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GREENHOUSE TECHNOLOGIES FOR TOMATOES

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Abstract: *Tomato (Lycopersicon esculentum) is selffertilized and diploid belongs to Solanaceae family. It is richest source of vitamins, minerals as well as antioxidants (lycopene). Conventional breeding plays very important role to increase yield and quality. However, resistance of biotic and abiotic cannot be achieved by some methods such as conventional methods. The characters like biotic and abiotic are produced in different crops mainly by modern methods of biotechnology for example transformation, somaclonal variation, QTL mapping. Through different breeding methods, many goals are achieved and many varieties have been developed of different better traits or combine traits in same variety. Agriculture and biotechnology is trying to improve the tomatoes as per demand.*
Keywords: *Conventional breeding, Molecular breeding, Molecular Marker, lycopene, Hybridization, Lycopersicum esculentum*

INTRODUCTION

Tomato (*Lycopersicon esculentum*) very important vegetable crops. It is second most consumed vegetable after potato (Solanum tuberosum) in the whole world. The word tomato comes from the Spanish word 'tomato' which means swelling fruit. Tomatoes can be grown under indoor and outdoor conditions. Tomato belongs to the family Solanaceae includes 3000 species [1]. Solanum Lycopersicumspecies is domesticated species of tomato. Tomato first originated in South America in the area of Peru and Ecuador, but they were first domesticated in Mexico. Spanish took domesticated form of tomato to Europe in 1523, Italy in 1544, England in1597 and Philippine and Malaysia in 1650. These were also taken to North America in late 18th century [2-5]. There is great diversity in from very dry to very wet, from coastal to mountains and about 3300 m elevation area at which it can be grown. In fact, this diversity is responsible for variation in the Lycopersicon.

Moreover, tomato is also used as model plant for research purposes related to genetics. Because it can be grown under many environmental conditions, short life cycle, insensitive to photoperiod, homozygosity, self-pollinating, diploid the reproductive potential rate is high, pollination can be controlled, hybridization and small genome. Tomato can also easily regenerate due to specific characters and it allows easy grafting which helps in development and practical studies. Due to these entire characters tomato crop is ideal for genomic studies [3, 6].

EXPOSURE

Breeding in Tomato

Tomato (*Lycopersicum esculentum*) (fig. 1) to the family Solanaceae. Solanaceae family is one of the economically important families of angiosperms and contains many of the commonly cultivated plants, including potato (*Solanum tuberosum*), tomato (*Lycopersicum esculentum*), pepper (*Piper nigrum*), eggplant (*Solanum melongena*), and tobacco (*Nicotiana tabacum*). Tomato is diploid and self-pollinated plant having 2n=24 [16-18]. Flower of tomato plant is perfect having both male and female functional part on the same flower (fig. 2). In genus lycopersicum, there is both self-incompatible compatible plants and but, tomato can easily hybridized with same species and also with wild varieties in suitable conditions to permit gene transfer from wild species [2].

Fig. 1. Tomato plant

Fig. 2. Flower of tomato plant

Breeding methods

Conventional breeding: Breeding has based on standard methods which are Mass selection, Pedigree, and Hybridization. These are all conventional methods for breeding. Conventional breeding has developed the cultivars and also dominant resistance genes to control pest and disease [6]. The replacement of inbred lines with hybrids increases the yield and other beneficial traits of tomato.

Mass selection: Mass selection is basically a breeding method. Through this method, tomato fruit quality and yield can be increased. In this method, phenotypically better plants are selected and they grow in bulk. And again, phenotypically better plants are grown, and this is repeated again and again till the desired characters are developed. In this way, quality and fruit yield are increased, desire characters are combined and new varieties are developed [7, 8].

Pedigree method: In the pedigreemethod, the controlled cross between the plants is carried. And by individual plant selection, the desirable trait is obtained, and inbred lines are prepared by growing them in lines and rows through successive generations. This method is beneficial and reliable to develop new varieties of the tomato crop. It develops new cultivars faster than mass selection. This is done by selecting individual plants in the early generation [9].

Hybridization: Hybridization is mostly done in the crosspollinated crops. It is also done in some cross-pollinated crops just like tomato and introduce many other tomato varieties. It needs some hard work and pollination is done by human intervention in tomato. Tomato is selfpollinated crop while tomato varieties can be developed through hybridization. First of all, inbred lives are produced by self-crossing. Then they cross the inbred lives of different varieties and grow plants

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and the plants are selected which have traits which are required. Sometimes undesirable traits are also transfer with the desirable traits then these undesirable traits are eliminated by backcrossing method although this is time-consuming [2, 6].

For a successful crop of tomatoes the grower needs to diligently observe certain practices at each stage:

Field Selection:

• Consider previous planted crop. As general rule, farmers should observe at least a 3-season break from tomato or any other crop from the solanaceous family. This is done to avoid disease cycles and ensure less cost in disease management.

