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Improved Production Technologies of Tomato (*Solanum lycopersicum*): *Enhancing Yield, Quality, and Profitability through Scientific Cultivation Practices*

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INTRODUCTION

Tomato (*Solanum lycopersicum*) is a widely grown and most critical vegetable crop in the world. It is of the family Solanaceae and originates from western South America as well as Central America. Because of its ability to grow in a large range of climatic and soil conditions, tomato is now produced in nearly all nations, where it forms an integral part of both subsistence and commercial farming.

With regards to its global importance, tomato is in a pinnacle position due to its nutritional value, culinary uses, and economic value. It is eaten in various forms fresh, cooked, processed into sauces, ketchup, juice, puree, or dehydrated products and meets the status of staple food in numerous dishes across varied cuisines. Rich in vitamins A, C, and E, antioxidants like lycopene, and minerals, tomato contributes significantly to human health by reducing the risk of chronic diseases and supporting immune function.

Status in India

In India, the second most valued vegetable crop after potato, both in area and production, is tomato. Recent estimates indicate that India accounts for high proportions of global tomato production and the leading growing states are Andhra Pradesh, Madhya Pradesh, Karnataka, Maharashtra, Odisha, Bihar, and Tamil Nadu. The crop grows under open field conditions and in protected cultivation modes such as polyhouses and net houses based on regional climatic suitability and production targets. Even though tomatoes are a highly demanded and profitable crop, the cultivation of tomatoes in India is frequently threatened by various biotic (like pests like fruit borer, whitefly, and diseases like early and late blight, bacterial wilt, and virus infections) and abiotic (like drought, salinity, and temperature extremes) stresses. Both yield and quality are negatively influenced by these factors, causing huge losses to farmers.

Need for Improved Technologies

The primary constraints in tomato production are utilization of low-quality or disease-vulnerable planting material, along with customary and unscientific agriculture. Inefficient fertilizer management, poor irrigation management, and absence of pest and disease control are added to the yield gap. The use of advanced production technologies, such as high-yielding and disease-resistant varieties/hybrids, protected cultivation, drip irrigation and fertigation, integrated nutrient and pest management (INM and IPM), and post-harvest handling practices, has been found to have promising impacts in increasing crop productivity and quality. In addition, precision agriculture technology, climate-resilient practices, and market-based strategies have brought new opportunities for tomato farmers, particularly in peri-urban settings where there is a high demand for fresh and quality produce. Incorporating these innovations into the traditional system of production can make tomato farming a more sustainable, lucrative, and resilient business. With its high market value, nutritional value, and economic payoff, tomato remains a crop of strategic significance for Indian agriculture. Yet, for its full potential to be realized, an urgent need is to narrow the technology adoption gap, strengthen research-extension-farmer linkages, and facilitate capacity building among stakeholders. In doing this, tomato cultivation has the potential to be a potent lever for achieving food and nutritional security, generation of incomes, and diversification of agriculture in India.

Climatic and Soil Requirements

Climate

Tomato is a warm-season crop that prefers to grow best under moderate temperatures and dry weather. The ideal temperature level for its healthy development and growth is between 21°C to 27°C. This favors vigorous vegetative growth, pollination, and fruit development. Temperatures exceeding 35°C may cause flower abortion, fruit set failure, and sunscald, and temperatures of less than 10°C may reduce pollen viability considerably and inhibit plant development. Frost is very harmful to tomato plants, and even slight chilling damage can weaken physiological functions. Hence, tomato production is most ideally suited to areas with frost-free weather, low humidity during flowering and fruiting, and sufficient sunlight for photosynthesis. In regions prone to temperature extremes, protected cultivation techniques like polyhouses, net houses, or low tunnels may assist in keeping beneficial microclimatic conditions and prolonging the growth season.

Soil

Tomato grows well in well-drained, rich fertile loamy soil high in organic matter with good water retention capacity. The soil to be used for tomato crop should have a slightly acidic neutral pH ranging from 6.0 to 7.0. These soils support improved nutrient uptake, root growth, and microbial processes needed for healthy plant growth. Poorly drained heavy clay soils can cause waterlogging, root rot, and oxygen deficiency, all of which are harmful to plant health. Conversely, extremely sandy soils with low nutrient holding capacity may need frequent watering and extra organic additions to stay productive. Saline or alkaline soils are not favorable for tomato production because excessive salt levels lead to physiological drought, nutrient toxicity, and reduced plant growth. In an effort to enhance soil health, well-decomposed farmyard manure (FYM), compost, or green manures should be incorporated before transplanting. Soil testing is also recommended at regular intervals to determine nutrient levels, pH status, and salinity risks, which facilitate proper corrective action and management of inputs.

