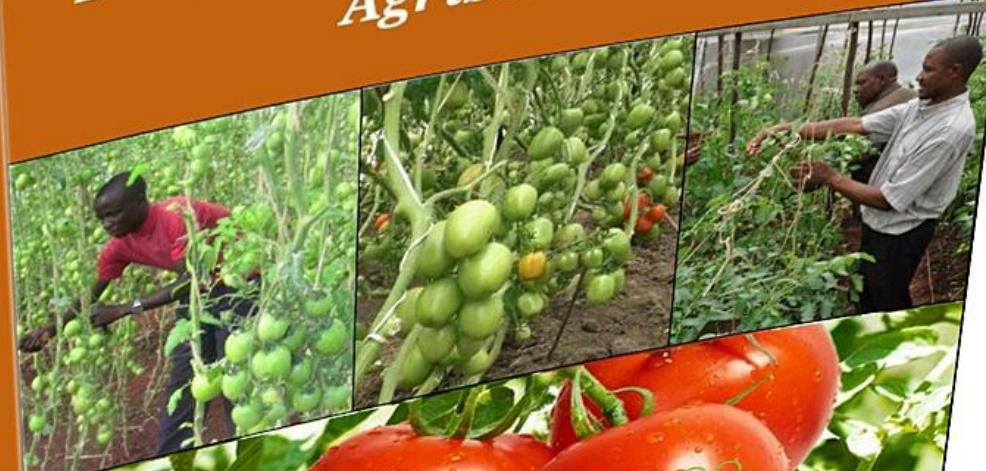


# TOMATOES FARMING

## STEP BY STEP GUIDE

*Learn How To Start A  
Profitable Tomatoes Farming  
Agribusiness*

*Profitable Farming In Kenya*



AgriBUSINESS

Timothy Angwenyi

# Tomatoes Farming

## Step-by-Step Guide

### Learn How To Start A Profitable Tomatoes Farming Agribusiness

The market demand for tomatoes is always high in Kenya. This explains why tomato farming in Kenya is such a profitable business idea. Tomatoes grow very fast. Most tomato varieties in Kenya such as the Anna F1 reach maturity 60-75 days after transplanting.

A well grown tomato fruit can weigh more than 150 grams and give a yield of more than 30 tonnes per acre. One can eat the tomatoes while fresh, cook them as vegetables, add to salads or get the processed tomatoes.

Provide warm conditions with average humidity to make more money with tomato farming in Kenya. Extremely high temperatures will lead to lower yields. In addition, excessive humidity will increase susceptibility to tomato diseases such as the bacterial wilt.

**NOTE:** Tomatoes belong to the Solanaceae (Nightshade family) together with pilipili hoho. Avoid planting tomatoes (including the nursery) where the other members of the Nightshade family have previously been grown within the last 3 years. They include capsicum (peppers), potatoes, and eggplants. This is to reduce the risk of various Nightshade-family diseases such as the Fusarium wilt.

Though looks unique but planting tomatoes for business is a profitable option indeed. Starters may grow tomatoes in greenhouses in the areas nearby home. Turn it a small farm and transform your hobby into small business. Get yourself prepared and find various categories of tomatoes if you are serious about planting tomatoes for sale.

Planned approach and dedication yield best outcome and your business become a profit making venture.

There is no hard and fast rule for planting tomatoes. Best research about plant categories and maintaining them by watering and harvesting is helpful for planting tomatoes in organized manner. Tomatoes produced must go into the market on right time. It should be well consumed. Have dedicated small team of laborers for plantation and ensure that your tomatoes reach in the market without any delay. Also, ensure that proper arrangement of transportation has been done to shift them from the farm into respective markets for selling.

Have you ever wondered how profitable it could be to start a tomato farm? Do you want to invest in tomato farming business but not sure of return on investment? This eBook will help you learn the profitability of tomato farming in Kenya, how to start- with step by Step guide and how to market and get back your invested capital with huge profit.

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Agribusiness Writer

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Profitable Farming Guide Series

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## About The Writer

Hello! My name is Timothy Angwenyi Morebu.

My phone number is **0714723004**. My email also is [timohangwenyi@gmail.com](mailto:timohangwenyi@gmail.com). I am a Agribusiness writer, Agri-tourist & an Entrepreneur. Am currently writing *guides on various ways of earning a living in Kenya through Profitable Farming (Entrepreneurship)*, whereby i educate Kenyans on business ideas to venture in Agriculture sector.

Helping people start Agribusinesses and achieve the income they desire has become a huge part of my life. Being able to share the knowledge I have gained through visiting people's farms and attending Agriculture seminars and exhibitions has become extremely important to me.

I consider my readers my friends. I am always so appreciative that they take their time out to read my eBook guides and to learn about Agribusiness ideas from me. Once you have finished reading this guide, I have no doubt that you will have learned a great deal about Tomatoes Farming in Kenya.



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# Chapter 1

## Introduction & Cost of starting Tomatoes Farming



Tomatoes farming agribusiness is highly profitable if well planned. In this chapter, i will give vivid description of tomato farming in kenya and also some calculations of the amount of capital you will need.

Tomato is a crop which has high returns on investment (ROI), making it a suitable agribusiness crop. One tomato plant grown in the open can yield about 5kgs of tomatoes. At a spacing of 90×60cm, plant population per acre is about 7407. With average tomato market price of Ksh 20 per kg, cost of production of Ksh.148,140, the farmer can earn:

$(7407 \times 5\text{kg} \times \text{Ksh.20} = \text{Ksh.740,700}) - 148,140 = \text{Ksh.592,560}$  from one acre of tomatoes

It is not enough to get a nice job in the city, sit in the office and work day in day out, a good number of Kenyan young professional are realizing. Office work alone, according to them, makes one dull, unambitious and financially constrained to live a good life, therefore, one must have a "side hustle".

A side hustle in the Kenyan street parlance means an activity or a job that one engages in besides his work to make extra money. Of the many "side hustles" the Kenyan young professionals, mainly men, are engaging in, farming is turning out to be a top choice.

Lawyers, accountants, journalists, bankers, doctors, lecturers, fashion designers and information technologists all are venturing into farming as they realize how lucrative agribusiness is.

While some are keeping livestock like chickens and rabbits, majority are leasing land outside Nairobi and growing fast-maturing horticultural crops that include tomatoes, capsicum and cabbages and traditional vegetables whose market is insatiable in the capital.

Vincent Mulando, Patrick Shimenga and Paul Onyango are some of the young Kenyan professionals who have gone into farming.

Vincent Mulando, a young lawyer, runs a firm in Nairobi that is fast-growing with his clients including top commercial banks in the East African nation. Shimenga, on the other hand, is a senior information technologist with an insurance company in Nairobi while Onyango works with a leading commercial bank.

The three friends came together and leased a five-acre piece of land in Juja on the outskirts of Nairobi, where they are currently growing tomatoes, capsicum, sukuma wiki, cabbages and traditional vegetables.

It has been over five months since they started the venture that has given them at least two harvests. "This is what I now want to focus my energies on even as I work hard to build my career in banking," said Onyango, who visits the farm every weekend.

There is good money in farming and it is worth the investment. The population is growing fast and so is the demand for food. "You cannot go wrong with farming as long as you do things right," he added.

The three leased the farm at Ksh.5,300 per acre monthly, fenced it and bought a water pump, which they use to draw water from a nearby river for irrigation.

"We are yet to recoup our investment of about Ksh.315,700 but what we have gotten from the harvest is promising that we would get our money back by the fifth harvest," said Mulando, adding that they supply their produce to a supermarket in Nairobi and have employed two workers on the farm.

Away from Juja, university lecturer Beatrice Mundia keeps chickens and grows crops on her two-acre farm in Kisaju on the outskirts of Nairobi, where she also lives. Mundia keeps 400 layers and grows tomatoes and capsicum that she supplies to traders at a local market where demand is high.

"It is good to have another source of income on the side so that in case things do not go as they should at your main place of work, you have a fallback plan," said Mundia, who earns at least Ksh.142,000 a month from the venture.

Bernard Moina, an agricultural extension officer based in western Kenya, noted that it is good news for the country that professionals are embracing farming. "People are realizing that a white collar job is not all that one needs in life to progress and be happy. Farming is a good industry to invest, in particular, in Nairobi where demand for produce is too high making people make almost free money," he said.

Moina added that the fact that the professionals have the knowledge, the money to invest, and the passion is good enough to turn farming into a specialized venture.

## **How to run a booming tomato project**



Kirinyaga County is an agriculturally endowed land with breathtaking rice fields on the Mwea plains and dense, lush tea and coffee plantations on the upper sides, which neighbour Mt Kenya forest.

The picturesque is complemented by patches of blossoming horticultural crops in many parts of the county where farmers who have invested adequate resources in tomato, vegetables and French beans are reaping fortunes.

One such farmer is Githaka Nyingi, a young man minting serious money in his locality from tomato farming, just three years since he ventured into it. When he talks about income versus cost from tomato farming, you can easily get carried away as he explains how you can make over a million shilling in profit from an acre of tomato in four month's time.

He has a rider though: "Lucrative tomato farming entails precise planning and timing in addition to months of hard labour for one to have quality fruits at time of high demand." If you

have travelled along Kerugoya-Kutus road in recent days, a short distance from Karia shopping centre you must have noticed tens of tomatoes packed in boxes ready for the market.

On both sides of the road, acres of tomato plants stand out as youthful farmers, disappointed by poor returns from maize, have ventured to the fruit's planting. Nyingi is among them and he has perfected the art of farming tomato profitably.

Prices of tomatoes keep on fluctuating due to market forces of demand and supply and this is what has discouraged some farmers from venturing into tomato farming. To farmers who rely only on rain to farm tomato, their crop matures at a time when supply is so high that prices fall to a low of below Sh.1,000 per box occasioning losses to farmers since the crop's management is costly.

After observing tomato market behaviour, Nyingi rented a piece of land near a water pond to avoid reliance on rain-fed agriculture so that he times his tomato to mature when demand is high. "Farmers in Mwea and Laikipia are favoured by even topography, less diseases and pests, and plenty of irrigation water hence their production costs are lower.

They farm in large scale and when their crops mature they flood the market. During rainy seasons, they are unable to take their crops to the market due to poor roads condition and that is when my crop is at climax," he says.

Nyingi initially worked in the tourism sector with East Africa Canvas but after the 2007/08 post-election violence, he quit. During the breaks he would plant a quarter or an eighth acre of tomatoes in his small piece of land but did not put much attention to it hence the earnings were not significant.

Best practise In 2013, he was inspired by the money farmers in Mwea were making from tomatoes and he rented an acre piece of land and set aside money to adequately manage the crop, employing the best agricultural practices.

This entailed choosing hybrid seeds which are costlier than the conventional ones used by most farmers in the area and planting them in small polythene bags, which is laborious compared to planting on a seed bed.

Nyingi says hybrids offer better disease resistance, higher yield and possess other improved traits.

According to him, the advantage of growing tomato on polythene bags instead of seedbed is that the later get ‘shocked’ during transplanting hence the first flower dries up.

“I spent Sh.150,000 tending the crop and found demand high such that I sold each box at between Sh.4,500 and Sh.6,000. I made sales worth Sh.1.4 million from 220 boxes. I was motivated because I had never made such money in my life. I decided to concentrate on tomato farming,” he says.

Currently, Nyingi has mature tomato crops in his one and quarter acre farm.

When his tomato hit the market early this month, a box was going for Sh.6,000 but as more tomatoes from other farms ripen and enter the market, price has fallen to Sh.4,000 and is expected to plummet further.

He spent Sh.250,000 tending the crop and if all goes well he expects to make sales of Sh.1.6 million and Sh.1.3 million profit in four and half months.

Tending tomatoes to yield such money requires great effort right from preparing nursery to harvesting.

Nyingi advises farmers to mix soil and manure in equal ratio then plant two seeds per polythene bag and then apply water.

Though one seed per bag is enough, the extra one is meant to replace those that fail to germinate or get spoiled during transplanting.

An acre of tomato requires seven tonnes of manure which he buys at Sh.21,000 from farmers in Mwea, Kitengela or Laikipia.

In the nursery, one must water them in the morning and in the evening daily for the first week and afterwards in the morning only until they are about 25 days old.

"I transplant them between the 23rd and 25th day before the roots have firmly attached themselves to the bags. The land is ready at that time. This is by ploughing to loosen the hard pan, applying manure and burying it lightly with soil. I dig trenches 3ft apart while the spacing from one plant to the other is one and half feet," he explains.

### **The secret**

He applies a teaspoon of DAP fertiliser per tomato at planting, then waters twice per day by pumping water from the nearby Karia ponds until it rains.

After three weeks, he applies a tablespoon of DAP and 17:17:0 fertiliser in equal ratio per plant and another three weeks later he adds 17:17:0.

Spraying using relevant sprays at the right time is also essential for flowers and fruits to keep diseases, worms and blight at bay.

He says tomatoes also require support using stakes when they are one month old.

The major challenge he faces is a viral disease locally known as kathuri which is characterised by plant withering such that it gives forth tiny fruits.

There is also the yellowing disease identified by yellow leaves, which hampers fruits from growing big.

“Some diseases are incurable while others require expensive chemicals. Spraying is labour intensive and expensive. As my tomato grow I spend Sh.10,000 on spraying. I must also be there to ensure there is correct mixing of chemicals,” he says.

He usually plants seedlings on February 1 so that the crop can be ready at May and the next crop on August 8 to time the crop for December.

Nyingi also farms French beans but he says they are not as profitable as tomatoes.

To safeguard his future when he might lack the energy to farm tomatoes, he has planted 150 bushes of batian coffee which is also blossoming and promising to bring good returns.

Every farmer looks for tricks to better tomato farming in Kenya. Most Kenyan farmers started with tomato farms having been told of the huge profits in the market. The truth sometimes is hard to bear as a lot of us, small scale farmers have lost fortunes in tomato farming Kenya.

### **Here are the best 4 tips to better tomato farming in Kenya:**

#### **Tip 1: Don't Crowd the Seedlings**

When close together, growth is inhibited and eventually leads to low yield. Many farmers crowd the plants aiming to increase production only get bring losses.

#### **Tip 2: Grow Vertically Rather than Horizontally**

Growing vertically increases production as the crop can grow up to 10 meters when vertical. Horizontal planting will use up more space and being close to the ground increases the chances of fungus and pathogen attacks.

### **Tip 3: Prune for Better Tomato Farming**

Remove suckers that grow on the joint between two brunches. These suckers will never bear fruit but only take away energy from the plant. This can also be done on the other parts of the plant but be cautious not to remove productive parts.

### **Tip 4: Remove Leaves**

As the plant begins to mature, the lower leaves will naturally begin to yellow and wilt. This is perfectly normal, so pull these from the plant when they appear. It will keep the plant fresh, looking good, and help ward off disease.

## **I Don't Use Fertilisers to Get My Bumper Tomato Harvest**



It is early Monday and the weather is chilly. There are light showers too and this is the norm in Nyeri County, especially in July. However, King'ori Mathenge is undeterred. He is already busy preparing his greenhouses to plant tomatoes and capsicum.

Mathenge knows too well how farming took him out of desperation after he was unable to get a job upon graduating in December 2010.

The 29-year-old has four greenhouses where he practices organic farming which relies on green manure, compost and biological pest control. He sells the produce to hotels in Nyeri and the Coast.

Mathenge chose organic farming because most people are running away from crops grown using chemicals. He gets the manure from the 450 chicken he rears on his farm.

He also buys sheep manure from pastoralists in Doldol, Laikipia County, which he mixes with the chicken manure to grow his crops.

He says he had no idea on farming and had to attend farmers' field days and agricultural shows to get some tips before starting. He attended one such meeting at Wambugu Farmers Training Centre in Nyeri.

However, he says he had never contemplated farming until 2011 when he failed to get a job after one year of searching.

"All I thought of was an office job where I would always be in a suit and tie. However, after several months of joblessness, I had to think outside the box. I needed to earn a living and that is when I thought of farming," he says.

## GAPS

"But before I decided what to grow, I studied the market to find the gaps I should fill," he told us at his farm.

"I have realised that deciding what to grow is where many farmers go wrong. That is why you find a product flooding the market because everyone is growing it," Mathenge says and adds that soil tests also help to know what type of crop can do well in a particular area and farm.

Mathenge had to seek his father's permission to use his quarter an acre land in Kirurumi village, near Aberdare Forest for farming.

And to keep pests away, Mathenge has been practicing crop rotation, another aspect of organic farming.

"To succeed in farming, one must grow crops that the market needs and not what everyone is growing. You must also ensure the crops are not harmful to human life, such as those grown with chemicals," Mathenge adds. And according to John Wambugu, an officer from the ministry of Agriculture, organic farming in greenhouses is the best these days.

"In greenhouses, temperatures are warm and this speeds up growth of crops while reducing fungal infections," Wambugu says.

He says although organic farming in greenhouses is rather expensive, it is the way to go since most people are shying away from crops grown using chemicals due to related health and environmental dangers," Wambugu adds.

"I started with a small greenhouse measuring 15m by 6m where I grew 400 seedlings of tomatoes," he says. The crop earned him Sh.90,000 within six months.

The young farmer has his market for tomatoes mainly in hotels in Nyeri. He also supplies some to traders in markets. He sells capsicum in Mombasa and Nairobi.

However, the prices are not constant and depends with supply in the market at a particular time.

"I sell a kilo of capsicum at a minimum of Sh.100 while that of tomato goes for Sh.80," he notes.

## **BIGGER GREENHOUSES**

Later on, Mathenge put up another greenhouse, bigger than the first one which earned him Sh.150,000 from the first harvest. By this time, he had two greenhouses. He harvested twice in one and earned Sh.180,000 before hailstorm destroyed his crops.

Mathenge did not lose hope. He borrowed money from his father, renovated the greenhouse and constructed a third one. He would reap Sh.300,000 soon after selling capsicum from the third greenhouse.

He says he later earned Sh.60,000 after selling tomatoes before hotels at the Coast stopped buying his capsicum after business went down due to terror attacks. "I was forced to concentrate more on tomato farming," he says.

With his mode of farming, he has been able to control common diseases such as Powdery Mill Dew that affects both crops and Tuta Absoluta. With this the bachelor of commerce graduate continues to say no, thanks to job offers.

Eustace Gachanja, the coordinator of the Kenya Organic Agriculture Network says organic farming is not as expensive as some think.

Other than enhancing yields by applying manure, crop rotation and planting of legumes, Gachanja says farmers can also have their farms certified as organic to enable them sell at premium prices in selected organic shops and restaurants.

"We also issue the East Africa Organic Mark to those who comply with the standards to enhance organic farming," says Gachanja.

## Starting a Tomato Farming Business – A Complete Guide



Are you interested in starting a tomato farming business? If YES, this section will educate you on how to starting a tomato farming business with little money and no experience.

I will provide you with an in-depth sample tomato farming business plan template. I will also take it further by analyzing and drafting a sample tomato farming marketing plan backed up by actionable guerrilla marketing ideas for tomato farming businesses. In this section of this chapter, we will be considering all the requirements for starting a tomato farming business. So put on your entrepreneurial hat and let's proceed.

Tomatoes originated in Southern America and only came to Kenya in the 1800s. They were always considered an ornamental fruit till the 1700s. Commercial tomato production began in 1960s. Tomatoes come in different types such as grape, cherry, plum or paste, fresh or beefsteak, and others. If you produce a variety, you are likely to make more money and have more customers than if you stick to one variety.

### Why Start a Tomato Farming Business?

Starting a tomato farming business is a rewarding business that is not too expensive to start up. However, before you start your tomatoes business, find out what kind of tomatoes people usually want. This information can be gotten from those who supply seeds, as they will be able to tell you what is popular and what isn't. Also, they will let you know the varieties that sell well; however, you will also need to ensure that the seeds you finally pick will grow well in your climate.

This means you would need to check your soil, and make sure it is very healthy. For instance, if you intend to plant heirloom tomatoes, your soil will need to have lots of organic matter and humus, and also have a neutral Ph that is under 7.

This will ensure that pests and disease problems for the tomatoes are reduced to the barest minimum. It is advisable you test your soil before planting; you can do this yourself or ensure that you take it to a soil laboratory to determine its health.

Once your tomatoes are fully developed and ready for harvest, they will turn into their natural colors – red, yellow, purple, or pink. Once you have harvested them you can start selling them. However, you would need to have carried out due diligence and search for your customers so that you don't just have your produce with no one willing to buy.

- **Tomato Farming Industry Overview**

There are two ways a tomato plant can grow, determinate and indeterminate. A determinate tomato will not only grow to a specified height that has been genetically determined, but it will produce all of the fruiting flowers at the same time; while an indeterminate will continue to grow and produce throughout the whole season.

Tomatoes in Kenya are harvested for two basic purposes such as:

- ❖ Fresh produce for direct consumption
- ❖ Marketing and processing

The psychographic and demographic composition of those that take tomatoes is very large. Tomatoes can be taken raw, cooked, processed as puree, or dried for tomato powder, or used as a beauty product. This means that almost everyone takes tomatoes. Those that use tomatoes include homes, restaurants, grocery stores, fast food outlets, spas, beauty salons, gyms, and so on.

Other people that require the use of tomatoes include wholesale markets, cooperatives, roadside stands, processing firms, pick-your-own-operations.

