1. Control of the white fly vector by the use of insecticides would control the spread of the disease.

ii) **Tomato Mosaic Virus**

It is caused by tobacco mosaic virus, which is often present in manufactured tobacco. Smokers may carry it on their hands and transmit it to tomato and curled foliage. If attack is early in the season, plants become stunted and yield reduced. The disease is spread by person who handle the plants or by insect with chewing mouth-parts.

Control

1. Control is the only remedy. Smokers should wash their hands with soap and water before handling tomato seedlings. Remove infected plants and burn.

iii) Other Virus Diseases

Plant viruses are one of the major problems in vegetable production in Nigeria. The majority of the vegetables grown in the country are affected by virus diseases that cause drastic yield reduction. Generally, viruses are transmitted through agricultural implements, planting materials, by insects, fungi, nematodes and other animals. The most common and economically important virus and mycoplasma diseases in Nigeria, along with their symptoms and mode of transmission are listed in table 3.

Control

1. Grow available resistant varieties
2. Use disease-free seeds
3. Rogue and destroy diseased plants and weeds that can habour viruses
4. Monitor vectors and their control

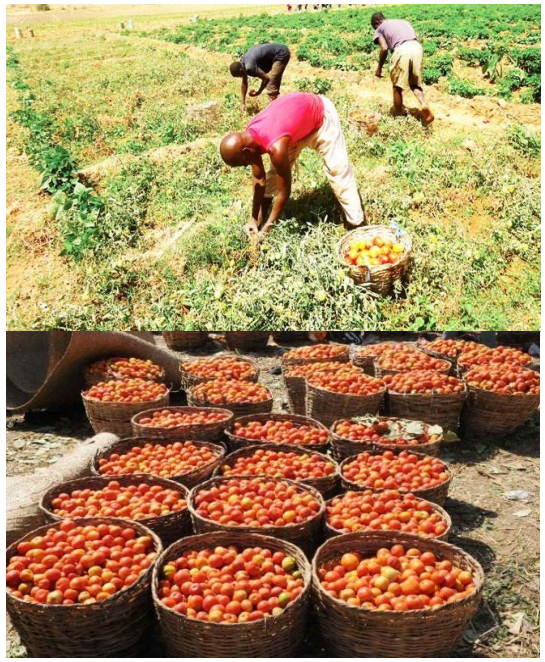
5. Follow appropriate crop rotation techniques
6. Manipulate crop growing period to avoid initial time of infection and to get the plant resistant stage
7. Maintain isolation distance
8. Disinfect all field equipments.

Table 3: Important Virus Diseases of Tomato, and their Mode of Transmission

Disease	Mode of Transmission
1. Leaf roll	Vector (Aphids)
2. Leaf curl	Vector (White fly)
3. Mosaic	Vector (Aphid)
4. Bushy stunt	Seed
5. Bunchy top	Mechanical
6. Curly top	Vector (leafhopper)
7. Spotted wilt	Vector (Thips)
8. Yellow roll	Vector (Aphids)

14.0 HARVESTING AND PROCESSING

Tomato harvest is done by hand; the fruits should be harvested as soon as they ripe. Delay harvesting encourages rotening of fruits and hence affects the overall yield.



The most important processing methods are: canning and drying. Canning is the most important method of processing tomato. It involves sterilizing or destroying all harmful living organisms in the tomato and keeping them sealed in cans, usually tin or glass, to prevent re-infection.

Preservation by drying involves removing water from the fresh crop to protect it from spoilage. Drying is an ancient method of preservation. Moreover, it has some advantages over other methods as follows:

- It requires less space for storage. Ten carloads of fresh food can be accommodated in one car when dry.
- It requires low-cost packaging material like propylene and polyethylene.
- It can be used in multipurpose food preparation. For example, soups, meals, chips and puffs can be made from dry food.

Due to low cost of preservation and their high nutritional quality, dried tomato products have become popular in

developed countries and consumption has been increasing in the last decade.

15.0 Yield

Heat tolerant tomato varieties yield better than the heat sensitive varieties, during dry season production period. This is due to their resistance to hot environments that allow higher fruit set compared to the heat sensitive varieties. In a trial conducted by institute for agricultural research (IAR) at Danbatta during 1989 hot season, heat tolerant varieties out yielded the heat sensitive varieties.

Table 4: Marketable yield (t/ha) in the 1989 hot season

Variety	Yield (t/ha)
T1 205 heat tolerant	16.4
T1 539 heat tolerant	11.2
T1 206 heat tolerant	10.2
T1 204 heat tolerant	10.8
SAMTOM-7 Heat Sensitive	7.4
T1 468 Heat Sensitive	7.6
T1 244 Heat Sensitive	5.9
T1 521 Heat Sensitive	2.3

References

Anonymous (1987). Improved vegetable production in Asia. FFTC Book series No 36. Taiwan Republic of China

Anonymous (1989). Fertilizer use and management practices for crops in Nigeria (series No. 2, (edts) W.O. Enwerozi, E.J. Udo, N.J Usoro, K.A. Ayotade, J.A. Adepeju; V.O. Chude, C.I. Udegbe.

Anonymous (1997). Crop and Irrigation water management. A paper presented at CIRAD/NAERLS/HJRBDA Specialized training workshop on 13th –15th Jan. 1997.

Ashrafuzzaman, H. (1977). A survey of diseases of winter crops in and around the Bangladesh Agricultural University. Bangladesh Journal of Agricultural Research 2(2) 28-33. In Vegetable production and Marketing, Proceedings of a national review and planning workshop 26 –29 January 1992 BARI, Joydepur, Gazipur, Bangladesh.

Bodunde, J.G; Erinle, I.D, Ewator, P.G and Amans, E.B. (1993). Four heat tolerant varieties, approved recommendation I.A.R. Samaru – Zaria.

Erinle, I.D. (1979). Tomato diseases in the northern states of Nigeria, Extension Bulletin No. 31, NAERLS/ABU Zaria.

Ishaque, M. and Talukdar, M.J. (1967). Survey of Fungal Hora of East Pakistan. Agri. Pakistan 18(1): 17-26. In vegetable production and Marketing proceedings of national review and planning workshop, 26-29 January 1992 BARI,Joydepur, Gazipur, Bangladesh.

Karim,M.A (1991): Insect and Mite pests of vegetable crops and their management (in Bangladesh). In Ahmed, K.U. and

Shahjahan, M. (ed). Production of vegetables in the homestead. A training manual (in Bengali). On farm research DWISION- Bangladesh Agricultural Research Institute, Joydepur, Gazipur, Bangladesh P. 127-140

Quinn, J.G. (1974). Environment and establishment of an industrial tomato crop in northern Nigeria. Paper presented at a meeting of the tomato-working group of EUCARPIA. International center for Advanced Mediterranean Agronomic studies, Bari, 8

Talukdar, M.J. (1974): Plant diseases in Bangladesh. Bangladesh Journal of Agricultural Research 1 (1): 61-86: In vegetable production and marketing, proceedings of a national review and planning workshop 26 –29 January 1992, BARI Joydepur, Gazipur, Bangladesh.