Improved Varieties and Hybrids

Selecting high-yielding, disease-resistant, and region-specific varieties is critical. Common improved varieties and hybrids include:

Type	Popular Varieties/Hybrids	Key Traits
Open-Pollinated	Pusa Ruby, Arka Vikas, Arka Saurabh	Suitable for open field, moderate resistance
Hybrids	Arka Rakshak, NS-501, Abhinav, Nunhems	High yield, disease resistance, firm fruits
Processing	Pusa Uphar, Punjab Chhuhara	Thick pericarp, high TSS, long shelf life

Nursery Management

Successful nursery management is a key step in having healthy and vigorous seedlings, the basis of a successful tomato crop. Appropriate care at the nursery stage reduces transplanting shock and promotes even crop establishment.

Seed Rate

For open field production of seedlings, the seed rate of 100–150 grams per hectare is usually adequate. But in protected cultivation, as plant spacing will be intensive and uniform, the seed rate of 250 grams per hectare is advisable in

order to maintain a proper plant population and early planting.

Seed Treatment

To avoid seed-borne and early soil-borne diseases, seed treatment is necessary. *Trichoderma viride* or *Pseudomonas fluorescens* at 5 grams per kilogram of seed can be used to increase resistance against fungal pathogens biologically. Chemical treatment with Captan or Thiram at 2 grams per kilogram of seed also is a potent protection against damping-off and other fungal infections at the germination stage.

Growing Medium

Selecting a proper and sterile growing medium is crucial for the development of healthy seedlings. A balanced medium made of soil, sand, and well-decomposed farmyard manure (FYM) in 1:1:1 proportion is standard in traditional nurseries. An alternative in high-tech nurseries or covered conditions is a soilless medium made of cocopeat, vermiculite, and perlite (3:1:1), which provides good aeration, water holding, and root growth.

Whichever the medium, sterilization is required to kill off injurious pathogens. Sterilization can be achieved by solarization, steaming, or application of formalin solution, after which adequate aeration prior to sowing is required.

Protection Measures

To protect seedlings from insect pests and vector-borne viral diseases, nursery beds must be covered with insect-proof nets or enclosed within a net house frame. Preventive biological controls like neem extract spraying (Azadirachtin) or fixing yellow and blue sticky traps aid in population monitoring and control of whiteflies, aphids, and thrips. Not using pesticides at this early stage maintains natural enemies and provides residue-free seedlings. Additionally, proper watering, shading in hot weather, and drainage should be ensured to prevent seedling stress and damping-off.

Field Preparation and Transplanting

Good field preparation and early transplanting are important for the development of a healthy tomato crop and high yields.

Land Preparation

Tomato needs a well-prepared, fine-tilth field with good root establishment and nutrient uptake. Plough the field deeply once with a mouldboard plough and 2–3 harrowings to crumble clods and level the land. At final land preparation, mix 20–25 tons of well-decomposed farm yard manure (FYM) per hectare and completely mix it in the soil to enhance soil structure, water retention, and fertility. Raised beds or ridges and furrows can be prepared based on the irrigation system and cultivation mode.

Spacing

Spacings maintained properly ensure good light, air permeability, and prevent spread of disease:

For open field crop growing, a row spacing of 60 cm and plant spacing of 45 cm is mostly preferred. Under protected cultivation systems like polyhouses or net houses, greater spacing of 100 cm between beds and 40 cm between plants is followed, either in single row or double row planting systems on raised beds. Such an arrangement allows ease of intercultural operations and ensures enhanced air movement around the plant, particularly in closed spaces.

Transplanting Time

The transplanting time for tomato differs based on the agro-climatic zone as well as the crop season. The overall transplanting timings are as follows:

- ✓ Kharif season: Transplanting is performed in June to July, at the time of onset of monsoon.
- ✓ Rabi season: Transplanting is accomplished during the period between October and November in most areas.
- ✓ Summer crop (under protected structures): For off-season production of high-value crops, transplanting may be carried out in the months from January to February under polyhouses or net houses, where temperature and humidity can be controlled to promote growth.