### **List of Niche Ideas within the Tomato Farming Industry**

As regards the niches in this sector, there aren't a large number of niches in the tomato farming business, as there are no real clear differences between one tomato farm and another.

However, some of the areas of specialization in the tomato farming business sector include; tomato processing for juice, sauce, paste and salsa, tomato sales, tomato dehydration for long storage purposes, ornamental tomatoes, exportation of tomatoes.

The thing about all these areas of specialization is, while a small scale farm might likely focus on one or two areas, a medium or large scale farm due to economies of scale might be able to specialize in most or all of the areas.

### **The Level of Competition in the Tomato Farming Industry**

Starting a tomato farming business is not considered as an expensive business, especially if you are starting out on a small scale. However, you would still be required to purchase the necessary equipment that will allow your farm efficiently regardless of the scale, the only difference being that larger scales will need to procure more equipment than smaller scales.

If you intend to start on a small scale, you can compete favorably against your competitors regardless of the scale if you choose your customers wisely. For instance, if you

produce on a small scale, you might not need to target processing companies as your customers, as they will prefer farmers who operate on a large scale, but you could target restaurants, and fast food, and local stands.

### **Economic Analysis**

Before starting a tomato farming business, you would need to ensure that you carry out a thorough investigation by visiting other tomato farms in your area as well as produce stands in the farmers market. Visiting the farm will provide you with the information needed to be able to plant your own tomatoes, while visiting the produce stands will help you see customer buying trends so as to have first-hand information of what customers would want.

However, if you intend to include grocery stores, and restaurants amongst your customers, you could decide to produce a variety of different types so that your customers could have their different preferences. Apart from knowing what tomatoes would move in the market, you have to be prepared for pests and diseases that could destroy your yield and also investment.

Another thing you would need to know before planting your tomatoes is the viability of your soil, this means that not all tomato variety might work with your soil composition, and so it would be necessary for you to carry out a test on your soil by sending samples to a soil laboratory for analysis.

Depending on the circumstances in the state you intend to produce your tomatoes you could decide to sell your tomatoes to tomatoes processing factories. Another thing to consider for your tomato farming business is the storage facilities available to store your tomatoes, since the tomatoes have to be in a good condition before they reach the customers.

### **Possible Threats and Challenges You Will Face When Starting a Tomato Farming Business**

The farming business though a lucrative business is one that has a lot of challenges and threats. A single challenge is sufficient enough to wipe away all your crops leaving you with a loss in investment. Some of the challenges you might face include diseases and pests, bad weather or natural disasters, lack of a good storage capacity, and stiff competition from your competitors.

Every business faces challenges and threats every now and then, how you handle yours, will make the difference between your success and failure as an entrepreneur.

## **Writing a Business Plan for Your Tomato Farming Business**

The best decision you would ever make before starting a business that you are serious about, and that you intend to make profit from, is having a business plan. A farm business is not something you just decide to start off without carrying out the necessary investigations that would ensure that you have knowledge of what you are going into. The findings from your investigation has to be written down somewhere, as well as what your thoughts are and how you intend to achieve them in your business.

This therefore means that a business plan is regarded as a guide that ensures you run your business successfully. It is a document which you will refer to from time to time, and which will influence your actions and decisions.

Your business plan if followed religiously can save your business from crumbling. It should however be noted that the strategies in your business plan are not cast in stone and can be changed depending on changes in the internal and external business environment. Your business plan should contain components such as how you intend to generate capital for your tomato farm business, who your target market is, and what future plans you intend for your business.

Some of the other components that must appear in your business plan to make it comprehensive enough are;

Your business plan should contain key components such as an executive summary, where your tomato farm is described holistically for investors to understand. Also, you would need to include components like your history, structure, vision, objectives and mission statements, products and services your farm intends to offer, location, as well as your overall strategy as a new entrant into the sector or industry you intend going into.

Your plan also needs to include your intended target market – who and where your customers are, how you intend to address the market segments, the infrastructure you would require to meet the start-up requirements for your business, SWOT analysis, and who your major competitors are in the industry you intend going into, and how your strategies are better than theirs, and how you intend to become one of the industry's leaders.

You would also need to input your financial analysis – cash flow, projected income and expenditure, balance sheet for at least five years.

Writing a business plan can be quite cumbersome especially when it gets to the financials. However, there are loads of business plan writers that you can approach for help in getting your business plan written; or you could decide to go online and download guiding templates that would help you put down a comprehensive business plan for your tomato farm.

### **A Detailed Cost Analysis for Starting a Tomato Farming Business**

The cost involved in starting a tomato farming business according to research in Kenya is capital and labour intensive. However as regards the equipment, they are mostly a one-time purchase, but labour and other operating expenses are usually recurring, however, you would learn how to juggle your expenses so as to keep your overhead low.

A tomato farming business is one where certain costs during start-up cannot be avoided. This is because the certain equipment you would use would be needed regardless of the scale of farm business you are running. Some of the items that you would need to ensure are in place if you intend to launch your tomato farming business in Kenya are as follows;

- ❖ Amount needed to buy or lease an acre of land depending on the size and location
- ❖ Cost of facility construction on land e.g greenhouse, fencing e.t.c
- ❖ Cost of seeds, fertilizer and pest & diseases control
- ❖ Cost of acquiring tools and equipment
- ❖ Miscellaneous expenses

Going by the above detailed research, you will need as little as Ksh.50,000 to start a small scale tomato farming business in Kenya. This is if you don't need a greenhouse i.e you are practicing open field cultivation and also you already have land... then Ksh.50,000 is good to start.

If you are intending to start a medium scale tomato farming business in the Kenya, you would need nothing less than Ksh.150,000. And if you intend to start a large scale tomato farming business in Kenya, then you should think towards raising close to Ksh.500,000 or more for your start – up capital.

#### ● **Financing Your Tomato Farming Business**

The tomato farming business might be something different from what you are used to, especially if you have never done farming before. Most people have the idea of starting a tomato farm but never do, which might be due to a lot of things which always includes finance. However, before you can get financing for your tomato farming business, you would need to have carried out your research, and ensure that you would put in the necessary hard work that is required.

Most horticultural crops – tomatoes being inclusive – are usually capital intensive. Apart from money, it also requires a significant amount of time and energy.

There are various options that are available when it comes to raising money to finance your tomato farming business, and they include;

- ❖ Approaching the bank for a loan for your farming business
- ❖ Raising money from personal savings and sale of personal stocks

- ❖ Applying for grants from relevant agriculturally inclined organizations
- ❖ Raising money from business partners
- ❖ Approaching investors for money
- ❖ Pitching your business idea to venture capitalists

## **Choosing a Suitable Location for a Tomato Farming Business**

The location you intend to use for your business is very important, especially if you intend on taking the business seriously and view it as a successful venture. To get a farm for your tomato business, you probably would need to buy acres of land on the outskirts of town if you live in a busy one.

However, if you live in the countryside and have a whole land just sitting vacant doing nothing, you might after analyzing the soil and determining it healthy for planting start your tomato farming business.

Another thing you would need to consider while searching for a location is how much budget you have got. If you do not have the necessary budget to purchase a suitable land, then you might consider leasing the land till you raise the money to own the land, or look for a fellow tomato farmer who would not mind sharing some acres with you, pool your resources together to get the land. However, if you prefer to operate on your farmland alone, you might need to source for finance from your investors.

Another thing you would need to consider when seeking for a suitable location is if where you have eventually chosen has got healthy soil that will ensure that you grow healthy tomatoes for sale. If you eventually get a location, and the soil isn't healthy for your tomatoes, you would have wasted money on a venture, except you sell off the land to someone else, while you seek another location.

Finally, your location must be large enough to accommodate a storage facility for your harvested tomatoes, and also a space for office facilities so that you would be able to carry out the necessary paperwork.

## **Technical & Manpower Details**

Farming of any kind is always a capital and intensive labour project, even if it is on a small scale. You would need tools to plough, plant, weed, keep the plants growing, and eventually harvesting your tomatoes. If you are lucky enough, you might be able to get these equipment for fairly use from farmers either offline or online that are looking to upgrade on the tools they have.

You could also try your local hardware store for some of the tools and equipment that you might need. It is economical for you if you decide to purchase some of your equipment for fairly used, as this would help keep overhead cost down.

Some of the equipment that you would need to fully launch your own tomato farming business includes;

- ❖ Tractor (for large scale growers)
- ❖ Tillage Equipment
- ❖ Transplanter
- ❖ Baskets
- ❖ Wheelbarrows
- ❖ Sprayer (Boom Type)
- ❖ Wagon or Trailer
- ❖ Shovels
- ❖ Gloves
- ❖ Rake

The nature of this business is such that you cannot run all the process alone. Even if you are running a small scale tomato farming business, as long as it not a small garden, then you would need the help of others in helping your business become a success. It makes economic sense for you to have your facility on your land if you are just starting out, so you would not need to worry about paying rent for an office facility. However, medium or large scale farmers might own two offices, one on their lands and another in the city.

Regarding the number of employees you would need to run your tomato farming business, it would vary depending on the size of your farm. One person cannot run the business from planting to harvesting. If you run a small scale tomato farming business, you would need at least a Farm Manager, Driver, Sales Persons, and Farm Hands. This is about 6 to 8 people.

### **The Production Process in Tomato Farming Business**

The production process involved in a tomato farming business is basically the same from the point of planting to the point of harvesting.

The process include, getting tomato seeds, determining their viability, ensuring that your soil is of the required state to grow your tomatoes. Weeding and watering are also processes that are involved in producing your tomatoes, and finally harvesting when they are about to ripen.

Other processes include packaging the tomatoes for either end customers, processing factories, for overseas customers, and so on.

### **The Marketing Plan**

- **Marketing ideas and Strategies for a Tomato Farming Business**

Before marketing strategies can be carried out, you would need to conduct a market research that will determine the best ways you could use to generate money for your tomato farming business. You would need to ensure that there is a demand for the types of tomatoes that you intend to plant, know when the demand occurs more, as well as carry out other marketing analysis that will make your tomato farming business boom.

Generally, while it might be more profitable if you stick to a particular variety or even few varieties; so that you can comfortably offer your tomatoes at a price that would not get stiff competition from other areas that might already be filled with competitors. This is why it is helpful to understand market trends before you venture into your tomato farming business.

If you are going to be running a small scale tomato farming business, you might not find it easy getting large customers since these kinds of customers would prefer tomatoes in large quantities that you might not be able to handle seeing that yours is a small scale, however, if you are running a medium or large scale tomato farming business, then you would strategies to draw in the big clients.

Some of the marketing ideas and strategies that you can use for your tomato farming business include;

- ❖ Develop a point of sale material that will enlighten customers on the uses of your tomato business
- ❖ Ensure that your distributors and suppliers make use of the referral method to help promote your business
- ❖ Pass out your business cards in stores, restaurants and other target areas
- ❖ Attend fairs and seminars, as well as food fairs and use in marketing your business.

### **Factors That Will Help You Get the Right Product Pricing for your Tomato Farming Business**

The factors that will help you get the right pricing for your tomato farming business is those that would ensure that you have your overhead and operating expenses covered so that it would make your rates fair and affordable and within market regulated prices. This is a regulated price market and so you should ensure that you do not plant at a higher cost than your counterparts.

### **Possible Competitive Strategies for Winning Your Competitors in Tomato Farming Industry**

Even though there are certain counties in Kenya e.g murang'a where tomatoes are produced more than others, this does not mean that if your county isn't among, you will find it easy competition wise. If you intend to start your tomato farm business, you must be aware of the other competitors you would face, and so must package your business in such a way that you have leverage over your competitors.

Customers may not want to know about how you plant your tomatoes, but they'd be interested in knowing about the benefits of tomatoes and the advantage each variety has over the other. This can be part of your competitive strategy. Enlighten your customers on tomatoes and its uses, and watch them flock to buy your tomatoes.

Another competitive strategy is ensuring that you concentrate and specialize on a particular niche, therefore becoming an expert in your niche.

### **Possible Ways to Increase Customer Retention for your Tomato Farming Business**

In order to grow your business, you would need to retain more than half of your customers. You can increase customer retention by staying in touch with your customers regularly through communication. This can be to inform them about the availability of your tomatoes, educating them on the uses of tomatoes and the different varieties available. Ensure that you tell them why your tomato is the best one for them.

Another way at increasing customer retention is to ensure that you give them excellent services, as well as incentives for referrals. You could offer extra tomatoes for coming to purchase your tomatoes with a friend, or give them a discount for the future ones they will purchase from you.

### **Creating a Suppliers/Distribution Network for your Tomato Farm**

If you plan on running a tomato farming business, then you would need to source for those that can supply you with tomato seeds, pesticides, as well as fertilizers.

Being in a good business relationship with your suppliers is highly beneficial to your business. Your seed supplier for instance, can tell which variety would give you a better yield, and which tomato seed type will be beneficial to your climate. They would also give you tips that would help you whilst planting your tomato to a very healthy standard. This will inadvertently lead to your tomatoes being sold quickly; bring about good revenue for you.

## **Tips for Running a Tomato Farming Business Successfully**

To be successful at your tomato farming business, you would need to have a vision of what you intend to achieve with your business. Any successful entrepreneur starts by envisioning success before they can make their business become a success.

However, for your tomato farming business to grow, you would need to provide room for the business to grow especially as regarding the infrastructure you would need for your farm. Your tomato farming business would need to have sufficient land to expand, as well as resources to harvest and process your tomatoes.

Also, having additional storage requirements will be very important for your tomato farming business. If you did not envision the potential for your tomato farming business to expand, and it does, you might fail because your business plan did not account for it.

Another successful factor is in networking. As a tomato farmer, you would need to meet with as much farmers as possible. You could also attend seminars, workshops, as well as other training events that will be beneficial for your tomato farming business. You might have to go to other tomato farms to see how other tomato farmers are handling their tomatoes, and get them to share tidbits with you on how your tomatoes can grow to yield much profit for your business.

# Chapter 2

## Ecological Requirements for successful cultivation



Before planting tomatoes, important factors such as should Location for planting, The previous crop planted, Topology, Type of soil e.t.c needs to be considered. This chapter discusses all the Ecological Requirements you need for successful tomatoes cultivation.

Tomato (*Solanum lycopersicum*) varieties include cherry, grape, paste, heirloom and large-fruited varieties. Although plant size and fruit size, color, taste and texture varies among the different cultivars, each one requires similar growing conditions and care to thrive and produce an abundant crop. Tomato plants grow readily in most climates.

Before planting tomatoes, the following factors should be considered:-

**Location for planting:-** Water proximity should be as close as possible to the planting field to avoid added costs of pumping water. Although water tanks can be used and this is specifically suitable when using drip irrigation system.

**The previous crop planted:-** Tomatoes should not be planted immediately after potatoes or pepper and a 3 month break should be observed. This is to minimize on risk of diseases and reduce costs on disease management.

**Topology:-** Gently sloping land is best as it facilitates drainage during rainy periods especially for open air method.

**Soil:-** The soil should be deep well drained loam. The soil should be prepared well and loosened and broken down well. The optimal pH for tomatoes is around 6-7.5. Soil analysis can be done to determine this and help you come up with the list of required fertilizer to prepare the land. If the pH is low, lime can be used to raise it and if high, gypsum can be used to lower it.

Tomato grows well on most mineral soils that have proper water holding capacity and aeration, and are free of salt. It prefers deep, well drained, sandy loam soils. The upper layer needs to be permeable.

Soil depth of 15 to 20 cm is needed to grow a healthy crop. In heavy clay soils, deep ploughing allows better root penetration.

Tomato is moderately tolerant to a wide range of pH (level of acidity), but grows well in soils with a pH of 5.5 – 6.8 with adequate nutrient supply and availability. Addition of organic matter is, in general, favourable for good growth. Soils with very high organic matter content, like peat soils, are less suitable due to their high water holding capacity and nutrient deficiencies.

## **Temperature and light**

Tomato requires a relatively cool, dry climate for high yield and premium quality. However, it is adapted to a wide range of climatic conditions from temperate to hot and humid tropical. The optimum temperature for most varieties lies between 21 and 24 °C.

The plants can survive a range of temperatures, but the plant tissues are damaged below 10 °C and above 38 °C.

Tomato plants react to temperature variation during the growth cycle, for seed germination, seedling growth, flower and fruit set and fruit quality. If cool or hot weather spells persist during flowering, pollen production will be low. This will influence fruit formation.

Light intensity affects the colour of the leaves, fruit set and fruit colour.

## **Water and humidity**

A simple rule of thumb can be used to determine whether local water supplies are sufficient for growing tomato. If there are herbaceous plants (plants with many thin leaves) growing in the natural environment, it will be possible to grow tomato. You should be able to count on at least three months of rain.

Water stress and long dry periods will cause buds and flowers to drop off, and the fruits to split. However, if rains are too heavy and humidity is too high, the growth of mould will increase and the fruit will rot.

Cloudy skies will slow down the ripening of tomatoes. However, adapted cultivars are available. Seed companies have special tomato varieties for hot-humid climates.

## Choice of varieties

Which variety to choose depends on local conditions and the purpose of growing. Local varieties (land-races) and improved (or commercial) varieties can be distinguished. They are the result of a continuous process of selection of plants. Selection criteria are based on characteristics such as type of fruit, shape of plant, vitality and resistance to pests and diseases, but also on factors related to climate and management.

Farmers select varieties that perform best under the local conditions. Only fruits from the best plants must be selected and kept for seeds for the subsequent season. Farmers may breed their own cultivars, but it is a costly and risky process.

Tomato breeding companies have produced F1-hybrids. These grow from seeds that have been produced by controlled hand pollination of male and female parent lines. These hybrids combine high yield, disease resistance and other plant and fruit characteristics.

In Kenya, more than 40% of the farmers use hybrids. When using hybrids, new seeds should be purchased each season. This may cost more money, but the resistance against diseases of hybrids means the tomato plants need less spraying with pesticides. The yields are also higher, creating more opportunity to bring tomatoes to the market.

Resistant varieties have an in-built resistance, which is carried in the seed. Resistance to a specific disease means that it is very difficult or impossible for a plant with this resistant characteristic to get that particular disease. Resistance can be a result of various plant characteristics.

Leaves can be densely covered with hairs so that certain insects do not like sitting on them. Some colours can be unattractive to certain insects. Such characteristics are visible.

Most characteristics that contribute to resistance to fungal and virus resistance cannot be seen. There are no varieties on the market that are resistant to all existing diseases and pests, but you can buy seed from plants that are resistant to one or several diseases.

Many farmers in lowland grow local varieties of uncertain origin. They have somewhat sour and bitter tasting fruits, small, round or flat, with many segments, and are especially suitable for grinding with condiments for sauces. They give a better yield than most imported cultivars under the heavy environmental stress of the rainy season.

# Chapter 3

## Tomato Varieties



Tomato (*Lycopersicon esculentum* Mill.) is one of the most important vegetables worldwide. World tomato production in 2001 was about 105 million tons of fresh fruit from an estimated 3.9 million ha. As it is a relatively short duration crop and gives a high yield, it is economically attractive and the area under cultivation is increasing daily.

Tomato belongs to the Solanaceae family. This family also includes other well-known species, such as potato, tobacco, peppers and egg-plant (aubergine).

Common names for the tomato are: tomate (Spain, France), tomat (Indonesia), faan ke'e (China), tomati (West Africa), tomatl (Nahuatl), jitomate (Mexico), pomodoro (Italy), nyanya (Swahili).

Tomatoes contribute to a healthy, well-balanced diet. They are rich in minerals, vitamins, essential amino acids, sugars and dietary fibres. Tomato contains much vitamin B and C, iron and phosphorus. Tomato fruits are consumed fresh in salads or cooked in sauces, soup and meat or fish dishes. They can be processed into purées, juices and ketchup.

Canned and dried tomatoes are economically important processed products. Yellow tomatoes have higher vitamin A content than red tomatoes, but red tomatoes contain lycopene, an anti-oxidant that may contribute to protection against carcinogenic substances.

Three different types of tomato plants can be distinguished:

- ❖ tall or indeterminate type
- ❖ semi-bush or semi-indeterminate type
- ❖ bush or determinate type

The tall and bush types are entirely different kinds of crops. The tall varieties are the best choice for a long harvest period. They keep growing after flowering. This feature is called indeterminate.

However, under tropical conditions, diseases and insect attacks will stop growth. The plants generally have more foliage. This will keep the temperature lower within the crop and the fruits grow in the shade of the leaves. Because they are covered, the sun does not damage the fruits and they ripen more slowly. Slower ripening and a high leaf/fruit ratio improve the taste of the fruits and in particular the sweetness.

The tall types have to be staked, caged or trellised. Short types usually support themselves and need no staking. Under severe weather conditions such as typhoons, however, staking may be advisable.

Determinate types stop growing after flowering. They require less labour, so they are popular for commercial cultivation. They have a relatively concentrated fruit set which lasts only two or three weeks and the fruits ripen much faster than those from indeterminate types.

Advantages of tomato:

- ❖ relatively short duration vegetable crop
- ❖ short or long production period
- ❖ can be grown as an uncovered field crop and in protected cultivation
- ❖ fits easily into different cropping systems
- ❖ has high economic value
- ❖ has high micronutrient content
- ❖ fruits can be processed, dried and canned

## Tomato Varieties in Kenya

There are many tomato varieties in Kenya. Some varieties mature faster and produce bigger fruit. They are more resistant to common tomato diseases. Some tomato varieties in Kenya need warmer weather. Planting the wrong tomato variety will hurt your agribusiness.

