CUVEwaters integrated water resources management

Introduction to gardening

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CROP PRODUCTION SYSTEMS

Drylands pose great constraints on crop production. Yields vary enormously from year to year, and crops frequently fail. The rainfall, soils, weed infestation and incidence vary greatly from place to place. For the farmer it is extremely difficult to plan ahead, and cropping is very risky. Although in most areas crops have to be grown under rainfed conditions, different traditional forms of water harvesting are used. The biomass is low, which lowers the applicability of practices such as mulching and composting.

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WATER

Water is the principal limiting factor. The low, unreliable rainfall means that often very little moisture is available for plant growth. The rains may start on time but then stop again, killing seedlings. Or the rains may be late, making the season too short for sustainable growth during the crucial phase of flowering. Recurrent droughts cause frequent crop failures. Farmers respond by using various ways to conserve rainfall and store it in the root zone.

SOILS

Soils show great variations in fertility, depth, texture and structure. Most are infertile and low in organic matter and available nutrients. High evapotranspiration and low rainfall raise the risk of salinization and soditization.

Inappropriate ploughing also increases water loss by evaporation.

Salinization could be reduced by improved irrigation practices and more water efficient methods such as drip irrigation.

POSSIBLE IMPROVEMENTS

Various ways to improve crop farming

- Soil and water management, water harvesting and storage: tanks, ponds and reservoirs
- Fertility management: Manuring, composting and mulching
- Intergration of trees on farms as boundary markers, woodlots, mixed with crops, agroforestry
- Production of high value crops under irrigation: vegetables and fruits

Tomato farming

Many different types and varieties of vegetables can be grown in a greenhouse. As with tomatoes the highest prices can be achieved on local markets we recommend concentrating on tomato farming inside greenhouses.

There are many techniques for growing tomatoes in a greenhouse. There is no single BEST way to grow greenhouse tomatoes, many ways are successful. An individual grower must experience tomato production, in order to determine the best and most economic techniques in his or her greenhouse (this can take a few years until the individual grower finds its best way). This manual is a general summary of greenhouse tomato practices.

Light and temperature control

Tomatoes require warm temperatures. Hence the introduction of greenhouse makes it possible to grow tomatoes throughout the year. Farmers growing tomatoes in greenhouses can take advantage of the cold season and can be able to sell their tomatoes at higher prices because the demand is high and there is less supply.

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Tomato plants grow best when the night temperature is maintained above 20 °C. The day temperatures should be maintained below 40 °C. Temperatures below 20 °C will prevent normal pollination and fruit development. The grower must assure that the green house is kept within the right temperature range. Therefore a thermometer should be placed inside the greenhouse. In warm or hot outdoor conditions, greenhouses with tomatoes must be ventilated to keep temperatures below 40 °C. Higher temperatures not only affect the leaves and fruit, but increased soil temperatures also reduce root growth. When temperatures get high, abortion of flowers takes part, which results in less fruits.

Stability control

Tomato plants must be tied or clipped with tomato clips to a string or twine suspended from a strong overhead cable. This starts as soon as they are about 25 cm high and continues throughout production. A separate support system must be build inside the greenhouse from pipe, etc. to support the crop. It should be remembered that each plant may weigh 10 to 15 kg when it is loaded with fruits, meaning that the support system must be quite strong. Actively growing tomatoes will have to be clipped to the support string or twined around the string every 6 to 10 days.

Fig.: Picture on the left shows farmers at Epyeshona tying support strings. Picture on the right shows tomatoes not supported falling down.

Water, fertilizer and growing media

Tomato production requires that plant nutrition is monitored carefully and regularly. Tomatoes require a well drained growing medium, regular watering and regular applications of fertilizer. The application of water is typically done with a drip irrigation system composed of distribution lines with drip tapes. Drip tapes are placed at the base of each plant. Tomato plants use more water, especially in warm weather. Below there is a guideline on how much and how often the watering and fertilizer application should be done.

	Planting	**Vegetative**	**Flowering**	**Fruiting**	**Harvesting**
Watering	2 liter/day	1 liter/day	1 liter/day	1 liter/day	1 liter/day
Soluble fertilizer	2 mg/liter	2 mg/liter/week	2 mg/liter/week	2 mg/liter/week	2 mg/liter/week
Fertilizer	20 mg/m² every month	20 mg/m² every month	20 mg/m² every month	20mg/m² every month	20mg/m² every month
Manure	10 kg/m²	10 kg/m²	10 kg/m²	10 kg/m²	10 kg/m²

Fig.: Application of fertilizer to tomato plants

Many types of fertilizer are in use for tomatoes. Generally, the fertilizer is moderate in nitrogen and high in phosphorus, potassium, calcium and magnesium. A grower must be sure that calcium and magnesium are included in the fertilizer program. Normal plant and fruit growth requires these nutrients to be present in the correct amounts. You have to keep in mind Namibian soil quality when selecting the fertilizer.