• Check the irrigation water quality. Excess sodium and fluoride may affect proper plant growth.

• Check water availability particularly if you intend to use irrigation.

• Ideally, the land should be gentle sloping to facilitate drainage.

Soil environment:

• Tomatoes can grow in a variety of soil types; they do best in well-drained, deep, uniform clay or silty loams. The soil should be loose, deep and of correct structure because tomato has a root system of more than 60 cm depth.

• The optimum pH for tomato production is between 6-7.5.

• In coming up with a fertilizer program the grower can carry out a soil analysis.

Land preparation:

• Proper land preparation is necessary to loosen soil and break hard pans or compacted fields.

• In nematode infested areas, fumigation can be done with registered products.

• In soils whose pH is low; lime can be applied to raise the pH. For alkaline soils, gypsum can be used to reduce soil pH; it is also handy in sodium-level reduction.

• Planting on beds is recommended for low-lying, areas with high run-off; Raise the soil 15cm high with walkways of 30cm between the beds. Lay drip lines with the nozzles facing up.

Seed requirement:

In calculating seed requirement, the amount of seed will be determined by the spacing that will be used. A plant density of 3 plants per metre squared is recommended. The grower should plant about 15 percent more seeds in their nursery to cater for the seedlings that will be used for gapping.

Tomato must has High Resistance to Alternaria stem canker, Verticillium, Fusarium wilt as well as nematodes

• Seeds should be planted at a depth of 1cm and a spacing of 15cm between the rows. The seeds are arranged along a furrow, and then covered lightly with soil.

• The seeds will sprout within 8 days. It will take about a month before the seedlings are ready for transplanting.

• The farmer will be required to monitor the seedlings for pests, diseases and weeds using appropriate control methods when need arises.

• Farmers can also use trays for raising the seedlings. Plants raised in trays generally have a better survival rate.

Transplanting:

• The seedlings need about a month of growth before they are ready for transplanting.

• Transplant directly into already prepared holes. Spacing ranges from 60x45 cm, or 60x60 cm depending on soil condition and water availability.

Agronomic practices:

Agronomic practices include: nutrient management, irrigation, support, pruning, weeding, pest and disease management, harvesting and marketing.

• Nutritional programs enhance proper plant performance. Crop nutrient requirements change with each stage of growth.

• The general principle is to apply Phosphate fertilizer as basal dressing for root development.

• At the onset of flowering, top dress with NPK at 200Kg/ha; a compound fertilizer is necessary for the supply of N, P and especially K that is needed for flowering. The NPK top dress can be repeated after the first harvest.

• To correct micro-nutrient deficiencies, foliar feeds can be applied alongside the regular pesticide applications.

• Avoid excessive Nitrogen; it leads to excess vegetative growth, poor fruit set, smaller fruits, hollow fruits and poor keeping quality.

• Inadequate calcium can lead to blossom end rot disease; this disease can be corrected by applying calcium fertilizers.

Irrigation:

• The amount and frequency of irrigation depends on prevailing weather conditions and the stage of growth.

• For a standard greenhouse of 240 square metres install a 500 litre tank, this will serve the plants for a single day - i.e. half a litre per plant per day.

Pruning:

• To avoid the spread of diseases from plant to plant, do not use secateurs or a knife, 'pinch out' instead using your thumb and forefinger.

• A weekly scouting is done for side shoots before they develop into big shoots.

• Remove side shoots, laterals, old leaves, diseased leaves & branches and overshadowed lower leaves by hand.

• After formation of the first fruit cluster of mature green tomatoes remove all the lower older leaves to allow for ventilation and disperse food to the fruits.

• Flowers should be pruned to 5-6 per cluster for medium- large sized fruits.

Pests and Diseases:

• Common pests include; Aphids, thrips, whiteflies (fig. 2), cutworms, bollworms, leaf miners, spider mites and nematodes.

• Common diseases include: Wilts, Blight, Leaf spots and mildews.

• For the control of pests, cultural methods are the best e.g. clean weeding, use of certified seed, destroying alternate hosts etc.

• Do not wait till the pest or disease symptoms begin to show. Carry out preventive spraying, observe the product label recommendations in each case. For diseases e.g. mildews, blight, copper-based or sulphur-based fungicides are used.

• Viral diseases can be controlled by controlling vectors. Key vectors include; aphids, thrips, whiteflies and nematodes.