You can make money in Kenya through tomato farming if you plant the right tomato variety. The best tomato variety will help increase your tomato farming profit. Tomato fruits are one of the most common vegetables in Kenyan meals, and are ever in high demand. Greenhouse tomato farming has increased the rate of tomato production in Kenya.

The first step in choosing the right tomato variety is to determine the market for your tomatoes: will they be for the fresh market or for processing? Most tomato varieties in Kenya perform better in a greenhouse. Greenhouse tomato varieties have higher yield and give heavier fruits.

Here is an updated tomato varieties in Kenya. Consult the local agricultural experts to be sure you are growing the tomato varieties in Kenya that are best for your region. Most tomato farmers plant the crop under small scale greenhouse farming.

## **Anna F1 Tomato Variety**



This tomato variety is a Monsanto hybrid. **Anna F1 tomato** costs a little more than the regular tomato seeds but it's worth the cost. Anna F1 has been tested and has been proven to be a top performer in Rift Valley and Mount Kenya regions. It is one of the best tomato varieties in Kenya, and is being grown in small scale greenhouse farming across East Africa.

Anna F1 tomato variety gives very high yields, requires lower labor and is fairly resistant to tomato diseases. It is a fresh market tomato variety that performs best when grown in a greenhouse. Anna F1 has firm, oval shaped fruits that are deep-red in color. It is one of the tomato varieties in Kenya that are resistant to Alternaria stem canker, nematodes and Fusarium wilt.

Anna F1 matures relatively fast: within 75 days after transplanting. Its maturity period depends on the weather. Like with most tomato varieties in Kenya, the first harvest of Anna F1 gives lower yields than later harvests. Anna F1 has an average tomato yield of 74 tons per acre, and 35 kg per tomato plant in its life span.

## **Faulu Tomato**



*One of the best OP varieties for dual purposes.*

Faulu is one of the fastest growing tomato varieties in Kenya, reaching maturity 60-70 days after transplanting. Faulu variety gives tomato fruits that are oval shaped, firm and weigh between 85 and 95 grams. Faulu is resistant to fusarium and verticillium wilt.

### **Characteristics:**

- ❖ Determinate
- ❖ Maturity 60 - 70 days from transplanting
- ❖ Fruit weight 85 - 95 grams
- ❖ Yield potential 12 - 16 tons per acre
- ❖ Oval shaped uniformed fruits, excellent setting and very firm fruits with good shelf life
- ❖ Fruits are very uniform size and set very well under high temperatures

### **Resistances / Tolerances:**

- ❖ Verticillium
- ❖ Fusarium

## **Mavuno F1 Tomato Variety**



Mavuno F1 tomato variety matures about 70 days after transplanting and its fruits are heavier, weighing between 100 and 130 grams. Mavuno F1 is one of the tomato varieties in Kenya with the longest life span of up to a year. Its fruits can stay fresh for 3 weeks at room temperature and is resistant to bacterial wilt, fusarium, tomato mosaic virus and nematodes.

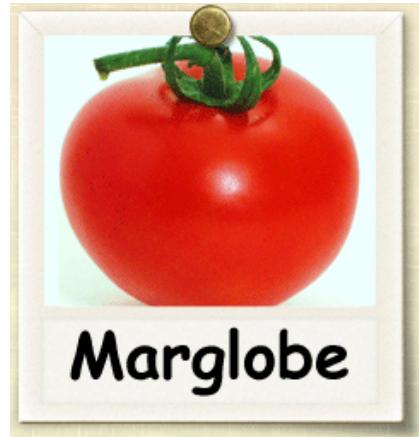
## **Money Maker Tomatoes**



Money Maker is one of the most popular tomato varieties in Kenya. It is a fresh market variety that requires little maintenance. Money maker does well in poor soil. It is hardy to poor weather and needs warmer environment to mature well.

The plant grows to about 5 feet and requires staking. You can easily grow the Money Maker tomato variety outdoors. Like most tomato varieties in Kenya, you should protect your Money Maker plants from frost and maintain warm temperatures – do not plant it during the cold seasons.

### **Marglobe Tomato**



Marglobe tomatoes are also very popular in Kenya. It is a fresh market variety whose fruits weigh between 170 and 180 grams. Marglobe is one of the earliest maturing tomato varieties in Kenya, with an average maturation period of 67 days. It can yield up to 50 tonnes per hectare. It is marketed by the Kenya Seed Company and Simlaw Seeds.

### **OXLY**



*An improved Rio-Grande type with oval fruits suitable for all markets.*

### **Characteristics:**

- ❖ Determinate
- ❖ Maturity 75 days from transplanting
- ❖ Fruit weight 90 - 100 grams
- ❖ Yield potential 12 - 16 tonnes per acre
- ❖ Very good shelf life and transportability
- ❖ Very fast germinating with vigorous plants

### **Resistances / Tolerances:**

- ❖ Good tolerance against Leaf Roll Virus

### **ONYX F1**



An excellent Determinate Hybrid Tomato with Oval Fruits

### **Characteristics:**

- ❖ Determinate
- ❖ Maturity 70 days from transplanting
- ❖ Fruit weight 100 - 110 grams
- ❖ Yield potential 18 tons per acre
- ❖ Early maturing
- ❖ Excellent shelf life with very firm fruit

## **RAMBO F1**



An excellent determinate tomato with perfect oval shape - wilt tolerant variety.

### **Characteristics:**

- ❖ Determinate
- ❖ Maturity 75 days from transplanting
- ❖ Fruit weight 150 grams
- ❖ Yield potential 30 tonnes per acre
- ❖ Very good shelf life and transport quality
- ❖ Vigorous plant with uniformly set and firm fruits
- ❖ Excellent fruit grade out up to 90% in grade one

### **Resistances / Tolerances:**

- ❖ High bacterial wilt tolerant
- ❖ Fusarium Wilt (Fol: 1,2)
- ❖ Verticillium Wilt (Vd & Va)
- ❖ Bacterial Spot
- ❖ Nematode

## **SANDOKAN F1**



An excellent outdoor tomato with a perfect oval shape.

### **Characteristics:**

- ❖ Determinate
- ❖ Maturity 75 days from transplanting
- ❖ Fruit weight 150 grams
- ❖ Yield potential 30 tonnes per acre
- ❖ Excellent shelf life and transportability

### **Resistances / Tolerances:**

- ❖ Tomato Spotted Wilt Virus (TSWV)
- ❖ Fusarium Wilt (Fol: 1,2)
- ❖ Verticillium Wilt (Vd & Va)
- ❖ Bacterial Spot
- ❖ Nematode

## **STRIKE F1**



An excellent Determinate Hybrid Tomato with Oval Fruits

### **Characteristics:**

- ❖ Determinate
- ❖ Maturity 75 days from transplanting
- ❖ Fruit weight 120 - 130 grams
- ❖ Yield potential 20 tons per acre
- ❖ Excellent shelf life and transport quality

### **Resistances / Tolerances:**

- ❖ Fusarium Wilt (Fol: 1, 2)
- ❖ Verticillium Wilt (Vd & Va)

## **CHONTO F1**



A Premium greenhouse tomato with blocky heavy fruits.

### **Characteristics:**

- ❖ Indeterminate
- ❖ Maturity 75 days from transplanting
- ❖ Fruit weight 150-200 grams
- ❖ Yield Potential 15kgs per plant in greenhouses
- ❖ Long shelf life of up to 21 days at room temperature
- ❖ Strong calyx retention and long harvest period

### **Resistances / Tolerances:**

- ❖ Tomato Yellow Leaf Curl Virus (TYLCV)
- ❖ Tomato Mosaic Virus (ToMV)
- ❖ Fusarium Wilt (Fol: 1,2)
- ❖ Verticillium Wilt (Vd & Va)
- ❖ Grey Leaf Spot
- ❖ Nematode

### **BRAVO F1**



A premium greenhouse tomato with oval fruits.

### **Characteristics:**

- ❖ Indeterminate
- ❖ Maturity 75 days from transplanting
- ❖ Fruit weight 120-150 grams
- ❖ Yield potential 10 -13kgs per plant in greenhouse
- ❖ Long shelf life of up to 21 days at room temperature
- ❖ Adapts well to a wide range of agro-ecological zones, long harvest period

### **Resistances / Tolerances:**

- ❖ Tomato Yellow Leaf Curl Virus (TYLCV)
- ❖ Fusarium Wilt (Fol: 1,2)
- ❖ Verticillium Wilt (Vd & Va)
- ❖ Grey Leaf Spot
- ❖ Nematode

### **HARMONY F1**



An excellent Indeterminate Hybrid Tomato with Oval fruits for Greenhouse

### **Characteristics:**

- ❖ Indeterminate
- ❖ Maturity 60 - 75 days from transplanting
- ❖ Fruit weight 100 - 120 grams

- ❖ Yield potential 12 - 15 kgs per plant with up to 10 fruits per cluster
- ❖ Excellent shelf life with very firm fruits

#### **Resistances / Tolerances:**

- ❖ Verticillium Wilt
- ❖ Fusarium Wilt
- ❖ Tomato Mosaic Wilt

#### **MONALISA F1**



Indeterminate type. Uniform fruits ensure high marketability.

#### **Characteristics:**

- ❖ Indeterminate
- ❖ Fruits mature rapidly after setting
- ❖ Fruit weight 95 - 100 grams
- ❖ Yield potential 9 - 11 Kgs per plant in greenhouse / 50 tons per acre outdoors
- ❖ Oblong shaped uniform fruits

#### **Resistances / Tolerances:**

- ❖ Intermediate resistance to Bacterial Wilt
- ❖ Intermediate resistance to Tomato Yellow Leaf Curl Virus
- ❖ Resistance to Tomato Mosaic Virus
- ❖ Resistance to F1 Fusarium Wilt
- ❖ Resistance to Fusarium Crown and Root Rot

### **SAMANTHA F1**



Indeterminate type hybrid. Vigorous plant with good fruit setting.

#### **Characteristics:**

- ❖ Indeterminate
- ❖ Maturity 60 - 70 days after transplanting
- ❖ Fruit weight 90 - 95 grams
- ❖ Yield potential 9 - 11 kgs. per plant in greenhouse / 50 tons per acre outdoors
- ❖ Suitable for regions with Bacterial Wilt problems
- ❖ Oblong shaped uniform fruits

#### **Resistances / Tolerances:**

- ❖ Intermediate resistance to Bacterial Wilt
- ❖ Intermediate resistance to Tomato Yellow Leaf Curl Virus
- ❖ Resistance to Tomato Mosaic Virus

- ❖ Resistance to F1 Fusarium Wilt
- ❖ Resistance to Fusarium Crown and Root Rot

If you plan to grow tomatoes outdoors, consider their resistance to common tomato diseases. The hardy the variety, the better for outdoor tomato farming in Kenya.

These are the most popular **tomato varieties in Kenya**. It is recommended that you visit several tomatoes farmers to learn what they are dealing with in their tomato farming. Remember to ask them which tomato varieties have worked well for them.

# Chapter 4

## Planting and Nursery Preparation



Ploughing (or digging) is necessary to prepare the land for a new crop. It improves the structure and water holding capacity. In areas where water is a limiting factor, ploughing enhances water conservation as well.

Fallow ploughing the land after harvesting the previous crop improves the soil structure and water-holding capacity. It also helps to reduce soil-borne pests and diseases by exposing the soil to the hot sun.

Deep ploughing is necessary to break an impermeable hard subsoil layer (ploughing pan), remove the weeds and bring the land to fine tilth. It also encourages root growth. It is often necessary to harrow two times, breaking the clods and removing crop residues to level the land.

Cultivating tomato on raised beds, ridges or furrows facilitates drainage of water and irrigation. Despite this, more than 60% of the crop is still cultivated using flood irrigation.

## Nursery bed preparation

A nursery bed is a specially prepared portion of land put aside for raising seedlings. It acts as a temporary home for young plants until they are eventually planted in a permanent garden.

Tomatoes are normally transplanted because much better results are gained when seedlings are raised in a nursery. Two methods of raising seedling in nurseries can be used:

- ❖ sowing in seedbed



- ❖ sowing in seedling tray



Smaller quantities of seed are needed, the seedlings can be selected for growth and health before planting in the field, the plantlets can be well protected and the planting distance is more regular than after sowing directly in the field.

The following are the requirements to make a nursery bed:

- ❖ Fork: For removing any unwanted materials from the garden
- ❖ Hoe: For tilling and removal of weeds
- ❖ Spade: For carrying soil, weeds
- ❖ Rake: For removing any unwanted rubbish
- ❖ Watering can: To water the plants
- ❖ String and sticks: For measuring to ensure proper spacing

### **Site selection.**

The nursery should be located near the planting site so as the transplants are taken to the main garden without any damages that may be involved where distances are long, located near a water source because irrigation may be necessary, protected from strong wind, should not be located on a slope unless it is terraced since this may lead to erosion of not only the necessary top soil but the plants as well.

They should also face where sun comes from as plants need sunlight for better growth and should not be located in a water logged area. It is the farmer's choice depending on the type of soil whether to do a sunken nursery bed or a raised bed.

### **Preparation.**

Clear all the weeds and grass. Measure one meter wide of any convenience length and dig well. Test the soil's acidity. Tomatoes favor a more acidic soil with a pH of 6.2 to 6.8. Use a pH soil testing kit, available at home improvement and garden stores, to test the pH levels of the soil.

Fertilize each three meters square with one wheelbarrow of compost and sand to make a thick layer then water the bed.

### **Planting seeds.**

Plant your seeds in rows.



It is recommended that lines face where the sun rises from. Make straight lines, 2.cm deep at a spacing of 7 cm apart. The size of the seed is the size of soil you put or cover the seed with. Mulch the bed with dry grass, and then water it using a watering can. Water the bed whenever it is necessary and avoid over watering it.

### **Water about once a day in the morning only.**

Do not water at night, as this creates dangerous conditions for your plants as insects love wet dark environments and rot and other diseases such as mold, verticillium rot, etc. are easily avoided by watering during the morning.

Also, watering during high noon isn't great because most of the water will evaporate before the plants are able to absorb.

## **Germination.**

The seeds will start germinating after 5 – 7 days. Remove the grass and then put a shade 1 m high and ensure some sun light go through.



## **Transplanting**



When seedlings are ready for transplanting remove the shade a day before transplanting as this gives the seedling chance to get used to the strong sun-shine. Transplant early in the morning or late in the evening (from 6 – 10 am or 4 – 6pm).

Transplant the seedling to the field 3 to 6 weeks after sowing. A week before transplanting, seedlings should be hardened by reducing the application of water, but 12-14 hours before they are taken out of the seedbed they should be thoroughly watered again to avoid excessive damage to the roots.

Seedlings of 15-25 cm tall with 3-5 true leaves are most suitable for transplanting. Transplanting should be done in the afternoon or on a cloudy day to reduce the transplanting shock.

Type of plant Distance between rows and plants:



- ❖ Bush type (determinate)      1.0 x 0.5 m
- ❖ Semi-bush type (semi-determinate)    0.75 x 0.5 m
- ❖ Tall type (indeterminate)      0.75 x 0.5 m

Water the plants immediately once they have been transplanted. When removing the seedlings, keep a large clump of soil attached to the roots to prevent them from being damaged. Spacing between plants and rows depends on the cultivar growth habit, soil type, cropping system and also whether the plants are to be supported by stakes or left on the ground.

The common spacing is 50 cm between plants and 75 - 100 cm between rows. If the tomatoes are to be supported by sticks, then the distances between rows can be decreased to 20-40 cm.

Make the holes for the plants deep enough so that the lowest leaves are at ground level. Press the soil firmly around the root, and water around the base of the plant to settle the soil.

After transplanting, mulch can be placed on the ground around the plants to protect them from heat during the first five days. Mulch is composed of plant remains (e.g. rice-straw or sorghum-straw) used to cover the soil to control weed growth, prevent erosion and conserve water.

Care should be taken not to wet the lowest leaves, as this can stimulate the growth of mould. A more advanced method is to put plastic mulch on the beds and punch holes in the plastic before planting.

The transplanted plants should be protected from heat during the first five days, e.g. by covering them with large leaves.

# Chapter 5

## Crop husbandry



### Manures and fertilizers

To get high yields, tomatoes need to be fertilized. There are two groups of crop nutrients: organic manures and chemical fertilizers.

#### Organic manures



Farmyard manure, poultry manure and compost are three types of organic manures. They are described in this section.

The most common kinds of farmyard manures are goat, cow and pig manure. Of these three kinds, goat manure has the best balance of nutrients. Cow manure has relatively little phosphate. Pig manure is usually rich in mineral salts but has relatively little potassium. Manure from hen and sheep is also good organic manure.

It is better to use farmyard manure on sandy soils than on clay soils, because it is quite sticky. Sandy soils will not fall apart as easily if manure is added, and will therefore be able to hold more water.

If only farmyard manure is used, 12.5-25 tons/hectare/year (5-10 tons/acre/year) is a reasonable amount to apply. Smaller applications of manure can also be enough if growing conditions are not so good or if chemical fertilizer is also applied.

Poultry manure is usually three to four times as strong as farmyard manure. It is a very valuable kind of manure as plants can easily absorb the nutrients from it. A good way to apply poultry manure is by first mixing it with an equal amount of crumbly soil or sand.

Sprinkle this mixture between rows, and then rake or hoe it lightly. Poultry manure, unlike farmyard manure can be used on clayey soils because it is not too sticky. It is also suitable for acid soils because it contains a lot of calcium (alkaline).

It is advisable to plough dry manure into the ground as fresh manure is too strong and can damage the sprouting plants.

Compost is easy to make from all kinds of organic materials. Examples of materials that can be used are crop residues, kitchen wastes, garden cuttings and manure. Compost is a rich source of macro- and micronutrients. It supplies nutrients at the right time in required quantities. It is especially useful for improving the soil structure and fertility.

It is important to have manure that is well decomposed, and which is not too sticky or too wet. It must not be too dry, as it is difficult to moisten manure again.

Benefits of compost and manure: Improve soil fertility and structure, and decrease the need for phosphorus (P), nitrogen (N) and potassium (K) application. They provide a variety of nutrients for crops and can be prepared in 2½ – 3 months.

### **Chemical fertilizer**



Chemical fertilizer (except for calcium) does not improve the soil structure but enriches the soil by adding nutrients. Chemical fertilizer is relatively expensive, but in some areas, in terms of nutrients provided, it is less expensive than manure. It does not pay to use a lot of chemical fertilizer in small-scale cultivation, or where prices are fluctuating and yields are low (as a result of diseases, unfavorable weather or poor soils).

Chemical fertilizers can be divided into two groups: compound fertilizers and simple fertilizers.

### ***Compound chemical fertilizers***

This kind of fertiliser is a mixture of nitrogen (N), phosphorus compounds (P<sub>2</sub>O<sub>5</sub>) and potash (=K<sub>2</sub>O). The compound fertiliser 12-24-12 contains 12% N (nitrogen), 24% P (phosphorus) and 12% K (potassium).

### *Simple chemical fertilisers*

This kind of fertiliser contains only one nutrient. It is used when a crop has a specific deficiency (e.g. sodium nitrate, urea or super phosphate). Tomato especially needs phosphorus after transplanting. It is better to apply nitrogen and potash during the growing stage of the crop. Use a slow-release type during the rainy season and a fast release type during the dry season.

In the tropics the application of chemical fertiliser ranges between 40-120 kg/ha of nitrogen, 30-90kg/ha phosphate and 30-90 kg/ha potash. Never spread chemical fertiliser on young or wet plants because this will cause burns.

### **How to combine organic and chemical fertilisers**



Before planting, the soil is fertilised by applying organic matter. Tomato is usually given a combination of organic and chemical fertilisers. It is not necessary to apply this mixture at one

time. For example, you can apply half when preparing the beds or mixed with the soil in the holes for the seedlings.

The remainder can be applied when the plants flower or when the fruit is formed. It is best to rake this into the soil between the rows. A second application, to replenish nutrients in the soil, is especially advisable on sandy soils, where nutrients are leached more quickly. Foliar application of nutrients (i.e. to the leaves) is advisable to improve the yield.

## Watering



Tomato is not resistant to drought. Yields decrease considerably after short periods of water deficiency. It is important to water the plants regularly, especially during flowering and fruit formation. The amount of water that is needed depends on the type of soil and on the weather (amount of rain, humidity and temperature).

It is especially important to water regularly (e.g. 3 times a week) on sandy soils. Under good circumstances once a week should be enough.

About 20 mm of water per week is needed under cool conditions, about 70 mm during hot and dry periods. Watering plays a major role in attaining uniform maturity and reducing the incidence of blossom end rot, a physiological disorder associated with irregular water supply and the resulting calcium deficiency in the fruit during its enlargement.

There are several irrigation methods:

### **Surface irrigation**



The simplest method is to pour water into channels (furrow irrigation) or onto flat fields that are surrounded by small dykes (flood irrigation). Ensure that the water is evenly distributed.

### **Sprinkler irrigation**

Sprinkling using permanent pipes is widely used in greenhouses. Sprinkler heads are placed underneath the crop and in strips so that the pathways are kept dry.

### **Drip irrigation**



### ***Wetted strips***

A black PE-film hosepipe that has small holes about 2 millimetres in diameter can be placed on the ground near the base of the plants. The soil needs to be flat or may slope very slightly towards the end of the tube. The lengths of the hose can be as long as 20 to 30 metres. The water pressure must be about 0.2 atm (2 m).