Many growing media can be used successfully for greenhouse tomatoes. Good field soil mixed with compost manure is preferable. However ready manure from chicken, goats, sheep and rabbits can also be used. For every square meter 10 kg of manure have to be applied once every month. If the grower correctly manages manure, fertilizer and watering well, then a good crop is assured.

Tomato variety selection

There are several tomato varieties for green houses in the market. A number of trials have to be done and record kept checking on what the best variety for the specific area is. In the case of the Epyeshona Green Village, two varieties are currently under experiment. There is ANA F1 and SAKATA. These varieties are known to get between 15 kg and 20 kg tomatoes per plant in 6 to 10 months of harvest.

Table: Expected Tomato fruit yield from the two varieties on trial. Seed were sown February 16th, 2011 for ANA F1 and March 24th, 2011 for SAKATA.

Tomato Variety	Average kg per plant expected	Average number of fruits per plant expected	No. of plants inside the greenhouse
ANA F1	15-20	20	100
SAKATA	15-20	10	100

Expected day of first harvest will be 30th May 2011 (greenhouse tomatoes are normally ready in between 75 and 90 days).

The average total weight of fruit harvested from each plant range from 15 to 20 kilograms. The ANA F1 species can grow up to 10 m long. The SAKATA can grow up to 5 m high.

The two types have also been demonstrated outside to determine the difference from greenhouse tomatoes to outside tomatoes.

Flower pollination

Tomato flowers must be pollinated in order to get the fruits set and fruit development. The side walls of the greenhouse are made of shade net. The wind is responsible for pollination. Shaking of tomatoes once a week or while removing of suckers also increases pollination.

Pruning and suckering

Tomato plants in a greenhouse are pruned to a single stem. All lateral branches or suckers must be removed when they are 5 cm to 7 cm long. This allows for maximum air circulation and simplifies pest control. Suckering must be done regularly and plants should be checked at least once a week.

Pest control

Greenhouses minimize the use of pesticides and fungicides. Minimal application is done as in comparison of tomatoes grown outside.

Start a regular disease and insect control program after the plants have been set for a week and continue this at 7 to 10 day intervals for the life of the crop. Do not wait until the plants are infested to start spraying.

Tab: Pest and Pesticides

	Pesticide/ insecticide/ fungicide	**Controls problem/disease**	**Symptoms**	**Usage rate 10-20lts knapsack sprayer**	**Spray intervals**	**Withdrawal from eating**
1	Cuprocaffaro (copper)	**Early blight/ fungal diseases**			14 days	7days
2	Garden Ripcord	**Lawn caterpillar, beetles, termites, ants**				
3	K-O Gard	**Cutworm**				
4	Bravo	**whiteflies**				
5		**Red spider mite**				
6		**Aphids**				

PRECAUTION! Do not use more than two chemicals at the same time. Always read the product label and leaflet before application.

Marketing

The market for greenhouse tomatoes is quite good in Namibia. Tomatoes can be sold directly from the greenhouse at retail prices or sold to wholesale distributors, supermarkets or restaurants at wholesale prices. Greenhouse tomato farmers have an upper hand to those growing outside. The Greenhouse farmers can grow Tomatoes in all seasons including winter. The average tomato sale from greenhouse is 15 N$/kg.

Picture: A well managed Greenhouse in Kenya

Economics

Success in greenhouse tomatoes depends completely on management. The farmers must keep good records through the crop, so they can honestly evaluate their costs and returns. A well managed greenhouse with 600 plants (8m x 20m = 160m²) can produce approximately 8,000 kg. At an approximately 15 N$/kg, the total income in a year would be approximately 120,000 N$.

Compost making

Composting means piling up crop and other farm wastes in layers to make them decompose quickly. Composting is done to produce an organic fertilizer that is balanced in plant nutrients. This organic fertilizer, known as humus, improves soil fertility, moisture retention and soil aeration.

Location

Compost can be used in all soils with low fertility. It is especially good in areas that have low rainfall, where artificial fertilizers cannot be used efficiently because of a lack of moisture. It is also useful in sandy soils which have poor water-holding capacity. Compost improves the structure and drainage of all soils

Advantages

- Large amounts of vegetation, such as crop remains, garden weeds, kitchen and household wastes, hedge cuttings, garbage, etc, are put to use.
- When properly made, compost becomes immediately available as plant food without the need to be first broken down by soil microorganisms.
- Compost does not cause excessive weed growth, as is the case with ordinary farm manure.
- Good crops can be obtained without the need for extra chemical inputs.
- All farmers, regardless of their financial abilities, can make abilities, can make and use compost

Disadvantages

- Compost requires a lot of labor to prepare and spread it over the farm.
- The nutrient composition of the compost varies a great deal. It depends on the materials used and the preparation methods.
- Not enough vegetation to make compost may be available in drier areas

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Requirements

- Various types of vegetative materials
- Topsoil
- Animal manure
- Wood ash
- Water
- A long sharp pointed stick
- Wheelbarrow, watering can, hoe, machete

Pile method

The pile method is best in ……..