Pre-transplant, seedlings of 25–30 days old with 4–5 true leaves and strong roots should be chosen. It is preferable to transplant in late afternoon or on overcast days to minimize transplanting shock and water loss. Light watering should be provided soon after transplanting to aid plant establishment.

Irrigation Management

Effective irrigation is of paramount importance in the cultivation of tomatoes, particularly under changing climatic and soil conditions. Drip irrigation is strongly advised since it facilitates exact and even distribution of water to the root zone with minimal wastage, which aids in

fertigation fertilizer administration with irrigation.

The interval between irrigations is determined by the soil water content, growth stage of the plants, and climatic conditions, but in general, irrigation at 4–7 day intervals is sufficient. Sandy soils need more frequent irrigation compared to loamy soils. Excessive irrigation should be avoided since it results in waterlogging, which is conducive to root rot, wilting, and cracking of fruits, particularly at the fruiting stage. Mulch installation together with drip lines also maximizes moisture retention and minimizes wastage of water.

Weed and Mulch Management

Weed Control

Weeds compete with tomato plants for water, light, and nutrients, as well as providing alternate hosts to pests and diseases. Proper weed management is a must during crop growth initiation. Manual hand weeding at 20–25 days after transplanting (DAT) and a second weeding at 40–45 DAT is practiced.

For chemical control, pre-emergence herbicides such as Pendimethalin @ 1 kg active ingredient/ha can be sprayed immediately after transplanting to inhibit weed germination. But the effort should be made to use it uniformly and check for phytotoxicity.

Nutrient Management

Nutrient	Recommendation (kg/ha)
N : P : K	120 : 60 : 60 (open field)
FYM	20–25 t/ha
Micronutrients	Boron, Zn, Mg, and Ca as foliar sprays
Fertigation	Split application of water-soluble fertilizers (e.g., 19:19:19, 13:0:45) at various stages of growth for protected cultivation

Mulching

Mulching with black polyethylene sheets of 25–50 micron thickness is extensively practiced in open field and protected cultivation. Mulching has several advantages:

- ✓ Conserves soil moisture by minimizing evaporation,
- ✓ Suppresses weed growth by preventing sunlight,
- ✓ Regulates soil temperature, and Enhances fruit quality through prevention of soil contact, thereby minimizing rotting and blemishes. Organic mulches such as straw or dry leaves can also be employed, particularly in organic production systems.

Integrated Pest and Disease Management (IPDM)

Problem	Symptoms	Management
Fruit Borer	Boreholes in fruits	Neem oil sprays, pheromone traps, release of Trichogramma
Whitefly / Aphids	Leaf curl virus vectors	Yellow sticky traps, Imidacloprid (0.3 ml/l)
Early Blight	Concentric rings on older leaves	Mancozeb 0.25% or Azoxystrobin sprays
Late Blight	Water-soaked lesions on leaves and fruits	Metalaxyl + Mancozeb (0.25%)
Root-Knot Nematode	Galling of roots	Use of resistant rootstocks or neem cake application

Staking and Pruning

In indeterminate tomato hybrids, staking and pruning are important agronomic practices for maximizing yield and quality.

Staking

Tomato plants are likely to sprawl on the ground when unsupported, which exposes them to a higher risk of fruit rotting, pest attack, and fungal diseases. To counteract this, staking with bamboo poles, jute twines, or trellis supports is performed to support the plant, maintaining it in an upright position while keeping the fruits away from the ground surface. The process also improves light interception and facilitates harvesting.

Pruning

Pruning removes side shoots (otherwise known as suckers) developing between the stem and leaf axils. Pruning suppresses unwanted vegetative growth, enabling the plant to direct more energy towards fruit production. Pruning enhances air movement, lowers humidity around the leaves

(and thereby disease pressure), and leads to bigger, earlier-ripening fruits. Periodic monitoring and early staking and pruning will greatly enhance both the yield and marketable fruit quality of the tomato crop.

Harvest and Yield

Careful harvesting of tomatoes must be done to prevent damage and maintain fruit quality. Harvesting at the right stage of maturity varies depending on the destination market and transit time. For far-off markets, fruits are picked at the mature green to breaker stage, where the fruit is fully sized and the first color change is observed. This allows the tomatoes to ripen during transport, which minimizes spoilage. For domestic markets, tomatoes can be picked at the red ripe stage of maturity to offer improved appearance and taste to the consumers.