### ***Watering individual plants***

The soil needs to be flat and the water clean because the small droplet openings must not get blocked. Filtering can be done at the place where the water enters.

Many drip irrigation systems work on a low water pressure of 0.1-0.2 atm (1 to 2 metres water column). This can be achieved very cheaply for a small system by attaching a WC-float valve at the beginning of the main pipe.

Fertiliser in solution in the correct dosage can be added to the drip irrigation system. As opposed to sprinkling and other types of irrigation, drip irrigation can save 30-70% of your water, especially in a very dry climate.

## **Pruning**



Pruning is important for tomatoes, especially for thick bush and indeterminate types. It improves the light penetration and air circulation. Pruning the side-shoots is called nipping. Pruning the tops of the stem is called heading.

The need for pruning depends on the type of plant and the size and quality of the fruit. If plants are not pruned, they will grow at random and fruit will be smaller.

### **Pruning to shape**

As far as pruning is concerned, tomatoes come in two forms, bush and upright. Bush varieties are the best for outdoor cultivation because they require no pruning for most of the season. Remove any yellow or decaying foliage as soon as possible to avoid the spread of disease.

If plants become too large to support themselves, either trim out a few major branches or add more support canes. The side branches can be tied on to the additional support canes.

Limit the number of tomato-bearing branches to seven or eight by pinching out any surplus ones. When first fruits begin to form, the plant will produce shoots between the main stem and the leaf stems.

The lower side-shoots should be removed by pinching them out with the fingers. If they are allowed to grow they will produce masses of foliage but few tomatoes. Any shoots that have been overlooked and allowed to grow should also be removed.

Lower leaves that show any sign of yellowing should also be removed to avoid the risk of infection. When the plant has developed 6-7 branches with tomatoes, stop the plant from growing further by breaking off the growing tip.

If more than seven branches of tomatoes begin to develop, pinch extra branches out to encourage the plant to produce good quality tomatoes rather than an abundance of low-quality late-maturing fruits.

### Nipping



It is important to pinch out side-shoots. When plants are nipped, the small side-shoots are removed and only one main stem remains. The fruit clusters grow along this main stem. Nipping enhances quality and size of the fruits.

### **Heading**

The tip of the main stem of the tall type is pinched off when 3 to 5 leaves are fully grown. The shoots that grow out of the top 2 to 4 buds are left to grow. In this way 2 to 4 side-shoots will grow as main stems, supported by sticks.

When these stems are 1 - 1.25 m long, the tops should also be pinched off. New side-shoots should be removed regularly by nipping them. Usually 3 to 4 fruit clusters grow along each stem.

### **Trimming leaves**

Old, yellow or sick leaves should be removed from tomato plants. This controls the development and spread of diseases. Be careful when pruning the plants. It is very easy to spread disease via your hands or any tools that are used, so avoid sick plants. Clean tools regularly.

It is best to prune in the morning on a sunny day so that the wounds can dry quickly. It is advisable to burn or bury the infected leaves to avoid disease infections.

## **Support systems**

Staking or trellising tomato plants with bamboo poles, wood stakes, or other sturdy material provides support and keeps the fruit and foliage off the ground. Staking will increase fruit yield and size, reduce fruit rot, and make spraying and harvesting easier.

Indeterminate varieties should be staked to facilitate pruning, pinching, harvesting and other cultivation practices. Determinate varieties should be staked in the wet season to prevent fruit contact with the soil.

Many staking arrangements are possible. Plants should be fixed securely to the stake or string supports, beginning about two weeks after transplanting. Rice straw, plastic strips, horticultural fixing tape or other materials can be used for fixing. Fixing should be done to support fruit clusters.

### **Tying up**

Tomato plants (tall type) can be tied to sticks to support the stems while they are growing.

Tie them loosely to the sticks and retie them regularly as they grow. So as not to damage the roots of the plants, support sticks should be put in place before transplanting. The sticks should be three side-shoots at least 1.5 m long, as they will be pushed 40-50 cm into the ground.

Sticks that are to be used again should be washed with a disinfectant beforehand, to kill any germs that might still cling to them.

## Fencing



It is useful to make fencing of sticks and rope or wire to support tomato plants (tall type) for several reasons:

- ❖ plant gets better support and this prevents stem from breaking
- ❖ there is better ventilation, so less chance of spreading diseases, especially in humid areas or seasons
- ❖ preventing contact between fruits and soil means fruits will not rot
- ❖ it is possible to plant more plants per hectare
- ❖ weeding and harvesting is easier

Fencing can also be handy for bush-type tomatoes, to prevent heavy clusters of fruit from touching the ground. Leaves and fruit in contact with the ground rot easily because they are more likely to be damaged by diseases and insects. This can be prevented by placing a fence of two parallel strings on either side of the plant or by placing straw or mulch under the plants.

## Weed control



Weeds compete with the tomato plants for light, water and nutrients. Sometimes they provide shelter for organisms that cause tomato diseases, such as Tomato Yellow Leaf Curl Virus (TYLCV), and reduce the yield.

Effective non-chemical weed management begins with deep ploughing, diverse crop rotations and competitive cover crops.

The following integrated practices are useful for controlling weeds effectively:

- ❖ Remove the previous crop residues and use sanitation practices to avoid introducing weed seeds.
- ❖ Deep cultivation and exposing soil to sunlight before transplanting help to destroy the weed seeds.
- ❖ It is important to keep the field weed free for 4-5 weeks after transplanting. It is during this period that weed competition must be suppressed to avoid reduction in yield.
- ❖ Weeds growing between crop rows are the easiest to control. Shallow ploughing (up to a depth of 15-20 cm) or using mulch usually removes them.
- ❖ On large acreages, mechanical cultivation is a common method of weed control within and between rows. Shallow cultivation 1-2 inches deep controls weeds and

loosens soil that has crusted or become compacted. Loosening the soil helps the absorption of rainwater and supplies oxygen to the soil micro-organisms. In turn, these micro-organisms decompose organic matter and provide nutrients for the tomato crop. Hilling the soil towards the plant row (earthing-up) helps to smother small weeds in the row and tomato plants develop roots further up the stem.

- ❖ The first cultivation may be done fairly close to newly established plants and later cultivations should be shallower and away from the stems to avoid plant damage and reduced yield.
- ❖ Hand weeding is an effective method to control weeds growing between plants in a row.
- ❖ Mulching with plant residues is good for weed suppression, soil moisture retention and slow release of nutrients as they decompose. The plant residues enhance the beneficial insects like predatory beetles. They also increase the population of spiders and earthworms. Commonly used organic mulches are wheat straw, paddy straw, weeds, sorghum and pearl millet straw.

## Crop rotation

Where tomato is planted in monoculture, crop rotation is important. Crop rotation means planting different crops on the field each season and only returning the same crop after at least three growing seasons.

This interrupts the life cycle of pathogens and reduces the chance of damage by diseases or pests. Do not rotate tomato with potato, tobacco or eggplant (aubergine) because these plants belong to the same family (Solanaceae) and have the same types of pests and diseases.

Some examples of crop rotation with tomato are:

- ❖ Tomato followed by maize and beans.
- ❖ Tomato followed by upland or irrigated rice. It is best to plant tomato two weeks before the second upland rice harvest.

Remember to grow two other consecutive crops before planting tomato again on the same field (i.e. once in every 3 cropping seasons, e.g. cereal-legumes-tomato).

Tomato can be grown in monoculture or in an intercropping system. Intercropping has advantages because this reduces the incidence of diseases and pests. Smallholders will gain the most from the advantages of mixed cropping.

Some examples of intercropping systems:

- ❖ Tomato intercropped with sugarcane. The dwarf cultivars of tomato are planted on a raised bed about 1.2 m wide, with sugarcane grown in the furrows between the beds.
- ❖ Tall type tomatoes are grown along stalks covering 0.6 m of the bed. Next to the bed, about 0.6 m higher, pepper and cauliflower are grown. The furrows are 0.3 m wide and serve as a path.
- ❖ Intercropping of tomato with cabbage. Combining these crops will reduce the damage done by the diamond-back moth.
- ❖ Alternate climbers, such as runner beans and peas, with tomato. Two weeks before tomato is harvested, the beans and peas can be planted in between the tomatoes. The sticks supporting the tomato can be used for the new crop.

Tomato fits well with different cropping systems of cereals, grains and oil seeds. Cropping systems like rice-tomato, rice-maize, okra-potato-tomato are popular in irrigation scheme areas.

Cauliflower-okra-sunflower-cabbage-tomato, maize-tomato-watermelon and rice-peas-tomato have been proved economical systems. Leafy green vegetables or radish can be grown successfully as tomato intercrops.

In Uganda farmers follow a unique mixed cropping system. Fifteen days before transplanting a tomato crop, marigold (*Tagetes erecta* and other closely related varieties) is sown along the field border and also along the water channels in the field. This mixed cropping system helps to control the fruit borer in tomato.

Crop rotation with cereals and other leguminous crops improves the soil health and reduce the pest infestation. Crop rotation with cereals or millets is effective in controlling the nematode population.

## Protected cultivation

People have always protected their crops from unfavourable climatic effects. Shrubs and walls protect against the wind, foliage and slats against harsh sunlight and rain, and glass and plastic against the cold.

Traditionally, glass has been used in greenhouses to let the sunlight in, but the discovery of transparent synthetic film was a major break through. It made the building of a greenhouse much cheaper.

### Greenhouses



Before starting a greenhouse project one must carefully check whether all requirements for its success have been met.

As far as the climate is concerned, besides protection against fluctuating temperatures, protection is also needed against the sun's powerful rays (solar radiation), heavy rain, hail and strong wind. Crops often need to be protected against a combination of weather conditions.

The climatic data from the FAO (Food and Agriculture Organisation) data base can serve as the basis.

High standards will need to be placed on the type of soil, the soil profile and the location. Thus, if at all possible, choose soil with a good structure in a flat area for your greenhouse project.

In view of the more expensive production equipment and the higher quality of the product, it is important to consider the location of your farm carefully. Greenhouse cultivation needs more attention than outdoor cultivation. Therefore, you need to be within easy reach of your business at all times.

Good infrastructure for transporting materials and products is also of importance, as is the availability of electricity.

Finally, you need to know how you can sell the products you want to grow.

### ***Climate control***

The climate in the greenhouse is regulated by ventilating, heating and cooling and by using screens. The growth and level of production of plants largely depends on the amount of sun that the crop gets per day.

Inside a greenhouse the light intensity is lower than outside. Screens can be used to prevent too much sunlight entering the greenhouse. A movable screen can be very useful when the weather changes between sunny and cloudy weather. Screens also reduce evaporation somewhat, so that the crop requires less water.

The most important climatic information concerns the dry and wet periods and the extremes. If there is too much rain you need to make certain to drain the excess water from the greenhouse roof as well as around the greenhouse. The water from the roof can be collected in a basin for irrigation. Sufficient storage capacity will help to better tide over the dry periods.

Tomato grows best at temperatures between 18 and 23°C. Above this temperature ventilation should take place. The wind-chill factor is also significant to the plant. Low atmospheric humidity and much wind are likely to cause damage earlier.

The humidity of the air, (RH, relative humidity), affects the growth and health of the crops in various ways. A high RH encourages fungal diseases, because condensation can easily occur on the crop in the early morning, creating the ideal conditions for fungal spores to germinate rapidly. The plant itself also becomes less tolerant to sudden dry conditions.

Ventilation can be done by opening a part of the greenhouse cover in the sidewall, the roof or in the front or back entrance.

### ***Water supply and crop husbandry***



As no rain may enter a closed greenhouse, it is extremely important that the crops have their own water supply. First of all it is important to know how much water your crop needs and how much water can be supplied by the system you are using.

Plants need water mainly for transpiration, but 5-10% is needed for their growth. Plants transpire to cool themselves and to encourage transport of minerals that the roots have absorbed. The amount of transpiration is determined by sun, temperature, air humidity and wind speed.

The methods by which crops in the open field are supplied with water also apply to crops in the greenhouse. Most of the crop husbandry in greenhouses is the same as for open field crops.

### ***Types and constructions***

There are several types of constructions and accompanying covering materials. The simplest form of cover is to lay sheets of plastic film on the ground or over a simple support system. The sheet on the ground may create a slightly higher temperature in a seedbed and the moisture will be retained. Ensure that the plastic film cannot blow away.

A simple support with stakes from wood or bamboo can be used to fix a plastic film or vegetable screening material on top of a seedbed.

Low tunnels can be made of hoops of wood, bamboo, plastic flexible tubes or strong wire. The hoops need to be placed at intervals of about 2 or 3 metres and anchored in the ground. After stretching the plastic film (for instance, polythene or PVC) over the hoops, the sides can be weighted down with a layer of soil.

Further anchoring of the tunnel is done by a retaining cord or wire over the plastic film at each support hoop. For ventilation, the plastic film can be lifted up or shifted a little.

The plastic film is removed at harvest time and sometimes even earlier if the weather is favourable. Thus, the tunnel protects the crop in bad weather against low temperatures, hail and also from birds and insects.

Low costs and a simple construction method are the most important advantages of low tunnels. The disadvantages are that they only provide a limited temperature gain, opportunities for ventilation are very limited and caring for the plants (husbandry) is difficult.

Low tunnels are usually used for only one crop. In most cases plastic film cover on the ground and low tunnels are the first step towards protected cultivation.

Walk-in-tunnels are high enough for people to walk and work in, and can accommodate a taller crop, but a simple walk-in tunnel has its limitations:

- ❖ In a warm climate, the simple means of ventilation limits the cultivation options.
- ❖ The use of cheap polythene (PE) film means that the covering will only last for one growing season because it will break down through the solar radiation and friction.
- ❖ Wooden hoops may break easily, steel hoops become so hot that the plastic stretches and breaks.
- ❖ Simply anchored plastic is vulnerable to storm damage.
- ❖ It is difficult to support tall crops properly.

Tunnels with a solid construction have the advantages of climate regulation, more cultivation options and a longer lifespan. They have enough space for working in them. The structure consists of galvanised tubing, which could be reinforced with wires in the length. To protect the plastic, the frame is covered with foam tape. The simplest form of ventilation can be done by using roll-up the plastic on the side of the tunnel.

More advanced methods of ventilation are available and depend only the finance possible.

Shade halls are essential in a dry sunny climate or in the dry season of a monsoon climate to protect the crop against the blazing sun. Special screening material (woven cloth, netting) is available, differing in quality and in the degree to which it shuts out the sunlight. Ventilation occurs via the open netting of the cover on the sides

### ***Financial turnover***

Whenever growers decide to invest in improvements to their production systems they need to make sure that their income will also grow adequately. Care needs to be taken that the investment also means improvement of the market value of the product. The golden rule is that the greenhouse grower starts on a small scale, gains experience and only then considers expanding the business and investing more.

### **How to farm tomatoes in a greenhouse**



Kenya has started greenhouse production of tomatoes, raising hopes that the popular vegetable will become available throughout the year at affordable prices.

In the new system developed by the Kenya Horticulture Development Programme (KHDP) and agricultural inputs suppliers Seminis Seeds and Osho Chemical Industries, a grower requires about 240 square metres of land and a greenhouse kit to get started.

The cheapest kit, comprising a 500 litre water tank, irrigation drip lines, plastic sheet, seeds and chemicals has been put at Ksh.150,000 (\$2,239) for those participating in the project. The plot of land can grow 1,000 plants.

The fourth demonstration site, for the Coast province, was launched last week at the Agricultural Training Centre in Mtwapa, Mombasa. Others are in Nairobi at the Horticultural Crops Development Authority compound near the Jomo Kenyatta International Airport, at the Agricultural Training Centre, Kabiangi in Kericho, and at the Lake Basin Development Authority compound in Kisumu.

According to the KHDP, the greenhouse tomato project, one of the activities the programme is supporting to help increase the incomes of rural households, is borrowed from Israel, where the country has most of its agriculture under greenhouses due to scarcity of water and land. It is also widely practised in the United States.

If the concept is widely embraced, Kenya could start enjoying year-round supply of tomatoes, which currently get damaged during the wet seasons, pushing prices through the roof. According to Peter Randa, the marketing manager and project technical advisor, growing crops under greenhouses has many advantages, among them the ability to produce huge quantities on a small piece of land and continuous harvesting. The tomatoes have a shelf-life of 21 days compared with 14 for those grown in the open.

It takes a shorter period — two months — for greenhouse-produced tomatoes to mature, while it takes a minimum of three months with outdoor farming.

Due to controlled irrigation and temperatures, the crop sports a continuous output of flowers and fruits, all at different stages. One plant has a potential of up to 15 kg at first harvest, going up to 60 kg by the time it has completed its full cycle — recommended at one year.

The plant vines are supported inside the greenhouse with sticks and strings, growing up to 50 metres in height. If well looked after, the minimum plot of land under greenhouse production can yield up to 25,000 tonnes of tomatoes.

Tomatoes are generally highly susceptible to diseases requiring heavy application of pesticides but under the greenhouse growing techniques, which come with basic training on hygiene, most of common infections are easily kept at bay. Also kept at bay are insects and other pests known to invade plants as well as weeds.

Apart from huge savings on crop protection chemicals, which constitute a huge part of production costs, less labour is employed in a greenhouse, while exposure to chemical toxins associated with application is minimised or eliminated altogether. It is also good for the environment.

Planting materials for the greenhouse tomato production have been specially developed as high yielding, although they can grow outdoors as well. For this programme, the partners are recommending the Annaf1 hybrid tomato seed developed by Seminis East Africa.

On its part, Osho Chemicals is providing free chemicals to farmers in the initial stages of planting as well as technical advice on application, said marketing manager James Ndabi.

The introduction of greenhouse tomatoes in Kenya heralds what could be a major shift from open pollinated farming to hybrid high yielding methods, which if adopted in other sectors could lead to massive improvements in crop production, output, incomes and ultimately self-sufficiency in food production.

According to Mr Randa, there has been a marked uptake of improved planting materials in the country, a sign that farmers are keen to adopt new products and technology.

In Eldoret, KHDP reports, greenhouse production of tomatoes is coming along fast since this is where the technology was first introduced. The horticulture programme, funded by the United States Agency for International Development, estimates that in the next five years, most tomatoes grown in Kenya will be under greenhouses.

Mombasa is seen as having a huge potential for the technique since the Coast province imports more than 75 per cent of its food from upcountry and Tanzania.

## Organic farming

Organic farming is a system that excludes the use of synthetic fertilisers, pesticides, herbicides and growth regulators. Organic farmers rely on crop rotations, crop residues, animal manures, legumes, green manures, organic wastes and mineral bearing rocks to feed the soil and supply plant nutrients.

Insects, weeds and other pests are managed by mechanical cultivation and cultural and biological controls.

In many developing countries e.g Kenya organic farmers can register their farm with the government. A farmer who has organic certification can sell produce on the organic market, which will earn more income than selling conventionally grown products.

Organic agriculture is an ecological production management system that promotes and enhances biodiversity, biological cycles and soil productivity. It is based on minimum use of external inputs and management practices that restore, maintain and enhance ecological harmony.

In most developing countries family members manage organic farming without depending on outside labour. Organic farming provides sustainable food and family income to small and marginal landholders.

The primary goal of organic agriculture is to optimise the health and productivity of soil, plants, animals and people. The principal guidelines for organic production are to use materials and practices that enhance the ecological balance of natural systems and that integrate the parts of the farming system into an ecological process.

Organic agriculture practices cannot ensure that products are completely free of residues. Pesticides and chemical residues can reach organic farms through irrigation systems and the wind. Farms that share a common water source are more prone to this problem.

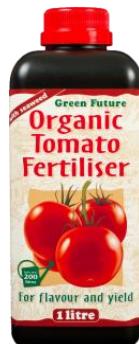
Farmers choose organic methods for a variety of reasons. One of the strengths of organic produce is that it sometimes earns 10-30 per cent more on the market than conventional produce. Organic farming leads to reduced input costs, improved soil health, reduced environmental impact, and a better functioning of agro-ecosystem.

The main basis for maintaining sustainable organic agriculture includes integrating livestock, maintaining on-farm tree diversity, using own seeds and compost, applying bio-pesticides and working out suitable cropping systems.

### **Soil fertility**

The foundation of organic farming is a microbially active soil enriched with organic matter and a balanced mineral diet. Humus building practices and additions of rock minerals not only supply plant nutrients, but increase tolerance to insects and diseases, help control weeds, retain soil moisture, and ensure production quality.

The organic fertility system revolves around a combination of practices such as crop rotation, forage legumes, cover crops, and green manures, livestock manures (preferably composted), lime, rock phosphate, and other rock minerals, and lastly, supplemental organic fertilisers.



Tomatoes that receive legume and compost treatments, and are grown on soils that have been managed organically for several years, give good yields.

Soil building practices such as green manuring and composting practices encourage abundant soil micro-flora. Maintaining optimum soil fertility improves the disease resistance capacity of the crop. A well maintained organic farm will give an optimum tomato yield with manure applications of as low as 9-10 tons/hectare/year (4-5 tons/acre/-year).

Soils with no history of organic management will probably need additional organic fertilisation. Fertiliser can be incorporated during field preparation and bedding operations, or banded to the side of the row at planting.