1. Select a location close to where you want to use the compost. The place should be sheltered from the wind, rain, sun and runoff. A compost pile must not get either very dry or very wet.
2. Measure a rectangle 120 cm wide by 150 cm or more long (the length depends on how much composting material you have. Do not make the rectangle wider than 120 cm, as you must work on the compost without stepping on it. In rainy places, it is best to make pile above the ground. In drier areas, use the pit method.
3. Dig a shallow pit about 30 cm deep. Put the soil aside (you will need it later).
4. Begin building a compost pile by putting a bottom layer of rough materials such as mahangu stocks, maize stocks and hedge cuttings in the pit. This layer should be about 30 cm thick. Chop up any materials which are too long to improve the air circulation in the pile. Sprinkle some water in this layer.

5. Add a second layer of dry vegetation, hedge cutting or grass. This layer should be about 15cm thick. Sprinkle water on this layer too. You should sprinkle water on each layer as you add it. The pile should be moist throughout.

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6. Put a third layer of animal manure. The manure contains microorganisms which are vital for decomposition.

7. Sprinkle some ash or dust on this layer. The ashes contain valuable mineral including potassium, phosphorus, calcium and magnesium. The ashes also neutralize the acids produced during decomposition, especially by the animal manure.
8. The next layer should be of green materials about 15-20cm thick. Use green leaves from high protein leguminous trees like calliandre, leuceana, sesbania. You can also use hedge cuttings of plants like Tithonia.


9. Sprinkle on a little topsoil or old compost. The top soil contains bacteria which are useful in the decomposition process.
10. Add more layers in turn, starting with dry vegetative materials, then animal manure, followed by wood ash, green vegetation and topsoil. Remember to sprinkle water on every layer. Build the pile to 1.5m high. A well made pile has almost vertical sides and a flat top.

Watering of compost at every stage

11. To complete the pile, cover it all over with a layer of topsoil about 10cm thick. This layer prevents plant nutrients from escaping from the compost pile. Lastly, cover the whole with dry vegetation such as banana leaves to reduce moisture loss through evaporation.

12. Take a sharp, pointed stick and drive it at an angle so that it passes through the pile from bottom. This stick will act as your “thermometer”. After three days, decomposition will have started in the pile, and the stick will be warm when you pull it out.
13. Pull the “thermometer ‘’ out from time to time to check the progress of the pile. You can also tell from the thermometer how dry or wet the pile is: it should be moist and not wet.
14. Sprinkle water occasionally (About every 3 days, depending on the weather). If it has been raining, you may not need to water the pile.

15. After 2-3 weeks, turn the pile over. Do not add any fresh materials except water. You must turn the pile if the thermometer is cold when you pull it out, or if it has a white substance on it, as this shows decomposition has stopped. Turning the pile is important because it mixes the different layers, making the decomposition faster and more complete.
16. The compost should be ready after 4 -6 weeks. Check the temperature of the pile to make sure. If the stick feels warm when you pull it out, the pile is still decomposing and the compost is not ready. Finished compost should have a fresh, earthly smell and contain no grass, leaves, or animal manure.
17. You can store compost by covering it with a layer of banana leaves or polythene.

Do's and Don'ts

Do's	**Don'ts**
o Choose a sheltered site for the compost pile o Chop up long stems and big leaves o Sprinkle some water on every layer, and ensure the compost is moist all the time o Turn the pile every 3 weeks o Protect the finished compost from, sun, wind and rain	o Don't use materials that might contaminate the soil. o Don't step on the soil o Don't use waxy leaves(such as eucalyptus leaves) o Don't over –water the compost pile. o Don't compact the layers o Don't use materials that do not decompose.

Pit method

The pit method of making compost conserves moisture, so it is useful in areas with low rainfall and a long dry season. Do not use it in wet areas, as the compost may become waterlogged.

1. Dig a pit 1.2m wide and o.6m deep, and as long as you need for the amount of materials you have.
2. Build a pile in the pit to allow air to get into the layers beneath.
3. Add water if necessary.
4. Push long poles into the pile to allow air to get into the layers beneath.
5. Turn the pile every 2 weeks.

You can produce a regular supply of compost by digging three pits side by side. Every 2 weeks, turn the compost from one pit into the next one, and start a new compost pile with fresh vegetation in the empty pit.

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Using the compost

Well-decomposed compost should be applied at the rate of 20 tons per hectare (8tonnes / acre: about two large hopefuls per square meter, or enough to barely cover with a layer 1 cm thick). In double–dug beds for vegetables, apply 3 wheelbarrows of compost on 10 m² of beds.

Composting

Choose the proper combination of raw materials when making compost manure for better nutrient supply

Table: Organic material in % of selected materials that can be used to produce compost

Item	Organic Material	N	P	K
1	Cow manure	0.5	0.2	0.35
2	Goat manure	1.4	0.2	0.65
3	Poultry manure	1.3	1	1.6
4	Boma (mixed) / Kraal	0.7	0.1	0.7
5	Compost (house/hold)	0.5	0.2	0.8

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