The yield of tomato is highly variable based on growing practices, variety, and agro-climatic conditions. Under open field cultivation, yields vary from 25 to 40 tonnes per hectare. Under protected cultivation systems like polyhouses and net houses, it is possible to achieve up to 80–120 tonnes per hectare because of the improved management of inputs, control over the climate, and disease management.

Post-Harvest Handling and Marketing

Correct handling of tomatoes after harvest helps in reducing losses, quality retention, and enhance marketability.

Sorting and Grading

Tomatoes must be sorted after harvest to exclude diseased, damaged, or deformed fruits. Sorting is carried out according to size, color, and ripeness for purposes of meeting the market requirements and ensuring uniformity in packaging.

Packaging

Tomatoes can be stored packed in ventilated plastic crates or corrugated fiberboard cartons that have openings for air to pass through and prevent bruising and mechanical damage during transport. Over-packing or stacking must be avoided to minimize bruising.

Storage

Short-term storage of tomatoes can be at the range of 10–12°C temperature and relative humidity of 85–90%, which aids in shelf life and firmness preservation of fruit. Controlled atmosphere storage and cold chain are desirable for long-distance transportation.

Value Addition

Tomato is a good raw material for processing, with possibilities of value addition. Typical products are tomato pulp, puree, sauce, ketchup, juice, and dried tomato powder. These processed items assist in post-harvest loss reduction and enhanced income from diversified marketing routes.

New Technologies in Tomato Production

A number of advanced technologies are revolutionizing tomato production, making it more efficient, productive, and profitable.

Protected Cultivation

Covered structures such as net houses, polyhouses, and shade nets provide all-year-round production of tomatoes with temperature, humidity, and pest control. This results in more yields, improved quality, and minimum use of pesticides.

Grafting

Grafting of tomato scions on disease- or nematode-resistant rootstocks aids in reducing soil-borne diseases and increases plant vigor. It is especially useful in protected culture and problematic soils.

Hydroponics

Hydroponics make soil-less tomato growing possible with nutrient-fortified water to achieve maximum nutrient intake and water conservation. The method is increasingly used in urban agriculture and commercial farms for its convenience and environmentally friendly practice.

Precision Farming

Precision farming combines technologies like remote sensing, GPS, sensors, and ICT tools to track crop health, soil health, and environmental factors. This facilitates evidence-based decision-making, optimal input utilization, and timely remedial actions.

Biofortification

Tomato breeding schemes are now targeting biofortification producing varieties that are nutritionally enhanced with vitamins (such as provitamin A), minerals (iron and zinc), and antioxidants such as lycopene. Such varieties have the potential to reduce nutritional deficiencies and improve health.

CONCLUSION

Tomato is a valuable crop with high income generation potential and nutritional enrichment. With the adoption of upgraded production technologies like quality hybrid seeds, protected cultivation, fertigation, IPM, and scientific post-harvest management, farmers can raise yields and profitability substantially. Increasing demand

in fresh and processed markets, support for modern practices in tomato farming can add to sustainable agriculture, food security, and rural development.

REFERENCES

Gatahi, D. M. (2020). Challenges and opportunities in tomato production chain and sustainable standards. *International Journal of Horticultural Science and Technology*, *7*(3), 235-262.

GER, K. G., BELEW, D., NEBIYU, A., & BARNABAS, J. (2024). Growth, Yield, and Yield Components of Tomato Varieties (Solanum lycopersicum L.) Influenced by the Application of Blended Fertilizers (NPS) at Jimma, South-West Ethiopia. *Current Agriculture Research Journal*, *12*(2).

Gerszberg, A., Hnatuszko-Konka, K., Kowalczyk, T., & Kononowicz, A. K. (2015). Tomato (Solanum lycopersicum L.) in the service of biotechnology. *Plant Cell, Tissue and Organ Culture (PCTOC)*, *120*(3), 881-902.

Shiferaw Geleta, D., Yefru Derbe, S., Seifu Woldegiorgis, B., Weldeyohanis Kifle, S., & Müller, B. (2024). Production and management practices and technologies used for growing potatoes and tomatoes. *Agricultural and Resource Economics: International Scientific E-Journal*, *10*(3), 192-218.

Yadav, S., Prajapati, R. R., & Prajapati, M. R. (2014). Knowledge and adoption of tomato growers about improved tomato production technology. *Guj. J. Ext. Edu*, *25*(2), 172-174.