Vermicompost is the most suitable organic manure for enriching soil fertility. It provides a wide range of nutrients to the crops in soils that are shifting from inorganic to organic farming.

### **Crop rotation**

Crop rotation is a major component of organic farming, affecting both soil conditions and pest cycles. Rotation with non-solanaceous crops for three years will help to avoid pest problems in tomato. Long rotations may be impractical for small farmers.

Tomato followed by cereals and millets reduces the incidence of diseases on tomato. Beans, marigold, cowpea and green leafy vegetables are the common crops that are mixed to avoid the incidence of pest and diseases in tomato.

### **Sanitation practices**

Tomatoes are very prone to damage from pathogens. During cultivation, water sources must be checked to ensure that they do not become contaminated with the water draining out of the tomato beds. Manure used for fertilisation must be applied well before the crop is harvested.

Domestic animals must be kept out of tomato fields during growing and harvesting. The same applies to other animals such as small rodents, reptiles and amphibians.

# Chapter 6

## Pest and Diseases



Prevention of pests and diseases in tomato is extremely important. This chapter discusses the most important pests and diseases and gives advice on their prevention and control.

Practically all pests and diseases can be adequately controlled by applying synthetic chemical pesticides. However, most pesticides are costly and are sometimes very harmful to humans and the environment, so their use should be restricted to emergency cases.

In addition, there are a few pests that have developed resistance to certain pesticides. Therefore, Integrated Pest Management (IPM) strategies that combine the use of resistant/tolerant varieties, suitable cultural practices and the rational application of pesticides (with emphasis on biological pesticides) are recommended. Some of these measures are mentioned below.

Some information will be given on synthetic chemicals and natural pesticides at the end of this chapter. However, I do not give recommendations about specific synthetic pesticides for the control of specific pests and diseases. Growers who intend to use synthetic pesticides may refer to bonafide local pesticide suppliers or the local agricultural extension service.

## Nematodes



Nematodes are very small worms living in the soil that feed on plant roots. Due to their small size (only a few mm long), it is not possible to see them with the naked eye. Some nematodes feed from the outside of plants, others enter the plant. All feed on the plant's sap, which can reduce the plant's productive capacity.

Even greater damage can occur if viruses or fungi enter the plant as a result of the injuries caused by the nematodes, and then proceed to make the plant sick, and eventually die.

If you discover an area in the cultivated field where part of the crop is clearly lagging behind in growth, the plants are lighter in colour, and their leaves are abnormally shaped but do not show signs of a mosaic pattern, then you may well have a nematode infestation.



It usually begins in a small, limited part of the cultivated area, and spreads slowly throughout the plantation.

Root-knot nematodes are of major importance in tomato cultivation. They cause galls (infected swellings) on plant roots. Three common types of root-knot nematodes are: *Meloidogyne incognita*, *M. javanica* and *M. arenaria*. Affected plants remain small, and are liable to soil-borne fungal and bacterial diseases. Nematodes cause yield losses of about 30% in tomato in the tropics.

Nematode infestation and transmission can occur in many ways: via infected plant material, tools, rainwater and irrigation water, strong winds (which carry infested soil particles), and contaminated soil carried on shoes, or animal feet. Nematodes will survive in soil as long as it stays moist.

Chemical pesticides (nematicides) and soil sterilants (including steam-treatment) are effective but costly control methods. It is worth trying the following IPM-measures to suppress or limit a nematode infestation:

- ❖ Rotate tomato with other crops such as cereals, cabbage, onion, ground nut, cassava, sesame, etc. Do not rotate with Solanaceae. It is not advisable to rotate with crops of the Cucurbitaceae family (e.g. cucumber or pumpkin) or papaya either, as these can also cause the transmission of diseases.

- ❖ Remove weeds and plant remains (rotten leaves and fruit). Interplant with plants that emit substances via their roots which nematodes do not like or which kill them, such as sesame or African marigold (*Tagetes erecta* and other related varieties).
- ❖ Expose the soil to sun and wind. Plough the soil several times. The nematodes will be ploughed up to the surface of the soil and will be exposed to the sun and high temperatures, which kill them.

## Insects

All stinging and sucking insects, such as whitefly, thrips and aphids cause physical damage only when they occur in large numbers. However, they may transmit viruses, which can cause much greater damage. These insects can come from outside your field, and may cause your entire crop to become infected.

Also, leaves damaged by insects become more susceptible to fungal and bacterial diseases. Closed glass, greenhouse, plastic sheeting or mosquito netting, or a combination of these, protect crops against insect attacks and virus infestations.

### **Whitefly (*Bemisia tabaci*)**

The adult fly is white in colour and 1-2 mm long. It feeds, just like the larvae, on the leaf sap. When plant leaves are turned over, a whole swarm of whitefly may fly up. They lay eggs on the underside of the leaves. The eggs hatch after about 1 week. After 2 to 4 weeks the larvae form a cocoon and metamorphosis takes about one week.



Whitefly are especially a problem in the dry season. Once the wet season starts they disappear. Some measures to combat whitefly:

- ❖ Encourage the presence of natural predators of whitefly, by planting shrubs or other plants between the crop rows (interplanting) or along pathways between borders.
- ❖ Do not spray pesticides.
- ❖ Use resistant cultivars (hairy leaves make it difficult for the whitefly to lay its eggs).
- ❖ Spray a solution of kerosene and soap to control whitefly

### Aphids (Aphidae)

Aphids are soft, oblong insects about 2.5 mm in length.



There are aphids with and without wings. Direct damage occurs when they attack the crop in large numbers, especially the youngest leaves and stems. In addition to causing direct damage, aphids also transmit several viruses.

Measures to control aphids:

- ❖ Remove old crop debris before sowing new crop.
- ❖ Intercrop with other crops.
- ❖ Use nitrogen fertiliser in moderate amounts; apply organic fertilisers.
- ❖ Spray a solution of soap, cow urine or extract (*Azadirachta indica*).
- ❖ Cover the ground with grey plastic sheeting, which repels the aphids by reflecting sunlight.

### **Thrips (Thripidae)**

Thrips are very small insects, only 0.5 to 2 mm long.



You have to look carefully to spot them. They usually have wings. Thrips lay their eggs on the leaf. The larvae appear after about 10 days. The larvae and adult thrips suck the leaf sap, causing silvery spots on the leaf surface.

The adult thrips also leaves its excreta on the leaf; these are small black dots. A few thrips species are vectors of Tomato Spotted Wilt Virus (TSWV). The cocoon metamorphoses in the soil.

#### Measures to control thrips:

- ❖ Cover the ground with plastic sheeting to prevent the thrips from passing into the soil for their cocoon stage.
- ❖ Plough well, so that cocoons are brought to the surface where they will dry up and die.
- ❖ Remove crop debris.
- ❖ Spray plants with a solution of soap or neem extract (*Azadirachta indica*). This will not affect the cocoons in the soil so repeat spraying regularly to kill the aboveground adults.

#### Butterflies and moths (Lepidoptera)

Butterflies and moths are common pests in tomato crops. They lay green or brown eggs on young leaves, flowers and fruit. The hatched larvae (caterpillars) feed on leaves, flowers, fruit and even the roots.



While feeding, the caterpillars grow in size, passing through a number of larval stages. Eventually they form cocoons in the soil. A few weeks later these hatch and the adult butterflies fly out and disperse.

Measures to control caterpillars:

- ❖ Remove weeds regularly.
- ❖ Plough one month before sowing or transplanting.
- ❖ Remove and destroy the infected fruits.
- ❖ Use crop rotation.
- ❖ Check regularly for the presence of eggs and then take measures to control the young larvae.
- ❖ Use light traps that attract moths at night, preventing them from laying their eggs on the plants.
- ❖ Apply wood ash, wood chips or shavings and/or calcium on the seedbeds.
- ❖ Intercrop with cabbage.
- ❖ Spray *Bacillus thuringiensis*, a biological insecticide, which you can buy from your pesticide supplier.
- ❖ Spray with a neem solution (*Azadirachta indica*) or other locally used natural pesticides.

### **Leafhoppers (Cicadellidae: *Empoasca fabae*)**

The most common tomato pest is the potato leafhopper. Leafhoppers are between 2 and 30 mm long, and walk sideways if they are disturbed. They lay green banana-shaped eggs on the underside of the leaf.



They feed on plant juice. Where they have sucked, the leaf becomes lighter in colour. If damage is severe, the entire leaf becomes light-coloured.

Measures to control leafhoppers:

- ❖ If possible, plant during the rainy season.
- ❖ Use resistant cultivars (e.g. hairy leaves make it difficult to lay eggs)
- ❖ Mulch well (this prevents leafhoppers from forming cocoons in the soil).
- ❖ Spray with a neem solution (*Azadirachta indica*) or other locally used pesticides (e.g. pyrethrum, derris, sabadilla). The best time to spray is in the first month, when the plants are about 10 cm tall, as the female leafhoppers lay their eggs around this time.

### **Mites (*Tetranychus spp.*)**

Mites are spider-like insects. They are smaller than 1 mm, often yellow, red or orange. They lay their eggs on the underside of the leaf. The larvae and adult insects suck sap from the leaves. Leaves and stems become yellow and dry up.



Mites can make an airy web (fluff) of thin threads, similar to that of the spider. They do most damage in the dry season.



#### Measures to control mites:

- ❖ If possible, plant in the wet season.
- ❖ Stimulate the presence of natural predators by intercropping or growing near roadside, shrubs and other varied vegetation.
- ❖ Spray with a soap or a kerosene-soap solution

#### **Helpful insects**

Some insects can help to control harmful pests. Some examples of natural predators:

- ❖ Ladybird beetle controls whitefly.



- ❖ Green lacewings control aphids and whitefly.



- ❖ Hover flies (Syrphidae) control aphid eggs.



- ❖ Trichogramma wasps control codling moth.



- ❖ Bacillus thuringiensis against Army worm.



## Diseases



Tomato plants are susceptible to several fungi, bacteria and viruses. Fungi and bacteria cause foliar (leaf), fruit, stem or root diseases. A virus infection often leads to dwarfed growth and decreased production. Damage caused by diseases can result in considerable yield losses for a farmer.

## Bacteria

Bacteria are tiny one-celled organisms. They are visible under a microscope but not with the naked eye. Unlike fungi, whose spores germinate and then can penetrate the plant's intact skin, bacteria almost always infect the plant through weak spots, such as scars, stomata and lenticels (small openings on the surface of stems and roots) and wounds (e.g. from pruning) or other mechanical injuries.

In the soil they can penetrate the plant through root lesions, caused for example by nematodes. Bacteria are everywhere in the air and on objects. Bacteria are carried to the place where they penetrate the plant by humans, on shoes and the legs of insects, by raindrops splashing, or dust in the wind.

Most bacterial diseases are transmitted when humidity and temperatures are high. Once they have penetrated the plant, bacteria usually end up in the vascular system of stems, roots and leaves, often causing the latter to wilt.

To avoid bacterial diseases from spreading in your plantation make sure your tomato plants do not get injured. Many bacterial diseases survive in the soil. Therefore practise crop rotation and do not grow tomatoes for several years on the same soil. The only way to eradicate them quickly is to sterilise the soil using chemicals or steam.

I recommend the use of resistant varieties, if seeds are available. Some bacterial diseases commonly found in tomatoes are discussed below.

### **Bacterial wilt (caused by *Ralstonia solanacearum*)**

This bacterium is especially common in humid tropical lowlands, where temperatures are relatively high. It causes bacterial wilt, which is a soil-borne disease. The first symptoms in infected plants are wilting of terminal leaves, followed in 2-3 days by a sudden and permanent wilt, but there is no yellowing.

Adventitious roots may develop on the main stems. The vascular system in the stem of infected plants appears light brown in transverse or longitudinal section; it becomes a darker brown at a late stage of infection.

The pith and the cortex near the soil line also become brown when the plant is completely wilted. A white, milky stream of bacteria will ooze from xylem elements when stem sections of infected plants are suspended in water.

The bacteria survive in the soil and enter roots of young plants through wounds made by transplanting, cultivation, insects or certain nematodes. The bacteria are spread through irrigation water, soil movement, or moving infected plants (e.g. when transplanting).

The following measures will help to control bacterial wilt:

- ❖ Use tolerant/resistant varieties.
- ❖ Avoid infested fields. Once the soil has been infected, do not grow *Solanaceae* for at least 7 years. Rotate with cereal crops.
- ❖ Do not injure roots or leaves, so be careful during transplantation and prune as little as possible.
- ❖ Make sure the field is well drained.
- ❖ If necessary, sterilise the soil

### **Bacterial spot (caused by *Xanthomonas axonopodis* pv *vesicatoria*)**



This bacterium is distributed worldwide, but it is more severe in the tropics and subtropics. It is spread via seed, insects, raindrops, infected plant debris and Solanaceae weeds. Heavy rains and high humidity favour disease development. The bacteria enter the plant through the stomata and wounds.



The pathogen affects leaves, fruits and stems. Small spots appear on the leaves and on the fruit of infected plants. These spots are generally brown and circular. Leaves turn yellow and drop off. Elliptical lesions are found on stems and petioles.

The following measures can help in controlling bacterial spot:

- ❖ Use pathogen-free seeds or transplants. Give hot water treatment: soak seeds for 25 minutes in water at 50°C.
- ❖ Practise crop rotation.

- ❖ Weed thoroughly; make sure you remove members of the Solanaceae family in particular.
- ❖ Clear away crop debris.
- ❖ Apply copper or copper+maneb

### **Bacterial canker (caused by *Clavibacter michiganensis*)**

Bacterial canker is an economically important tomato disease that occurs worldwide. The disease is spread via seed or the soil. The bacteria can survive in plant debris. Plants are infected via injured stems or roots. Damage may be severe when root-knot nematodes are present.



The leaves of infected plants become yellow, wilt and dry up. Long, brown stripes, which can split open, appear on the stem. Adventitious roots may develop on the stems. Stems may also display cankers under some conditions. Internally, the vascular tissues of the stems display light yellow to brown streaks.

Eventually the pith becomes dis-coloured and ‘mealy’. ‘Bird’s eyes’, round slightly raised spots with a red dot surrounded by a white ring, appear on fruits. These do not always occur, but are a helpful diagnostic aid when present.

The following measures help to control bacterial canker:

- ❖ Use pathogen-free seeds or transplants. Soak seeds for 30 minutes in water at 56°C, or 5 hours in a 5% solution of hydrochloric acid to ensure disinfection.
- ❖ Do not sow on infected soil. Sterilised soil, potting mix and pots or flats should be used when tomatoes are in a greenhouse.
- ❖ Disinfect pruning tools before each use and clean them well after use.
- ❖ Remove and burn crop debris.
- ❖ Rotate tomatoes with a non-host crop.

## Viruses

Tomato is very sensitive to virus diseases. A virus is a very tiny pathogen with a protein structure that is not visible with the naked eye or through an ordinary microscope. It is often spread in the plantation by insect vectors such as whitefly, thrips and aphids.

The damage caused by the virus is usually much greater than the mechanical injury caused by the insect vector.

Normally, plant tissue damaged by a viral disease does not die immediately. The most important symptom of viral infections is the light (white or yellow) colour of the leaves, or a mosaic pattern of light and darker shades of green on the leaves. In many cases, viral disease leads to dwarfed growth, rosette formation or other strange stem and leaf deformations.

The symptoms of viral infections are often not found everywhere in a cultivated field, as is usually the case with fungal or bacterial diseases. It is always possible to find a number of plants that show no signs of the disease.

Viruses that affect tomato crops include:

- ❖ Tobacco mosaic virus or tomato mosaic virus (TMV or ToMV)
- ❖ Cucumber mosaic virus (CMV)
- ❖ Tobacco etch virus (TEV)
- ❖ Potato virus-Y (PVY)

- ❖ Potato leafroll virus (PLRV)
- ❖ Tomato spotted wilt virus (TSWV)
- ❖ Pepper veinal mottle virus (PVMV)
- ❖ Chilli veinal mottle virus (CVMV Or Chivmv)
- ❖ Tomato yellow leaf curl virus (TYLCV)
- ❖ Tomato Big-Bud mycoplasma (TBB)

### **Tobacco mosaic virus**



TMV causes severe damage to tomato crops. The symptoms include yellow-green spotted leaves, rolled-up leaves, stunted growth and discolouration of fruits. Machinery or workers transmit the virus mechanically to healthy plants. The natural vector of TMV is not known. Seeds transmit the virus.

Control measures include:

- ❖ Use pathogen-free seed and destroy infected plants.
- ❖ Avoid contact with infected plants and with tobacco: never smoke tobacco near the plants - even cigarette ash can transmit infection. Wash your hands with soap and water before visiting a tomato crop.
- ❖ Do not grow other Solanaceae near the field.
- ❖ Use resistant varieties.

## Cucumber mosaic virus



CMV causes stunting in tomato plants. Leaves may show a mild green mottling or more shoestring symptoms in which the leaf blades are greatly reduced. Fruits are small in size and often misshapen. CMV is transmitted by different aphid species. Aphids usually introduce the virus into a tomato crop from weeds or neighbouring crops.

Control of the vector is important to prevent CMV epidemics:

- ❖ Grow resistant varieties.
- ❖ As CMV has a broad host range, it is important to eliminate weeds and ornamental plants that harbour the virus.
- ❖ Remove and destroy infected individual plants as this helps to limit the virus spread within the field.

## **Potato virus-Y**



PVY symptoms vary depending on the virus strain and range from mild mosaic to necrosis. PVY is transmitted by many aphid species. PVY is very difficult to control with insecticides. The use of reflective mulches and yellow sticky insect traps can limit virus spread by aphids. Growing useful weeds in tomato crops is very important for controlling PVY.

## **Tomato spotted wilt virus**

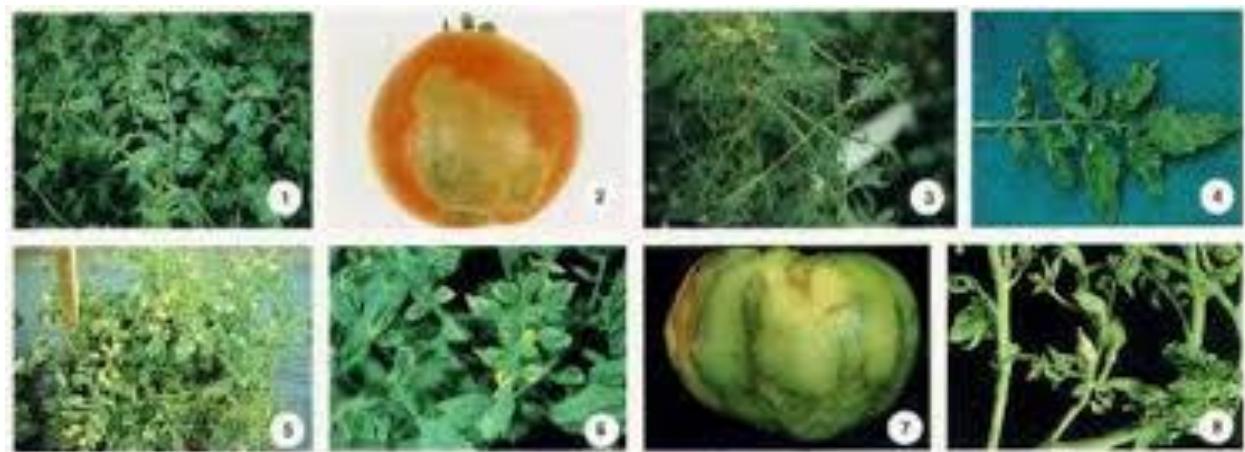


TSWV is an economically important tomato disease in the tropics. Infected plants are stunted and display yellow leaves. Fruits show characteristic green, yellow and red, slightly raised bulls-eye rings. TSWV is transmitted by several thrips species.

It is important to:

- ❖ Eliminate thrips and host plants to prevent the disease.
- ❖ Locate tomato crops as far away as possible from flower fields.
- ❖ Use resistant varieties.

### **Pepper veinal mottle virus**



PVMV causes mosaic spots in tomato. Severe strains may cause leaf and stem necrosis. In the wild PVMV is transmitted non-persistently by at least five aphid species: *Aphis gossypii*, *A. crassivora*, *A. spiraecola*, *Myzus persicae* and *Toxoptera citridus*.

To control PVMV:

- ❖ Tomato crops should not be planted close to infected crops.
- ❖ Weeding and control of aphids in the nursery may also reduce PVMV spread.

### **Chilli veinal mottle virus**



CVMV causes yellow mosaic pattern or chlorotic (pale green) spots on tomato crops. This virus is transmitted in a non-persistent manner by several aphid species.

The main disease control measures are proper cultural practices, including intercropping with maize or using reflective mulches to reduce the vector population.

### **Tomato yellow leaf curl virus**



TYLCV occurs worldwide. Infected plants are erect and stunted. Leaves are yellow and curl upward or downward. An entire yield can be destroyed if plants are infected in the nursery. Whitefly transmits TYLCV.

Common control measures:

- ❖ Use tolerant varieties.
- ❖ Use reflective plastic mulch.
- ❖ Protect seedlings with a net in the nursery.
- ❖ Control the insect vector.

## Fungi

Fungi are organisms that usually consist of filaments (hyphae). Clusters of hyphae (mycelium) are visible with the naked eye and look like very fine cotton wool. These are usually whitish in colour. Spore clusters and fruiting bodies are often brightly coloured. The green or whitish spore clusters that form on old bread and rotten fruit are a familiar example.