General Management of pest and diseases:

Pests and diseases remain the greatest challenge in Tomato production. Appropriate and timely management makes all the difference between good production, poor production or total crop failure. Proper identification of the pest and disease is critical in a control strategy. The general principles in pests and disease management include;

• Practicing crop rotation. Observe minimum 2 year rotation program

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• Planting resistant /tolerant varieties - Use certified disease-free seed treated with an approved fungicide to control seed rots and post emergence damping off

• Field hygiene-old crop should be removed from the fields, control weeds and crop debris since these are source of pests and diseases. Staking and pruning are also key to disease incidence reduction

Proper pest and diseases identification is the first and critical step in their management. This helps to detect problems early and take control measures on time.

MAJOR TOMATO PESTS

The greenhouse whitefly (fig. 3) (Trialeurodes vaporariorum)

This pest is serious as it has a very high multiplication rate, the whitefly larvae stages are also difficult to control with conventional contact products. The pest populations build up rapidly due to a life cycle of 20 days or less. Greenhouse Whitefly is a key vector to various viral diseases such as Tomato Yellow Leaf Curl Virus.They usually cause stunting and growth of sooty mould. Poor fruit are formed. The pest is known to transmit viruses.

Fig. 3. The greenhouse whitefly

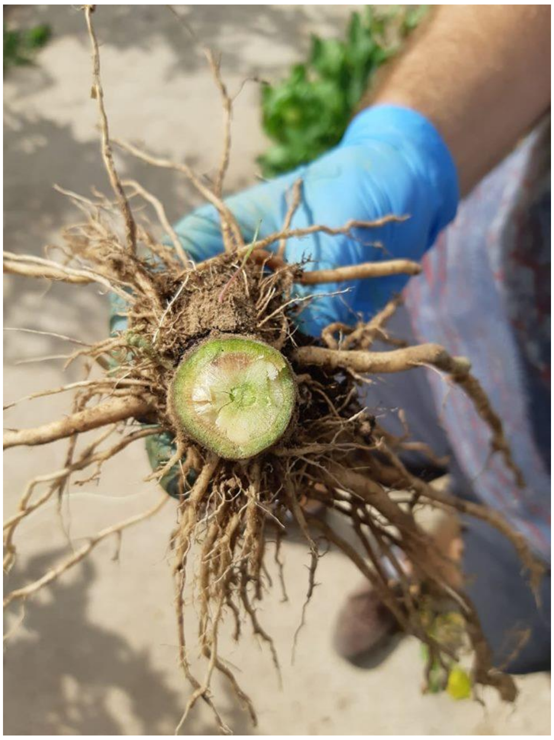

Fig. 4. Root disease

Control of whiteflies:

Physical control – use of nets and double doors, sticky traps and destruction of infested debris, registered pesticide products can also be used.

This disease can spread very fast wiping away plants within a short time. The disease also affects fruits.

Tomatoes may be infected at any age by the fungi. The wilt organisms usually enter the plant through young roots (fig. 4) and then grow into and up the water conducting vessels of the roots and stem.

Early Blight - Alternaria Solani

The disease is common in harvesting plants. In poorly managed green houses the disease can wipeout if timely management is not carried out. Disease development is most serious during warm wet conditions. Tomatoes infected with early blight develop small dark brown to black spots on lower shaded leaves, stems and fruits. Leaf spots are boarded by a concentric leathery tissue.

Spots in fruits often occur near the calyx end of the fruit. In the seedbed the small plants wilt and die eventually. In older crops, stem death occurs while leaves fall off the crop and fruits drop prematurely.

CONCLUSION

Tomato is the most important of all the cultivation crops. Tomato have a considerable importance. Market demands of this fruit are long shelf life, its shape, and color, in terms of quality and fruit flavor should be sweetness and juiciness. For Solanaceae family, tomato genome has been selected due to its small genome size, short reproduction period and due to its diploid genetics.

The breeding goals are fruit yield and resistance to disease and pests. Until now achievements in tomato breeding are depends on breeding methods. In plant breeding, molecular techniques opened new pathways for crop improvement. During last two decades, notable progress in molecular genetics has been confirmed including, cloning of gene, DNA sequencing, mapping of genes, QTL analysis, and markers development. Now, Functional genomics can be used for marker development. Transformation is also enterprising in development of marker. QTL analysis has very important impact on breeding programs. Many complex traits of fruit can be determined by this method. In next decades conventional breeding methods will not increase the production. Therefore, traditional breeding methods like Marker-assisted selection would be important tool for crop improvement. In future, tomato genome sequencing of gene-dense region will be determined.

Cultural control methods such as using tolerant varieties, certified disease-free seeds, practicing crop rotation, proper disposal of infected plant material and managing watering by reducing overhead irrigation can prevent the spread of the disease. Use of tools such as pruning knifes can also spread the disease from one plant to another hence, they should be sanitized. Fungicides that can be effectively used include Copper based fungicides, Carbendazim and Thiabendazole. Affected plants can be uprooted to reduce spread.

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