A fungal infection is often caused by fungal spores that land on leaves, germinate there and penetrate the plant tissue through its stomata (small openings in the plant's skin), wounds, or sometimes even directly through the plant's skin. The filaments develop at an increasing rate in the affected plant tissue, from which they extract nutrients and into which they may excrete substances that are toxic to the plant.

The affected plant tissue usually dies off. The harmful effects of the fungus are usually limited to the affected area, but there are some types of fungi that invade the plant's vascular tissues (xylem) and thus spread throughout the plant (*Fusarium* and *Verticillium* spp.).

The most obvious symptoms of fungal diseases are leaf spots. These spots are normally round or oval, but they can also be polygonal or spindle-shaped (with pointed ends). In an early stage of infection, 'moist' areas may be noticeable on the leaves, where the leaf will later die off.

At a later stage of infection, the leaf spots have a dead brown centre and are surrounded by a light or dark-coloured halo. Concentric rings of different shades of brown or grey form around the centre.

It is easy to control fungal diseases by using resistant varieties. Crop rotation may also help, particularly in the case of soil-borne fungal diseases. It is also important to eliminate crop debris.

Most fungal diseases can be controlled by applying the right chemical fungicides on the foliage (leaves). Where rainfall is heavy and frequent the fungicide (and also insecticide) deposits may be washed off the leaves and lose their effect. To avoid this loss of pesticide it helps to shield the crop plants from raindrops by tying strips of transparent plastic over them.

Another reason to keep the leaves as dry as possible is to prevent bacteria and some fungi spores from moving in a film of water, thus easily finding places to enter the leaf and infect the plant, through the lenticels.

The most important fungal infections in tomato are described below.

### **Early blight (caused by *Alternaria solani*)**



This fungus can be found everywhere, and its effect is most serious in humid and hot climates. It is spread via seed, wind, rain and infected plant remains. Plants that have been

damaged are more susceptible to this fungus. Round, brown spots (with concentric rings) appear on the leaves, reaching a diameter of 1.5 cm. Sometimes small lumps can be found on the stem or on leaves, causing leaves to turn yellow and wilt. Flowers and small fruit fall off.



Major control measures:

- ❖ Use tolerant varieties.
- ❖ Remove and burn damaged plant parts.
- ❖ Weed regularly and thoroughly.
- ❖ Use pathogen-free seeds.
- ❖ Adopt crop rotation.
- ❖ Make sure the plants have enough water.
- ❖ Do not plant young plants near older plants.
- ❖ Apply effective fungicides, if available.

## Late blight (caused by *Phytophthora infestans*)



This fungus can be found in all regions of the world, but is more common in highlands or in cool humid conditions in lowlands. The fungus is usually spread via crop remains. Dark, watery marks with a yellow spot on the inside are visible on the leaves.

Sometimes the marks start at the edge of the leaf and spread inward, sometimes the spots spread from the centre of the leaf outward. On the underside of the leaves, the spots are white. The stems and fruit can be affected also. Fruit gets brown spots and the leaves wilt.

The signs of late blight become visible early in the growing season.

Measures that can prevent late blight:

- ❖ Use tolerant varieties.
- ❖ Weed regularly and thoroughly.
- ❖ Remove and burn affected plants and plant debris.
- ❖ Do not plant young plants near older plants.
- ❖ Apply mulch on seedbeds, so that less watering is needed.
- ❖ Avoid planting tomato near potato crops.
- ❖ Increase aeration by staking and removing affected leaves.

### **Fusarium wilt (caused by *F. oxysporum*)**

From the bottom up, leaves wilt, turn yellow and curl at the edges. A brown stain can be seen if the stem or roots are cut. The plant may wilt on only one side or on a leaf, while the other half or rest of the plant remains healthy for a long time. Pink fungus fluff is found on dead plant parts.

Measures to help control Fusarium wilt.

- ❖ Use resistant or tolerant varieties.
- ❖ Adopt crop rotation.
- ❖ Remove and burn affected plants.
- ❖ Minimise the watering schedule. To prevent the soil drying out apply mulch on the seedbed.
- ❖ Decrease the acidity of the soil by applying calcium or marl.

### **Verticillium wilt (caused by *V. albo-atrum*, *V. dahliae*)**



This disease is most common in cooler climates (e.g. highlands). Signs of infection are similar to those of Fusarium, but they appear more slowly. The plants wilt, and leaves become yellow. Many side roots may form at the base of the plant.

The fungus spreads through crop debris, especially in slightly acidic soils (low pH). This disease also affects other Solanaceous plants.

Measures to control this wilting disease:

- ❖ Use resistant/tolerant varieties.
- ❖ Weed thoroughly.
- ❖ Plough and clear crop remains.
- ❖ Use healthy seed.
- ❖ Rotate with plants other than Solanaceae.
- ❖ Apply calcium or marl in the soil.

For the following diseases, apply the general control measures discussed at the beginning of this chapter.

#### **Powdery mildew (caused by *Leveillula taurica*)**



This mildew appears as yellow spots on the leaves and powder from spores on the underside of these spots. Unlike other forms of mildew, the hyphae (threads) are completely inside the plant. The plant is infected via the stomata and leaf surface. The disease spreads quickly in dry conditions.

### **Anthracnose (caused by *Colletotrichum coccodes*)**



Signs of infection by this disease are grey-brown spots (dents) on the fruit and, in humid weather, salmon-pink spores. The disease spreads quickly in humid weather, and when it is hot and humid. Transmission is most common via infected plant material (especially the fruit).

Therefore, measures relating to crop hygiene are very important.

## Other causes of crop damage

The abnormalities described below are not caused by insects or diseases but mostly by nutritional deficiencies and unfavourable climatic conditions.

### Fruit splitting



Little splits appear in the (usually ripe) tomato fruit due to large fluctuations in the moisture content of the soil or due to wide fluctuations of temperature. These reduce the fruit quality. Sensitivity to these fluctuations varies depending on the cultivar. Also, the splits make it easy for pests and diseases to enter the tomato.

Two ways to prevent splits are by covering the ground with a layer of mulch and watering lightly but more frequently, or by picking fruit just before it is ripe and letting it ripen indoors in a dry spot (e.g. on straw).

### **Sunburn (or sunscald)**



Brown or grey indentations appear on the fruit. The part of the fruit that is most exposed to the sun rots first. This can be prevented by providing more shade during fruit ripening by planting trees, or by judicious intercropping. Sunburn is more frequent on un-staked tomatoes.

### **Blossom-end rot**



This disease is caused by calcium deficiency. This is usually a result of too much salt in the soil, which is caused by the use of saline water, or irrigating with too little water during the dry season. The amount of salt in the soil can be lowered by flushing it out with one or more abundant applications of salt-free irrigation water (normally during the rainy season), making sure that there is good drainage.

## **Control of pests and diseases**

Cultural measures to limit the damage done by pests and diseases are discussed in the preceding chapters. The measures were based on the principles of Integrated Pest Management (IPM). But in cases of emergency, pests and diseases can also be controlled by using synthetic chemical or some natural pesticides, and by biological control.

Keep in mind that pesticides usually have a specific action. That is to say: insecticides kill insects only, and not mites, diseases or nematodes. Fungicides kill only fungi and some bacteria.

### **Synthetic chemical pesticides**

Synthetic chemical pesticides are developed by researchers working for chemical companies, and are sold by these companies. These chemicals can be toxic (sometimes very toxic) to human and animals.

They are most effective in controlling the pests and diseases, but they also kill the pest's natural predators, causing a serious resurgence of some pests when not applied at the right time, in the right way and in the right dosage rate per hectare.

Because they leave residues they also can do harm to humans and the environment, and therefore should be applied judiciously and only in cases of emergency.

A simple way to increase effectiveness of fungicides is to add 1 table spoon of household soap to the knapsack sprayer. This causes a reduction in the surface tension, turning the droplets into a film. In this way, farmers can reduce the number of applications.

## **Natural pesticides**

Natural pesticides are products, such as pyrethrum, derris (rotenone). They are called ‘natural’ as they are found in nature. These insecticides have been used since ancient times. Their application has a quick effect. Chemistry researchers have developed better formulations and have thus improved their effectiveness. They can be as toxic to the natural enemies of crop pests as synthetic chemical pesticides.

Other natural pesticides have a slow action, such as neem extract (*Azadirachta indica*), which represses rather than controlling pests. Its formulation and effect have now been improved too by chemical companies. But farmers themselves can prepare a rough formulation, as the neem tree is common in tropical areas.

Besides these pesticides there are other ways to suppress the development of pest populations such as spraying the crop with cow urine, cow dung, garlic and other products. These products are not really pesticides. They are not as effective and fast acting as synthetic chemicals can be.

Also some of them are laborious to prepare. But these methods for suppressing pests do little harm to natural predators and are safer for the environment and for consumers. Because of the negative side effects of synthetic chemical pesticides it is recommended to use these pest-suppressing methods wherever possible.

## **Biological control**

Controlling an insect pest by using its natural enemies is called biological control. Natural enemies can be birds, spiders, other insects and even fungi or bacteria. Insect pests can be controlled almost completely in a biological way when the crop is grown in greenhouses.

In the warmer regions the same effect can be achieved by enclosing the cropped area with mosquito netting. This prevents the natural enemies from flying away, and pest insects re-entering the plant.

Natural enemies can also play an important role in protecting crops grown in the open. You should enhance and protect the natural enemies that are already present in and around your plantation. You must NOT use pesticides, because these kill the natural enemies as well, and this may lead to a much more serious resurgence of the pest.

Some ways to control or suppress the development of insect populations:

#### ***Kerosene-soap solution***

This solution helps to get rid of aphids, mites, thrips and leafhoppers. Application: Dissolve 500 g soap in 4 litres of boiling water. Then add 8 litres of kerosene to make an emulsion. This can be done by beating the mixture well, or by spraying the solution into the kerosene (use a powerful pump, e.g. a plant spray).

You should end up with a creamy mixture, and no oily layer on top. Once it has cooled down it will congeal into a smooth, thick paste. Dilute the emulsion 10 to 15 times before using it.

#### ***Soap solution***

This is a good remedy against aphids and thrips. Application: Dissolve 30cc liquid soap in 5 litres of water by shaking it. Before spraying it on the crop, test the solution on a single plant. If the concentration of the solution is too high, burns (spots) will appear on the plant. The solution should then be diluted more.

### **Cow urine**

This has proven to be effective in controlling aphids, mites, thrips and other insects, and also against mosaic-virus and fungi. Application: Store urine in the sun for two weeks. The urine should be diluted 6 times before spraying it. Test it first on the leaves and fruit of the plants, and dilute more if necessary. A second spraying after 1 or 2 weeks will have more effect. This treatment can be used as a preventive measure.

### **Cow manure**

Cow manure can be used in the same way as cow urine as a pesticide and fungicide for pests and diseases in tomato.

Application: Put 3 cowpats in a bucket of water. Store the mixture for two weeks, stirring every day. If the smell becomes too strong, cover with a cloth. This solution should be diluted 3 to 5 times before spraying it. Other animal manure can be used in the same way, but test it on a single plant first!

### **Neem - Azadirachta indica (Melicaceae)**



Neem is a fast-growing tree, widespread in South-east Asia, Africa and Central America. The tree grows in various climates and soil types. It bears fruit after 4 or 5 years (average of 30

to 50kg/tree). The seeds contain 35% to 45% oil. Neem is effective against all the pests mentioned in this book, and against nematodes.

**Preparation:** A watery extract from the neem seed is used as a spray. As the product is broken down by sunlight, it is best to prepare it in the evening. Collect the fallen fruit, remove the pulp and wash the seeds. Dry the seed well and store in a well-ventilated space (e.g. baskets or bags). The seeds you need should then be peeled and ground.

The ground seeds (about 5 kg) are wrapped in a piece of cloth and soaked in 10 litres of water overnight. The next day, drain the water off with a sieve and dilute it 10-20 times with water (making a total quantity of 100 to 200 litres). You will need about 500 litres to spray 1 hectare (i.e. 13-25 kg ground seed).

As a preventive measure, use a weaker dilution. It might be necessary to spray a second time.

The pressed neem fruit cake (not only the seeds) can be used to control nematodes in tomato. Plough 1 to 2 tons/hectare of the cake into the soil.

# Chapter 7

## Harvesting



Harvesting on time and proper post-harvest treatment of the fruit is very important. The high water content of tomatoes makes them vulnerable to post-harvest losses. Over-mature fruit gets easily damaged or starts rotting. The first measure to help limit the extent of post harvest damage is harvesting at the right moment.

It will be necessary to harvest several times as the fruit of tomato plants do not all ripen at the same time. The first tomato harvest is possible 3 to 4 months after sowing. Harvesting will continue for about one month depending on climate, diseases, pests, and the cultivar planted.

During one season tomatoes must be harvested 4 to 15 times. Quality tomatoes are firm and are uniform in colour. If the tomatoes are to be used for the production of, for example, ketchup, chutney, purée or juice, the fruit must be picked when it is red and completely ripe.

If the tomatoes are to be sold as vegetables on the market, they can be harvested while still green. Green tomatoes can be ripened after picking, until they are red. A few red, ripe tomatoes will speed up the ripening process.



One disadvantage of early picking is that the nutritional value of the tomatoes is lower. One advantage is that green tomatoes are less likely to get damaged or to rot.

To uphold the quality and ensure a good harvest some simple and easy guidelines can be followed when harvesting:

- ❖ Workers need to know which tomatoes are to be harvested and what end use they will have.
- ❖ Harvesting needs to be carried out in dry weather and cool temperatures, hence in the early morning.
- ❖ Tomatoes must be picked with clean hands and twisted gently off a plant and not be squeezed or damaged by fingernails.
- ❖ Tomatoes must be gently placed in the container and not thrown in or dropped.
- ❖ Containers must be clean nylon net bags, plastic buckets, or wood or plastic crates.
- ❖ Picking containers should never be too full.
- ❖ The small picking containers used by labour need to be emptied into larger containers in the field. Larger containers need to be wide, shallow and stackable to avoid excessive weight.
- ❖ Larger containers must be kept clean and away from direct sunlight. In this operation the tomatoes have to be placed gently in the larger containers and never too many tomatoes should be piled on top of one another.

## Harvest labour planning



Tomato harvesting is labour intensive and it is important to estimate the time required, the cost involved and how much labour may be required.

A farmer estimates that his crop will require 6 harvests and each harvest will take a full day's work. He needs to hire four workers at Ksh.100 per day. This will cost him Ksh.2,400 for the total harvest (6 harvests multiplied by 4 labourers at Ksh.100 per labourer per day. In figures  $6 \times 400 = \text{Ksh.}2,400$ ).

It is important to understand that the farmer's time has to be calculated as well. Beside labour costs, other costs like the cost of containers, food for workers etc, must be calculated. A farmer should list all the possible sources of costs.

Costs can be divided into fixed costs and variable costs. In simple terms, fixed costs are those that do not change with an increase or decrease in harvesting requirements (e.g. tools).

Variable costs are those that increase or decrease according to harvesting requirements (e.g. labour).

## **When to harvest**



Harvesting will continue for about one month, depending on climate, diseases and the cultivar planted. Tomatoes can be classified in four stages of maturity:

Stage 1: Seed are white in colour (immature) and can be cut when the tomato is sliced. There is no juice inside the tomato.

Stage 2: Seeds have a tan colour (mature) and some juice present.

Stage 3: Seeds are pushed aside when cut. The colour inside is still green.

Stage 4: Juice becomes red in colour.

Tomatoes that are harvested at the first stage of maturity will ripen into poor-quality tomatoes. Tomatoes harvested at third and fourth stages of maturity will ripen into good-quality tomatoes.

It is also good to look carefully at how ripe the tomatoes are. How ripe a tomato is when it is harvested affects the fruit composition and tomato quality. Tomatoes accumulate acids, sugars and ascorbic acid when they ripen on the plant. Field-ripened tomatoes have a better flavour and overall quality than tomatoes that ripen after picking.

Hence it is important to understand ripeness stages. A simple colour index for red tomatoes can be given to the tomato pickers so that they are familiar with this.

- ❖ Green ripeness stage: Fruit surface is completely green. The shade of green may vary from light to dark.
- ❖ Breaker ripeness stage: Break in colour from green to tan yellow, pink or red on not more than 10 % of the tomato skin.
- ❖ Turning ripeness stage: 10% to 30% of the tomato skin is not green. It can be tan yellow, pink or red.
- ❖ Pink ripeness stage: 30% to 60% of the tomato skin is not green. It can be pink or red.
- ❖ Light red ripeness stage: 60% to 90% of skin colour is not green. It can be pinkish red or red.
- ❖ Red ripeness stage: 90% of the tomato skin is not green. It shows a red colour.

### **Seed selection and cultivation**

If tomatoes are grown for seed production some special practices are needed, from sowing to harvesting. Pests and diseases must be controlled, and nutrient and water management should be optimal to achieve good fruits and seed yield. When collecting seeds it is important to pick fruit only from healthy plants that also have other desirable characteristics, such as:

- ❖ good taste and easy to prepare
- ❖ resistant to diseases or pests
- ❖ produce a lot of fruits that are easy to store.

The selection process requires a lot of patience. However, if you continue to select the best plants every year, you will notice that fruit production increases in quality and quantity.

## **Hybrid seed production**

### ***F1-Hybrid***

Hybrids are plants that are a result of artificial cross-pollination. The first crop from hybrid seeds will produce well, but it is not advisable to use second-generation seed for planting. The chance that you will get plants with inferior characteristics is high. New seed must be bought and used for each crop.

Hybrid tomato varieties have many advantages compared to open pollinated varieties. Hybrids usually produce higher yields. They generally mature earlier and more uniformly. Many hybrids have better fruit quality and disease resistance. With all of these advantages, many farmers prefer to sow hybrid seeds in spite of the higher seed costs.

The demand for hybrid tomato seeds can open a new market for growers interested in seed production. This is good news, but hybrid tomato seed production is not easy. First, it requires much labour, especially during the time when crossing is done.

Second, it requires the mastery of special skills and a close attention to detail. Hybrid seeds can also be bought from commercial seed companies. I recommend doing this, rather than trying to produce them yourself.

### **Seed quality**

The quality of seed is crucial. If you have healthy seed, then your crop will be stronger than one grown from bad seed. It is better to have little seed of good quality than a lot of seed of bad quality.

It is possible to recognise good quality seed. Unfortunately good quality is only confirmed once the seeds have germinated. However, it is easy to spot bad quality seed before germination takes place. Bad quality seed smells dusty, looks damaged, wrinkled or empty.

You might see mould or insects, and the seeds will not all be the same size. You will usually just have to trust the quality of seed. There are ways to determine seed quality but they require precision work and time. One way to do this is to make 4 groups of 50 seeds each.

Sow the seeds in 4 trays or in 4 marked plots. For the seeds to be considered good, at least a third of them should produce healthy plants.

# Chapter 8

## Post-harvest handling



Tomatoes are delicate fruits and need to be sent to the market quickly. If they are not handled carefully they decay easily, which affects their taste, flavour and nutritional value.

### Handling

#### Containers



Tomatoes are picked in picking containers (nylon net bags or plastic buckets). These picking containers need to be emptied into larger containers placed in picking areas. The large containers must be transported frequently to the sorting areas on the farm. Therefore they must not weigh more than 25 kg.

The containers need to hold only tomatoes that are mature, ripe and free from damage. When the field containers are full, they should be transported to a sorting area located on the farm.

### **Sorting area**

In sorting areas, the fruits are washed and sorted by size, colour and variety. Sorting areas need to be out of direct sunlight, preferably cool and clean. People working in the sorting areas, must have clean hands and clothes. It is important that each worker is trained regarding his or her task.

### **Sorting**



In some small-scale handling and sorting operations, machines are used for washing, sorting and grading of tomatoes. Such machines cost a lot of money and are a fixed cost to handling operations.

Efficient washing and sorting can be done with ‘sorting canals’. These are long water containers in the reception areas that look like livestock drinking troughs. They have several advantages. Tomatoes can be off-loaded more quickly from field containers, for tomatoes can be gently poured into the water.

The water prevents the tomatoes from hitting a hard surface, so fewer will be damaged. Water cleans the dirt off the tomatoes. It is also possible, to add a permissible amount of chlorine solution to the water, to disinfect the tomatoes. It may also be possible to heat the water to several degrees above the temperature of the tomato pulp. This will prevent the tomatoes from absorbing water and will also counteract pathogens.

It is important to use clean and good quality water in sorting canals. The water must also be changed regularly. Once the tomatoes are taken out of the sorting canal they must be dried and carefully placed in a container, ready for dispatch to their final destination.

Grading simply consists of arranging the tomatoes into a number of uniform categories according to the economically important physical and quality characteristics. The process involves identification, classification and separation.

Grading has advantages:

- ❖ Uniformity is one of the first attributes that buyers look for. Appearance comes before aroma and taste.
- ❖ Tomatoes of different qualities can be sold to different customers.
- ❖ Setting standards will create customer confidence in the product and more importantly in the producer.

In some cases farmers may be able to pool their financial resources so that they are able to buy a washing and sorting machine.

## Packaging



Badly packed tomatoes will not only ruin the tomato crop for sale, but will also mean lower prices. How tomatoes are packed depends on the end use to which they will be put.

For example, some buyers may want fresh table tomatoes to be packed in small containers; other buyers may require dried tomatoes or tomatoes for processing. Even if tomatoes are just being sold at the farm gate, they will require some form of packaging, which can be a simple traditional basket or a nylon paper bag.

Packaging is convenient for handling, transporting and storing tomatoes. It protects against pathogens, natural predators, loss of moisture, temperatures, crushing, deformation of tomatoes and bruising. It also has an aesthetic function.

Fresh tomatoes are often packed without stems. Mature green mature tomatoes can be stacked on top of one another in a package, since they are firm, but remember that not too many must be packed all at once, or the tomatoes at the bottom of the package will be deformed or bruised due to excessive weight on top of them.

In all cases it is a good idea to use padding material at the bottom of packages and in between layers of tomatoes. Packaging material is expensive, in terms of total costs, and must not be wasted.

Some of the most common packaging materials:

1. large green leaves
2. clay pots
3. Baskets
4. wooden crates
5. cardboard crates
6. cardboard boxes
7. glass bottles or jars
8. plastic bottles
9. tin cans

It may be possible to form formal or informal associations with other farmers to organise packaging operations.

### **Storage**



Storing tomatoes in tropical and subtropical climates can be difficult without cold storage. Sometimes fast marketing is the only solution. Tomatoes that are to be sold fresh for table consumption must not be stored for long. Tomatoes that have been processed, for example

into tomatoes purée or juice, or dried or pickled can be stored from several months to a few years.

Storage facilities will vary according to marketing demands. Fresh table tomatoes will need to be stored somewhere where they can ripen or be stored for a short amount of time. At other times cold storage rooms are required. Processed tomatoes can be stored in typical storage rooms.

Tomatoes often need to be stored at different points while they are in transit to a final destination. For example the tomatoes are picked when ripe and stored for a few days in a cool room, after which they transported to distant markets. During the journey the tomatoes will ripen to the market stage.

Tomatoes that go for export are often transported in large containers that have cold storage facilities and ethylene treatment units.

Fresh tomatoes can be stored after they have been harvested and sorted or they can first be packaged before storing. Cooling before and during storage is important. Tomatoes are sensitive to chilling. Tomatoes that suffer chilling injury fail to ripen, and do not develop full colour and flavour.

Their colour development is irregular, and they are likely to suffer premature softening, browning of seeds and increased decay. Tomatoes will deteriorate if they are kept at temperatures below 10°C for longer than 2 weeks or if kept at 5°C for longer than 6 to 8 days.

Clearly it is difficult to keep tomatoes at cool temperatures without the aid of cold storage facilities, especially in the tropics and subtropics. Hence storage methods have to be adapted to methods used locally.

For example, one method of storing nearly ripe tomatoes is to place them in green leaves that have been washed. The leaves must be changed every 2 or 3 days until the product is sold.

These operations need to be conducted in a cool location that is ventilated. Other forms of storage are tomato drying and purée production.

It is important to estimate what the costs of storage are likely to be, both for fresh tomatoes and well as for processed tomatoes. Costs will vary depending on the situation. For example if a farmer has his/her own storage facilities, she will have to calculate the costs for maintenance of the building, cleaning, loss of produce, etc.

If a farmer does not have her own facilities she will have to calculate the costs of renting storage space and loss of produce.

To work out storage costs, first list all costs and then do the calculations. For example a simple cost calculation for storage space could be:

15 days storage required

100 crates of 15 kg each to be stored

Price per day per 15 kg crate stored: Ksh.2

Price of tomato loss (based on market price per kg) based on quality loss, rodents, theft: Ksh.15 per kg

So in numbers:

Storage time required costs =  $15 \times \text{Ksh.2} = \text{Ksh.30}$  per 100 crates =  $100 \times \text{Ksh.30} = \text{Ksh.3,000}$

Produce loss based on one crate of 15 kg =  $15 \times \text{Ksh.15} = \text{Ksh.225}$

Total storage costs for 15 days = Ksh.3,000 + Ksh.225 = Ksh.3225

## Processing



Processing allows fresh table tomatoes to be kept for longer. Processing can be done for farm household consumption and for commercial purposes. For farm household consumption it provides a more varied diet and also means tomatoes can be eaten out of season.

For commercial purposes it is a way of generating extra income and means more products to offer to buyers.

Do not forget that the nutritional value of tomatoes, especially for water-soluble vitamins, is highest when they are consumed fresh. When sold fresh, good quality table tomatoes in top condition will usually yield the highest possible profit, especially early in the season.

At the peak of the season however, supply may exceed demand, which will cause prices to drop. If you do not have much storage capacity, the surplus tomatoes will rot, unless they are preserved. Well preserved tomato products can be kept for up to a year or more, depending on processing techniques and storage conditions.

New processing operations should not be commenced for commercial purposes just because some of the left over crop has not been sold. Processing is an operation that costs money and if you are new to processing, it is not advisable to invest money in these operations if you only have a small quantity of tomatoes to process.

In this situation it is advisable to either sell the tomatoes at a lower market price or to carry out minimal processing operations for home consumption. If a processing activity is already in place then it is advisable to process tomatoes that have not been sold, keeping a careful eye on market prices to check whether the operation is economically feasible.



Alternatively, it may be possible for farmers to join together to organise processing operations. Joining forces creates an opportunity to share processing costs, and to process, pack and store greater quantities of produce. This may put farmers in a better position when it comes to bargaining with rural merchants, wholesalers and retailers.

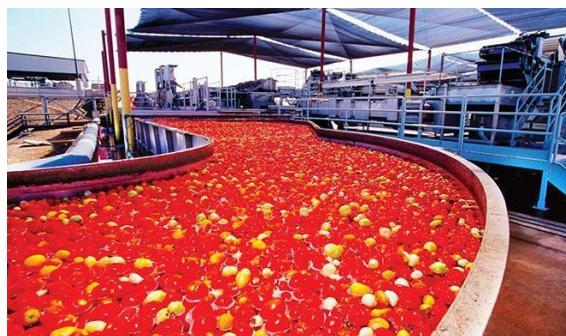
Processing has a number of advantages:

- ❖ Enables out-of-season consumption.
- ❖ Improves farm-household nutrition.
- ❖ Improves storage capacities for tomatoes.
- ❖ Longer storage periods than for fresh tomatoes.
- ❖ Easier storage: bottles, jars, etc. can be stored more conveniently than fresh tomatoes.
- ❖ Lower post-harvest losses of tomato crop.

- ❖ Improves marketing of tomatoes by making them more convenient for buyers to use.
- ❖ Provides an opportunity for labelling, which will attract consumers.
- ❖ May provide a new taste for consumers.
- ❖ Allows the farmer to diversify his/her income.

Processing also has some disadvantages:

- ❖ Competition from very large commercial processors. They can sell processed tomatoes at prices that small scale processors cannot match.



- ❖ Costs of setting up processing facilities can be high.
- ❖ Costs of actual processing (labour, time, machines, etc.) can be high for a seasonal operation.
- ❖ Energy sources required for processing may be scarce and may cost a lot.

Like all post-harvest operations, processing requires good management.

Tomatoes destined for processing must be of good quality, uniform in size and appearance, and have a good aroma and taste. One of the biggest mistakes made is that low quality tomatoes are used for processing. It is important to remember that low-quality fresh tomatoes will result in low-quality processed tomatoes.

Field tomatoes must be weighed on arrival for processing. Weigh again once the product has been processed. Then it is possible to calculate product loss during processing, as well as the costs of processing. These figures are useful for determining the price of the product.

It is important to be aware of the by-products generated by tomato processing: tomato skins and seeds. These by-products have value when treated correctly and should not be or thrown away. For example seeds from drying tomatoes can be used as seed used for next year's crop; tomato skins can be used in farm animal feed.

People who are going to do the processing operations must be trained to carry out their jobs. It may be possible for one person to do all the processing operations. On the other hand it may be that one person does the reception, washing and classification tasks, while another does the peeling, bottling, sterilisation and labelling jobs.



Machinery and utensils used for processing may be as simple as a pestle and mortar, or a hand-driven tomato pulp extractor, bottles, jars, knives etc. Machinery and utensils used should be made of stainless steel, enamel, aluminium or plastic. Do not use equipment made of iron as rust will spoil the product. All equipment must be kept in good working order, and most importantly, kept clean.

## Hygiene



Processing tasks must be clearly set out and it is very important that they are carried out in hygienic conditions. All people must have clean hands, and all equipment must always be clean, e.g. cutting surfaces.

You must also ensure that there are no flies etc. in the processing space. Water used for washing must not be contaminated and materials used must be easy to clean.

If processing tasks are not carried out properly they will result in low quality processed products. Bottles and jars of processed tomatoes must be sterilised. Make sure there is enough fuel available to be able to boil water for sterilising. For example, a jar weighing 500g must be boiled for 30 minutes, a jar weighing 750 g requires 40 minutes, and a jar weighing 1 kg needs 50 minutes to be sterilised. This requires a lot of energy.

Traditionally, the most important preservation methods used are drying and concentration (to juice, purée or paste). Both processes are described briefly here. For both processes the tomatoes should be ripe, free of mould (cut out infected parts) and free of stems, leaves and dirt (wash).

## Drying



In hot dry regions, sun drying is a cheap and relatively easy way of preserving. Firm, not too large plum or paste type tomato varieties (e.g. Roma type) are best suited for this purpose. Large, juicy varieties are not suitable. The tomatoes may be blanched before drying (dipped in boiling water for 1-2 minutes) but this is not absolutely necessary.

### *Open air drying*



Wash the tomatoes, cut them in halves or quarters and place in the sun on clean flat surfaces with the cut side facing up. Trays with plastic mesh stretched over them are well suited for this purpose. Place them on stands well above the ground. Cover the tomatoes with fine muslin cloth or mosquito netting to reduce contamination by insects, dirt and dust.

Depending on air humidity and presence of wind, drying takes 2-5 days. The end product is dark, red, leathery pieces with a water content of 15-20 percent. Further drying (to a water content of 5 percent) yields a hard and brittle product that can be pounded into small flakes or a powder. These products are convenient to store and easy to use in soups and sauces.

### **Heat treatment and concentration**

Preserving tomatoes and (concentrated) tomato products by means of bottling or canning generally yields products of fair nutritional value which can be kept for up to a year. The basic technique described here can be used for very small-scale operations. It requires:

- ❖ investments in equipment
- ❖ heat resistant containers (bottles or jars)
- ❖ a lot of fuel
- ❖ abundant clean water

The process involves placing the products in containers (e.g. bottles or jars) and heating them to a temperature that destroys micro-organisms that could be a health hazard or cause the food to spoil. The containers are sealed hermetically, which prevents re-contamination from outside.

Before filling them, clean and disinfect the bottles and jars in boiling water or scalding steam. Heating times and temperatures depend on several factors. For tomato products the most important are:

- ❖ The number and kind of micro-organisms present. Hygiene is most important. All tools should be spotlessly clean. Hands should always be well washed.
- ❖ The shape and size of the containers. It takes longer to heat the contents of a large jar than those of a small bottle.
- ❖ The acidity of the product. Some dangerous bacteria form spores that can survive temperatures higher than 100°C, the boiling point of water. When the product is not acid enough, these spores can germinate and cause disease. A pH of lower than 4.5 is acid enough. Tomatoes have a pH value of between 3.9 and 4.6. Check

acidity with a pH-meter (expensive) or litmus paper. If necessary add acid, such as lemon juice or citric acid.

### **Preparation of tomato pulp**



Tomato pulp serves as a base for a range of preserves such as bottled juice, sauces, purée and paste. The first step therefore is to prepare tomato pulp. Use only fully ripe tomatoes. Most tomato varieties can be processed this way, but for concentrated products the smaller types with a higher content of solids are preferred.

To prepare pulp, sort, clean and wash the tomatoes. Next, they should be blanched: dip them in boiling water for 2 minutes. This will kill most (invisible) microorganisms remaining on the skin and will make the next step of pulping and sieving easier.



Pulping can be done with pestle and mortar, a hand pulper or pulping machines. Skins and seeds (which can serve as fodder for animals) are removed by straining through a coarse sieve first with holes of 4 mm and then a finer sieve with holes of 1 mm. Most hand pulpers and pulping machines combine pulping and sieving.

The pulp is now ready for further processing, which should take place without delay. For most products the pulp should be heated right away to destroy microorganisms and enzymes. This can be done in a stainless steel or aluminium pan over a fire, stirring continuously. Fresh tomato pulp can also be kept in a freezer, if frozen immediately after preparation.

### **Products from tomato pulp**

#### ***Tomato juice***



Tomato juice is prepared from the entire pulp. Salt and lemon juice can be added to taste. The addition of lemon juice or citric acid (4-5 grams per litre) is recommended to make the product more acid. Bring the pulp to the boil quickly, pour it into bottles or jars and close these with lids or caps.

Leave some space under the lid: 0.5 cm for a jar and about 2 cm for a bottle. Preserve (pasteurise) bottles and/or jars by placing them in a bath of boiling water and heat them for at least 10 minutes.

During storage a certain amount of separation of pulp and liquid may occur, but a clear separation into a pale liquid and a solid pulp layer is a sign of under-pasteurisation. Though it is not likely to be harmful, it looks less attractive.

#### ***Tomato purée and tomato paste***



Purée and the more concentrated paste can be made from tomato pulp by carefully boiling it (stirring constantly to prevent burning) until enough water has evaporated. Fresh tomato pulp contains about 5-6 percent solids, depending on the tomato variety used.

Boiling it down to half its volume will therefore yield a purée with 10-12 percent solids. Further evaporation will yield a product with a solids content of up to 35-40 percent. This tomato paste has a very dark red colour and a strong taste of cooked tomato.

Salt can be added to taste. Using a steam-jacketed boiling pan with steam from a boiler will improve the colour and speed up the process. However, this is expensive and should only be considered for larger scale operations. After it has been concentrated, pour the product into jars and pasteurise in a hot water bath (water temperature near boiling) for 30 minutes.

The bright red colour of imported tomato pastes and purées can only be achieved by using vacuum evaporators at industrial scale. This is outside the scope of this ebook.

Another method for producing tomato paste is to hang the fresh, unheated, pulp in a sterilised cotton sack from a spring scale. The watery juice (the serum) will leak out and can be collected for further processing. After one hour, when the pulp has lost about half its weight, up to 2.5 % salt is added to the remaining pulp. This facilitates further draining and after another hour the weight will have fallen to one third of the original weight.

The remaining paste can then be potted and pasteurised. The heating time in a hot water bath (water temperature near boiling) is about one hour.

This tomato paste has a more natural flavour. The unsalted serum could serve directly as food for animals or be made into a soft drink. Add sugar and lemon juice to taste, bottle and pasteurise. The salted serum can also be used as a base for soups or sauces.

After each use, the cotton sacks must be washed well and sterilised by submerging them for five minutes in boiling water.

# Chapter 9

## Tomatoes Marketing



Marketing is an important activity in any business and should be approached systematically. If well planned, it will yield profit. If it is not properly done it may lead to heavy losses. That is why you need to adopt the best marketing methods that will yield profit in your business.

At the market, products are sold in bulk (wholesale) or in small quantities (retail). The prices are determined by the supply of and the demand for the products. Negotiations may be needed to finalise a sale. This process of buying and selling is called marketing. It includes all aspects of moving products from producers to the final consumer.

### What is a market?

Selling tomatoes involves transactions in which tomatoes are exchanged for money. This requires understanding of how, where and when transactions take place. Typically transactions take place in markets.

## The market



A market is the place where products are exchanged. It is a location, for example a village market, a retailer's shop or a roadside stall. At these markets, sellers offer their produce for sale and consumers are able to choose and buy produce. In other words, it is the place where 'suppliers' (small-scale businesses, such as farmers, retailers, etc.) meet 'demanders' (customers who are buying for themselves and their families, and business customers who are buying for processing or reselling).

A farmer has to offer a certain quantity of products to be able to make enough money to survive. What the farmer has to earn is profit. Profit is the difference between what the farmer has paid to produce the tomatoes and the price the farmer receives for his or her tomatoes.

For farmers to make profit, they need to obtain a price for tomatoes that is higher than the costs involved in producing and marketing tomatoes.

## Supply and Demand



Prices of products are determined by suppliers and demanders. Suppliers are all the people who can and want to sell tomatoes. Demanders are all the people who want to buy tomatoes. If for example demand is high and supply is low, the price of the product in demand will rise. For example if there is a lot of demand for tomatoes, but there are few suppliers of tomatoes (few sellers), the price of tomatoes will increase.

Demand is influenced by:

- ❖ Tastes: consumers all have different tastes.
- ❖ Season: consumer demand changes according to the season.
- ❖ Location: consumers living in different places have different demands for products.
- ❖ Income: consumers' demand for produce depends very much on how much they earn.
- ❖ Population: an increase or decrease in population will affect consumer demand.
- ❖ Age: affects quantity demanded and price.
- ❖ Price: the higher the price, the lower demand will be. The lower the price, the higher demand will be.

Supply is influenced by:

- ❖ Price
- ❖ Season
- ❖ Weather
- ❖ costs of production
- ❖ change in production techniques
- ❖ prices of other products
- ❖ quantity available

The price is simply an agreed price between suppliers and demanders where both are willing to exchange.

### **Market research**

Before deciding to grow tomatoes to sell fresh or processed, it is important to find out whether there is a market for your product. This is called market research.

A typical marketing research process is as follows:

- Step 1: Recognize that you need information
- Step 2: Define clearly the objectives of your research
- Step 3: Find out what methods can be used to gather the information
- Step 4: Understand the best methods for gathering information
- Step 5: Gather the information
- Step 6: Understand the information
- Step 7: Gain knowledge and learn from it
- Step 8: Make decisions based on new knowledge

## **Financing**



Any business activity needs money. This is necessary to be able to pay for items such as farm tools, fertilisers, seeds, etc. However farmers sometimes have difficulty finding the money they need to pay for all the expenses. This is because farmers have to pay for raw materials at the start, and then wait quite some time to able to sell the tomato crop.

Money made from sales of the previous tomato harvest season can be of great help. It is important to save part of the money earned, so it can be used to buy the inputs required for the next production cycle. Money can also be borrowed from many sources.

However, like all other products money also has its costs. The cost of borrowing is called the interest rate. This is the cost that the farmer has to pay for using money to finance production and marketing. It is important to work out how much money has to be paid back and when.

It is also important to consider how the payback period will affect the money in your pocket. This is called the liquidity of the business.

Make a list of all your expenses and a list of all your sources of income for each period of time. Compare the two to see if you have enough money to carry out all farming operations you plan to do.

There are various ways to obtain money. You may be able to borrow from family members, such as close or distant relatives. Advantage: the money is easily accessible and interest rates can be low.

Money can also be borrowed from money lenders. They are often the only source of money in an area and can charge quite high interest rates, but they are easily accessible.

Banks are also available for loans, but usually banks are not interested in very small loans and demand proof of property as a guarantee. On the other hand, banks charge low interest rates, well below those of money lenders.

Rural traders, processors, wholesalers or retailers can be good sources of money. They may be willing to lend money because it ensures their own supplies and it can create a good working relationship with the farmer.

Another good source of money for borrowing may be non-governmental organisations (NGOs) that offer assistance to small farmers. These are called micro-finance institutions (MFIs). Some of them help small-scale producers to organise themselves into formal or informal associations.

In many developing countries like Kenya, this has proved to be the best method of getting money to finance production and marketing.

## **Associations**



Sometimes farmers unite together, to form cooperatives or informal associations, for example marketing groups or production groups. Pooling resources together can have big advantages for small farmers.

The size of the association may for example encourage banks to lend larger sums of money than they would otherwise be willing to lend to individuals. Associations can also obtain advantages when buying raw materials. More raw materials can be bought at one time, for example farm tools, hence prices may be lower.

Also associations may have better negotiation power with rural traders, processors, wholesalers and retailers. Importantly, associations can often help with market research.

## **How to sell**

Farmers must decide how to sell their produce, in other words which marketing channel to use. Farmers may sell their products directly to final consumers at the farm, at the local village market, or at the roadside. It may also be possible to sell produce to a rural trader, processor, wholesaler, retailer, street hawker, exporter and also institutions such as schools, hospitals, hotels etc.

It is important to consider here which method will provide the most advantages for the farmer. In other words, which method will guarantee the best possible prices for your tomato products?

For example, part of the fresh produce may be sold to a processor, part to a wholesaler and part directly at the local village market. Many combinations of selling methods are possible.

### **Where to sell**

Farmers have to decide where to sell their produce. For example, if a small-scale farmer wants to sell to a processor, it is important to find a processor in a good location. This could mean a processor that is nearby, but it might mean a processor further away, but who offers better prices.

Selling at the local village market might be good, but you might get higher prices if you sell at a market in a bigger town. However, although prices may be higher at urban markets, costs may also be higher. You have to compare prices at different markets and also the transport costs to reach the location.

For example selling at a village market may cost little in terms of transport and setting up a stall. If a town or city is further away from the farm, the cost of transport will be higher and you may have to pay a fee for setting up a stall.

### **When to sell**

When to sell involves two important factors for a farmer. The first factor is earning the most money by choosing the right time to sell, usually when prices are higher. The second factor is reducing risk; the prices of fresh table tomatoes and processing tomatoes usually follow a regular pattern.

The nature of fresh tomatoes and the fact that they are not easy to store for long means that farmers are usually obliged to sell at harvest time, and receive low prices. It is worthwhile looking around for the best possible price from buyers.

These could include exporters or processors. This may involve a lot of negotiation, and it is good to carry out negotiations well before the produce is ready to harvest.

In some cases farmers can sell their crop before they have even planted it. This is often done for fresh tomatoes destined for processing by large processing companies. These companies need an assured supply in terms of quantity and quality, and may be willing to buy the produce beforehand. They often base the price they offer on past price patterns, and it is usually a little bit below market prices.

This may seem unfair to the farmer, but it is a good method of reducing price risk at harvest time and ensuring your income. Clearly the farmer must deliver the required quantity and quality. Risk is reduced, but not fully eliminated for the farmer.



When to sell processed tomato products will depend on demand for them. Some processed products can be sold throughout the year to many final consumers, or they can be sold in bulk to an institution, such as a school or hospital. If you can store your processed tomatoes you will have more time to decide when and where to sell your products, based on buyer demand.

## **Costing**

Farmers need to list all their marketing costs. These include:

- ❖ Labor: for harvesting, handling, washing.
- ❖ Processing: equipment.
- ❖ Packaging: wooden crates, glass bottles.
- ❖ Storage: storage shed, renting storage space.
- ❖ family consumption: the quantity of tomatoes used for family needs
- ❖ Transport: bicycle, animal-drawn cart, motorized vehicle.
- ❖ Produce losses: damage, theft.
- ❖ Capital costs: interest rates on borrowed money, storage of processed tomatoes.
- ❖ Fees, taxes, unofficial payments: fee for urban markets, porters to unload produce, government taxes, road payments while in transit.
- ❖ Unexpected costs: costs of accessing an urban market may have increased etc.

It is always good to allow for some unexpected costs when calculating production and marketing costs. These include:

- ❖ labour: for ploughing, planting, scouting for pests, applying fertiliser, etc.
- ❖ capital costs: equipment such as farm tools, buckets, depreciation, etc.
- ❖ organic fertilisers, fungicides and pesticides: nitrogen, phosphorus, potassium, etc.
- ❖ land: renting land, etc.
- ❖ water: irrigation, etc
- ❖ unexpected costs: more insecticide applications due to high level of infestation.

## **Record-keeping**

For keeping records it is vital that farmers keep track of all their costs and sales. They must keep written records of these. This will help the farmer understand his daily, weekly and monthly costs and sales.

Keeping track of costs and sales is called accounting. Records help farmers to assess how their farm is performing. Record keeping takes a lot of time and requires discipline, but gives the farmer insight into the following matters:

- ❖ what has been bought from other people, such as farm suppliers
- ❖ produce that has been sold
- ❖ payments made to labour
- ❖ the total value of the farm as a business
- ❖ help in understanding where losses are being made
- ❖ payments made to the farmer as an employee of his/her own business

Good record-keeping will give the farmer a clear picture of how much money is coming into and going out of the business in specific time periods. Importantly, record-keeping not only looks at money flows, as we saw above with cash flow, but it enables the farmer to evaluate all aspects of the farm business in money terms.

In record-keeping, what is owned by the farmer (the farmer's possessions) are called assets, e.g. farm tools. What the farmer owes (things that are not the farmer's possessions) are called liabilities, e.g. money borrowed.

Accounts are kept to keep track of the assets and liabilities a farm business may have. An account has two sides, like a weighing the scale. One side shows the assets and the other side shows the liabilities.

Assets	Ksh.	Liabilities	Ksh.
Cash	90,000	Loan from friend	18,000
Tools	20,000	Loan from bank	132,000
Shed	40,000		
Total	150,000	Total	150,000

In accounts for record-keeping, assets and liabilities must balance. Note in the table above, the total in each column, assets and liabilities, equals the same amount, Ksh.150,000.

The reason is simple: when a farmer makes a cash payment, both cash amount in assets and liabilities will be reduced at the same time. For example, in Table above, if the farmer pays back the loan he obtained from a friend, Ksh.18,000, he reduces his cash assets by Ksh.18,000 but he also reduces his liabilities by Ksh.18,000.

This double action keeps the account in balance. If the account does not balance the farmer will know that a mistake has been made. This is a good control system for the farm business.

## More Advice



### 8 mistakes to avoid in tomato farming in Kenya



#### 1. Not Hardening Seedlings

Hardening your seedlings is one of the most important things you can do to help ensure their survival. Without hardening, your seedlings won't be able to adapt to the change in temperature or the exposure to weather, like wind and rain. Some ways to ensure your seedlings are outdoor-ready include:

- ❖ Gradually increase your seedlings' exposure to the elements about a month after seeds have germinated.
- ❖ For the first day of exposure, keep your plants out of direct sunlight or rain, and don't take them out in the cold. Bring them back in after a few hours.
- ❖ Seedlings will need to be exposed to the elements increasingly over a period of about 7-10 days to be fully hardened and ready for the outdoors.



Providing vertical support for your tomatoes allows you to fit more plants into a small space.

## **2. Planting Too Closely**

Planting your tomatoes too closely not only stunts their growth and causes a drop in fruit production, but it also makes it too difficult for sun to reach through the plants. This means your tomato plant suddenly becomes the perfect breeding ground for plant diseases that love the damp conditions.

Here's how to ensure your tomato plants have adequate spacing:

Tomatoes grown upright in cages need at least 1 ½ feet between them, though 2 feet is ideal. Sprawling tomatoes will require twice the amount of space. While it's not a big deal to leave your plants slightly unsupported, you never want the plant to be touching the ground.

### **3. Planting the Wrong Tomatoes**

Now that we've covered spacing requirements, the next step is choosing the right type of tomatoes for the amount of room you have. There are two main categories of tomato plants:

- ❖ **Determinate** tomatoes only grow to be a certain size. They can be grown with or without support and don't require pruning. These plants generally put out all their fruit, then they stop growing and die.
- ❖ **Indeterminate** tomatoes will grow pretty much as big as you allow them to get. Therefore, they need more room and require support from a stake or cage. These plants will put out fruit all season, sometimes until the first frost.

Picking the correct type for your planting area will help you ensure your plants stay healthy and fruit-bearing all season.

### **4. Planting in the Shade**

Like other plants that produce fruit, tomatoes need at least 7 hours of sun per day. Placing them in a shady area deprives the plant of the amount of sun it needs, and it will impact how your plant grows.

Fruit production requires a tremendous amount of energy. Like all plants, tomatoes get this energy from the sun.

Plants that don't get enough sun will put out plenty of foliage, but little fruit. As pretty as those leaves may be, you can't put them on the dinner table.



For optimal crop yield, pinch off any suckers that are thinner than a pencil.

## 5. Not Pruning

If you have more space and opted for indeterminate tomatoes, part of your plant maintenance will be pruning. Reasons for pruning include:

- ❖ Since overcrowding makes it easier for plant diseases to spread, neglecting to prune indeterminate plants can be detrimental.
- ❖ The foliage on crowded plants will dry more slowly which encourages a variety of plant problems.
- ❖ Plants need to be pruned so nutrients are being directed to fruit growth rather than to new leaf growth. Not only will plants produce smaller tomatoes at a slower rate if they aren't pruned, but the overgrowth can also provide the perfect environment for plant diseases.

If your plants are looking diseased, sterilize your shears after use to avoid spreading the disease to healthy plants.



Treat early blight or other diseases with an organic fungicide. Remove all damaged leaves and dispose of carefully away from compost or other plants.

## **6. Not Ready For Early Blight**

Early blight can leave your plants completely bare of foliage, and if you're not prepared to treat it, this problem can quickly spiral out of control. Early blight is caused by a fungus that can overwinter in soil, so if you've had plants with this problem before, you should avoid planting in that area.

Early blight will first appear on the oldest lower leaves. You'll see brown spots that look like targets, and the leaves will yellow around it. Eventually the whole leaf will turn brown, die and fall off.

To help prevent early blight from devastating your plants, try rotating crops — moving them to a different area of the garden with fresh soil. However, if your plant is already infected with early blight, you can treat it using an organic fungicide.



## 7. Over fertilizing

Feeding your plants is important, but feeding them too much can be just as detrimental as not feeding them at all. If used too frequently, fertilizer can build up in the soil and cause problems.

Fertilizer provides plants with nitrogen, which is great. However, excessive nitrogen can cause your plants to put more energy into growing leaves than growing the tomatoes.

To combat this issue of over fertilization, look for fertilizers specifically designed for tomatoes, or opt for a shovel full of natural compost.

## 8. Not Watering Properly

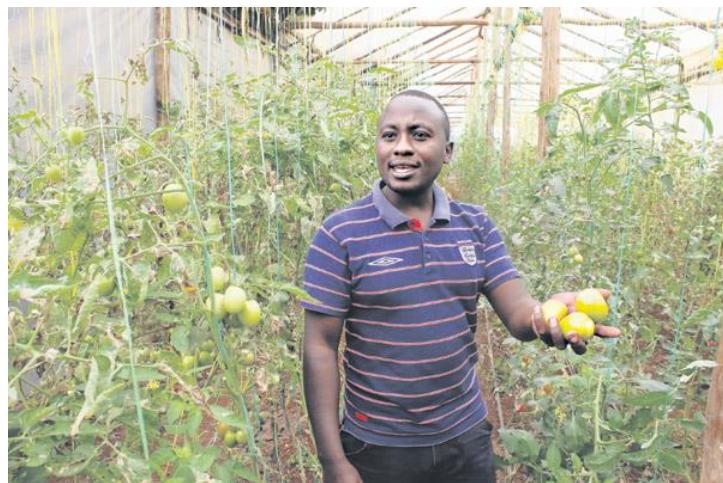
Inconsistent watering can lead to multiple problems for your plants, including blossom end rot. To water your plants correctly, consider:

- ❖ Providing your plants with a consistent watering schedule. Ensure they are able to dry out a little bit so they are not drowning, but be sure they don't dry out all the way.
- ❖ Watering early before the sun is in full force. Damp leaves can get leaf burn or other issues from lingering water.

While these tips won't solve every problem you could encounter in your garden, they're definitely a great place to start when working toward healthy plants. A good garden takes a mix

of time, effort and preventative measures — it's not as simple as planting a seed and watching it grow.

### **King'ori Mathenge: how I've made Sh. 480,000 from organic tomato farming**



King'ori Mathenge knows too well how farming took him out of desperation after he was unable to get a job upon graduating in December 2010.

The 29-year-old has four greenhouses where he practices organic farming which relies on green manure, compost and biological pest control. He sells the produce to hotels in Nyeri and the Coast.

Mathenge chose organic farming because most people are running away from crops grown using chemicals. He gets the manure from the 450 chicken he rears on his farm.

He also buys sheep manure from pastoralists in Doldol, Laikipia County, which he mixes with the chicken manure to grow his crops.

He says he had no idea on farming and had to attend farmers' field days and agricultural shows to get some tips before starting. He attended one such meeting at Wambugu Farmers Training Centre in Nyeri.

However, he says he had never contemplated farming until 2011 when he failed to get a job after one year of searching.

"All I thought of was an office job where I would always be in a suit and tie. However, after several months of joblessness, I had to think outside the box. I needed to earn a living and that is when I thought of farming," he says.

## GAPS

"But before I decided what to grow, I studied the market to find the gaps I should fill," he told Seeds of Gold at his farm.

"I have realised that deciding what to grow is where many farmers go wrong. That is why you find a product flooding the market because everyone is growing it," Mathenge says and adds that soil tests also help to know what type of crop can do well in a particular area and farm.

Mathenge had to seek his father's permission to use his quarter an acre land in Kirurumi village, near Aberdare Forest for farming.

And to keep pests away, Mathenge has been practicing crop rotation, another aspect of organic farming.

"To succeed in farming, one must grow crops that the market needs and not what everyone is growing. You must also ensure the crops are not harmful to human life, such as those grown with chemicals," Mathenge adds. And according to John Wambugu, an officer from the ministry of Agriculture, organic farming in greenhouses is the best these days.

“In greenhouses, temperatures are warm and this speeds up growth of crops while reducing fungal infections,” Wambugu says.

He says although organic farming in greenhouses is rather expensive, it is the way to go since most people are shying away from crops grown using chemicals due to related health and environmental dangers,” Wambugu adds.

“I started with a small greenhouse measuring 15m by 6m where I grew 400 seedlings of tomatoes,” he says. The crop earned him Sh.90,000 within six months.

The young farmer has his market for tomatoes mainly in hotels in Nyeri. He also supplies some to traders in markets. He sells capsicum in Mombasa and Nairobi.

However, the prices are not constant and depends with supply in the market at a particular time.

“I sell a kilo of capsicum at a minimum of Sh100 while that of tomato goes for Sh80,” he notes.

## **BIGGER GREENHOUSES**

Later on, Mathenge put up another greenhouse, bigger than the first one which earned him Sh.150, 000 from the first harvest. By this time, he had two greenhouses. He harvested twice in one and earned Sh180,000 before hailstorm destroyed his crops.

Mathenge did not lose hope. He borrowed money from his father, renovated the greenhouse and constructed a third one. He would reap Sh300,000 soon after selling capsicum from the third greenhouse.

He says he later earned Sh60,000 after selling tomatoes before hotels at the Coast stopped buying his capsicum after business went down due to terror attacks. “I was forced to concentrate more on tomato farming,” he says.

With his mode of farming, he has been able to control common diseases such as Powdery Mill Dew that affects both crops and Tuta Absoluta. With this the bachelor of commerce graduate continues to say no, thanks to job offers.

Eustace Gachanja, the coordinator of the Kenya Organic Agriculture Network says organic farming is not as expensive as some think.

Other than enhancing yields by applying manure, crop rotation and planting of legumes, Gachanja says farmers can also have their farms certified as organic to enable them sell at premium prices in selected organic shops and restaurants.

“We also issue the East Africa Organic Mark to those who comply with the standards to enhance organic farming,” says Gachanja.

# Conclusion

## My journey into agribusiness



When I am not writing I like to engage in my other passion farming. In Kenya there has been a school of thought especially among the younger generation that agriculture is for the older generation and basically not worth their time. However, this perception is slowly changing with more and more young people starting to engage in farming due to its lucrativeness.

Even though it is a lucrative venture it does have its risks just like any other business. The biggest risk is crop failure due to many factors which include pests and diseases and lack of rainfall. Use of wrong or substandard seeds or fertilizers can also lead to failure. As such my advice to any would be farmer is that they should ensure that they engage professionals before making any investment in agriculture. Just like in any other venture, these professionals (agronomists, vets) will aid you in minimizing the costs while at the same time maximizing your output.

My journey into farming started about 7 years ago when a friend of mine who had been farming for some time shared how lucrative it was. Needless to say I have never looked back as any venture that could give me over 100% returns was welcome any day. I started out with farming an acre of maize and beans alongside our family dairy farming business and the returns though not as impressive as I had imagined were good enough to allow me recover my costs and be able to plant the same the following season.

However, after farming maize for a few years I decided to try my hand in wheat farming. Everything started out all well up until the last month to harvesting when I started raining heavily. Prior to harvesting wheat requires dry weather conditions, needless to say that this meant heavy losses for me. As they say what doesn't kill you actually makes you stronger and the experiences learned so far has proved to be invaluable.

For any farmer, there is a deep sense of satisfaction that comes when after a hard day's work at the farm one can look across the field and marvel at their crop. One can't just help but smile at the sea of green as the healthy crop sways in the afternoon breeze. It is at such moments that one pops open a bottle of an ice cold Coke, sits back enjoys the view. Because such great moments are best enjoyed with a Coke in hand. All I can say is that I have no regrets since I started farming other than that I should have done it sooner.

### **Before you say I do..... to Farming**

It is early December now 2016 and the hullabaloo of Christmas and New Year greetings are coming. So has the depression of unmet New Year resolutions. The beauty of resolutions in my view, is that out of ten resolutions an average person will follow through with two or three. If you are disciplined enough you will be lucky to succeed in four or five.

Nonetheless, I see resolution making as more of a ritual to uplift yourself and drive you to new limits. Making resolutions makes you prioritize on your goals. It gives you a sense of direction and that is what is important. Well, that is my long and winding way of saying Happy 2017, with the obvious omission of New Year. And perhaps telling you that it is okay to make resolutions on January 1<sup>st</sup> and break plenty of them by January 10<sup>th</sup>.

## **Sweet tales of agribusiness**

Back to agribusiness, there are several young people getting lured into agriculture as a source of stable income. A substantial number of graduates are now finding agribusiness to be an exciting career choice. Agribusiness is currently a hot venture, no dispute. Writers and bloggers, myself included, have taken to the internet to make agriculture sound even sexier. The truth is that agribusiness has an attractive bottom line that is hard to resist.

To prove this, try sit with young people who are already making a killing from agriculture. Their gusto for the trade will make you want to quit your job and get your hands dirty too. These digital farmers will give you the figures they make and you will want to pack your bags and head back to the village to farm. However, you will make sure you have access to the internet so that you can keep up with the latest research and trends.

This happened to one of my cousins this year who is a journalist as he interviewed at least 25 young farmers and attended a few conferences. He so badly wanted to forfeit his career and become a farmer. He could not resist the sweet tales and tidy returns that were coming from Mother Nature. I mean, how hard would it be to pick up a jembe to make three hundred thousand a month?

Luckily, he didn't have the required money to invest and that held him back. He was so determined that without land nor prior experience he was ready to get started. I say he was lucky because he was not prepared for the dirty side of agriculture. He only had three months experience of writing and colouring other people's success in agribusiness. That does not in any way make him an agribusiness pundit.

This situation got him thinking that perhaps before investing his hard earned cash in agribusiness, he should take a breather and ask himself whether he is cut out for agriculture. Talk to someone who is in agribusiness. Ask them how they got there. Find out what time they get up and what time they get to sleep. Find out how many times they got disappointed by a failing crop or dying animals before hitting the jackpot. Find out what keeps them going despite their produce being a glut on the market, or a drug on the market.

## **10 things to consider**

Here are ten things that you need to think about before ditching that job to get into agribusiness:

### **1. Passion for agriculture**

Before entertaining the thought of diving into agriculture, ask yourself if you have any interest whatsoever in agriculture? The returns might sound enticing but are you the kind of person who likes plants or animals and taking care of them? Have you previously done anything to do with agriculture? Do you even have a kitchen garden? If you hate the thought of dirt on your hands, then agribusiness is not for you.

### **2. Identify your area of interest**

After assuring yourself that indeed agriculture is one of your passions, then start analyzing what area to focus on. You cannot excel in agribusiness if you are a jack of all trades. Pick one area and focus on it. If chicken farming is your thing then pursue it entirely.

### **3. Do your research**

After clearly defining your area of interest, get information about it. You will require technical knowledge about that crop or livestock you have narrowed down to. You need to know the best practice(s) that will yield best results. Identify the opportunities available in your chosen field. Find out how you can strategically add value to what exists to gain an advantage over your competitors.

### **4. Planning**

Getting into agribusiness without a business plan is like shooting your foot and later wondering why you cannot walk. Have a clear business plan and assess the risks of your business.

Agribusiness has money making in it. You therefore have to treat it like any other business. Dry run planning will reduce the possibility of your venture failing.

In addition, consider all the requirements necessary to start off your business. Do you have land? If you don't, how do you intend to acquire one? How much will it cost? How far is the land from your nearest selling point? What will be your means of transport and how much does it cost?

## **5. Start with the end in mind**

Market is the end in business. The primary goal of getting into agribusiness is to make profit. Before you get into any form of agribusiness, find out if there is a market for your product and seek a thorough understanding of that market. This saves you the hassle of having a product and no market for it in the long run.

## **6. Have some savings**

To set up a business you need money. To get into agribusiness will also require you to invest generously before you start reaping anything. My advice is that you stay clear of loans if you can and invest your savings instead. Agribusiness is risky for a starter. You are safer investing your savings than investing money that you do not have, a.k.a loans.

## **7. Do not invest all your life savings**

Since you are taking a risk by investing in agribusiness, you should have some money put aside in case things do not work out as planned.

## **8. Network**

Get to know people. Make friends in the agribusiness sector both online and offline; this way you will have people to share your experience with and to learn from. Join farmer groups on Facebook, Twitter and Google Plus. Contribute to agricultural discussions online.

Most importantly, cultivate healthy relationships with your suppliers and customers.

## **9. Commitment**

Agribusiness is just like any other business; it has its fair share of risks. In fact, I would rate it as a high risk business. You need a neat mix of tough skin and passion to survive. Numerous challenges will come your way and you have to be committed to the venture to get back on your feet every so often. Your entire crop might dry up due to a strange disease and there will be little that you can do. Your commitment to that business will drive you to continue despite such painful disappointments.

## **10. Have options**

Doing the same thing over and over again and expecting different results is insanity. This is one of my favourite aphorisms because it's true! If after three years you realize that you have not made any profit in your agribusiness venture, then perhaps it's time to pitch tent elsewhere. Keep an open mind and be ready to exit when the time comes.

Well that's it.

It is my hope that this ebook has been beneficial and enlightenment to you. I wish you success in your quest to become a successful farmer.

Thanks for taking your time to read this guide. Am still writing more and more Agribusiness guides that will nourish you in your profitable farming endeavours. Always keep in

touch with me on whatsapp **0714723004** to get more of my Agribusiness guides and Agribusiness advice.

Also whatsapp me and give me your feedback about this guide...

