



Farming God's Way

Vegetable Guide

By Grant Dryden

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Cover Picture

Orscilla Haggard's vegetable garden, planted and managed by Ation Mari

Farming God's Way

Farming God's Way is a resource given to the wider body of Christ, to serve the poor and deliver them from the yoke of poverty.

Motto

Motivated by obedience,
rooted in compassion
and delivered with love.

Farming God's Way Logo

The new logo produced in 2009 was designed to fully capture the heart of Farming God's Way. The poor across the globe are central in this theme and the orange glow depicts the promise of Isaiah 58 "Your light will break forth like the dawn", starting with Africa as our core focal point and extending to the remotest parts of the earth. The cross and bowl, symbolise Christ like humility and servanthood, where He was prepared to give up His crown and glory to serve the poor wholeheartedly. The horizontal portion of the cross is golden to represent God's Blanket protecting and covering the brown soil, which is such an important inheritance to pass on through generations. The vertical portion of the cross is blue to depict the provision of God's blessing in rainfall passing through the lush green growth and God's golden blanket, penetrating deeply, filling up the soil profile.



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This Farming God's Way Vegetable Guide should be used in conjunction with the Farming God's Way Trainers Reference Guide to include the Biblical and Management keys, which are so vital to ensuring we are able to truly remove and break the yoke, which is such a heavy burden on the lives of the poor.

Introduction

This Farming God's Way Vegetable Guide is a resource, advocating techniques that are proven and simple, to allow for successful implementation amongst the poor.

Farming God's Way is far more than a technological solution and what is important is that we keep with the principles of "doing what we see our Father doing". These include minimal soil disturbance; 100% cover with God's Blanket; ensure biodiversity, and continue implementing the Farming God's Way Biblical and Management keys. The Word of God is paramount to breakthrough in people's lives and I exhort you to work through the Biblical Keys thoroughly whilst teaching this material.

"Do not labour for the food that perishes, but for the food that endures to eternal life, which the Son of Man will give to you. For on him God the Father has set his seal." John 6:27
Jesus said to them, "I am the bread of life; whoever comes to me shall not hunger, and whoever believes in me shall never thirst." John 6:35

Great variations of vegetable production techniques exist from double digging, circle gardens, bag gardens, lasagne gardening, raised composting beds, deep ploughing, rotavating, incorporating inputs, etc. Some work well, others are not viable on large tracts of land, whilst others are just not ever going to catch on due to the effort required.

So can we do Farming God's Way with vegetables?

The vegetable garden that Ation Mari manages, displayed on the front cover, answers this question.

Vegetables are not as forgiving as field crops because they have:

- a. short growing seasons,
- b. weak, shallow root systems and
- c. very high nutrient demands!!!

To meet these demands we need to have a stable and fertile starting point, with well structured, crumbly soil, which is mostly not the case at establishment year. Farmers or vegetable gardeners are not very patient and want to start planting as soon as possible. Most farmers also want to start with the more difficult vegetables which can result in a negative experience. Be wary and selective of what you try early on with vegetables.

1. Guidelines for Successful "Farming God's Way Vegetable Production"

1.1. Garden Layout for Flat Planting on 75cm Baselines

Clear the garden of shrubs, weeds and creeping grasses, by uprooting and removing them out of the garden area. Preferably, if you have enough time, you can smother mulch the creeping grasses with at least 10cm of mulch for 2 months before land preparation begins, to kill off all creeping grasses. Measure off the size land you will be starting off with and fence it in, keeping in mind that it is better to start small and increase your area as you gain more experience. Ensure that the site is shade free and has easy access to water.

There are many ways to grow vegetables and many arrangements to do so, but we have chosen for simplicity to stick to the 75cm row lines to avoid conflict with the field crop row spacings and to ensure that rotations with vegetables are still using the same permanent row lines. This 75cm row spacing suits both the narrower and the wide row systems alike.

When planting some of the narrow row vegetables such as carrots, onions and beetroot, use an 18.75cm row spacing. Prepare 3 rows and leave the 4th row empty, leaving a 37.5cm walkway before returning to the next 75cm baseline. Simply split the 75 in half to 37.5cm and then divide that top portion once again to get the 18.75cm spacing. When using the surface application of compost system (see under Soil Preparation section 1.4 and 1.5 below) there is only a 2cm deep furrow, making even 18.75cm row spacing's an easy task.

Green beans, spinach, rape, lettuce and amaranth at split rows of 37.5cm allow for good canopy cover and space utilisation. Whilst for eggplant, determinate tomatoes, peppers and peas, 75cm is ideal. Indeterminate tomatoes do very well at 1,5m so skip alternate rows.

Carefully measure out the 75cm rows to run across the slope on the contour lines. However, if there is a risk of waterlogging in low lying areas or in heavy rainfall regions, they should run slightly downslope (see section 1.2). In most instances, flat planting as per standard Farming God's Way practises, is perfectly fine. In fact with the correct layout, permanent walkways and heavy composting, a natural raised row system will develop over the years.

Ensure permanence by placing "permanent pegs" at every 75cm row line on either side in your vegetable gardens. Cut 30cm long hardy sticks or metal reinforcing rods, and hammer them into the ground on the 75cm row lines, leaving only 5-10cm sticking out of the ground. Some Farming God's Way vegetable growers even have 37.5cm permanent marker pegs. See page 78 of the Trainers Reference Guide for more information of the benefits of permanence.

One of our three management keys is to do everything at "High Standards" and by keeping this design layout with permanent pegs we will reap great rewards from these standards.

"Whatsoever you do, do your work heartily, as for the Lord rather than for men." Colossians 3:23

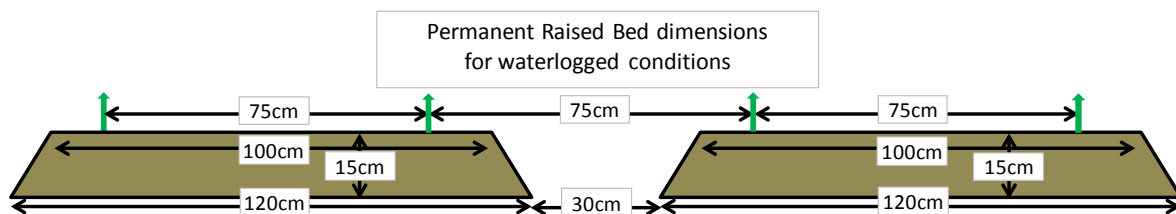
1.2. Raised Beds for Waterlogged Conditions

If you have waterlogging risks or problems, then you need to raise the beds, as vegetables are extremely intolerant to having “wet feet”. Recommended dimensions for the permanent beds are 15cm high, 100cm wide on top, 120cm bases, with about 30cm permanent walkways. Note that there are two 75cm rows on top of the bed and it is not a single row ridge. These rows can be split to include 3 rows at 37.5cm or split again to 5 rows at 18.75cm.

In areas where flooding is a risk, design the orientation of the rows slightly downhill, not on the contour, to enable the water to exit down slope and drain away from the vegetable garden.

Layout the area with a tape measure and permanent pegs on the 75cm lines then work the topsoil from the 30cm pathways to build up 100cm wide beds. This topsoil build up, along with the first season’s heavy surface composting (see “surface composting” in section 1.4.1), will comfortably provide a 15cm raised bed, high enough to keep sensitive roots out of waterlogged conditions.

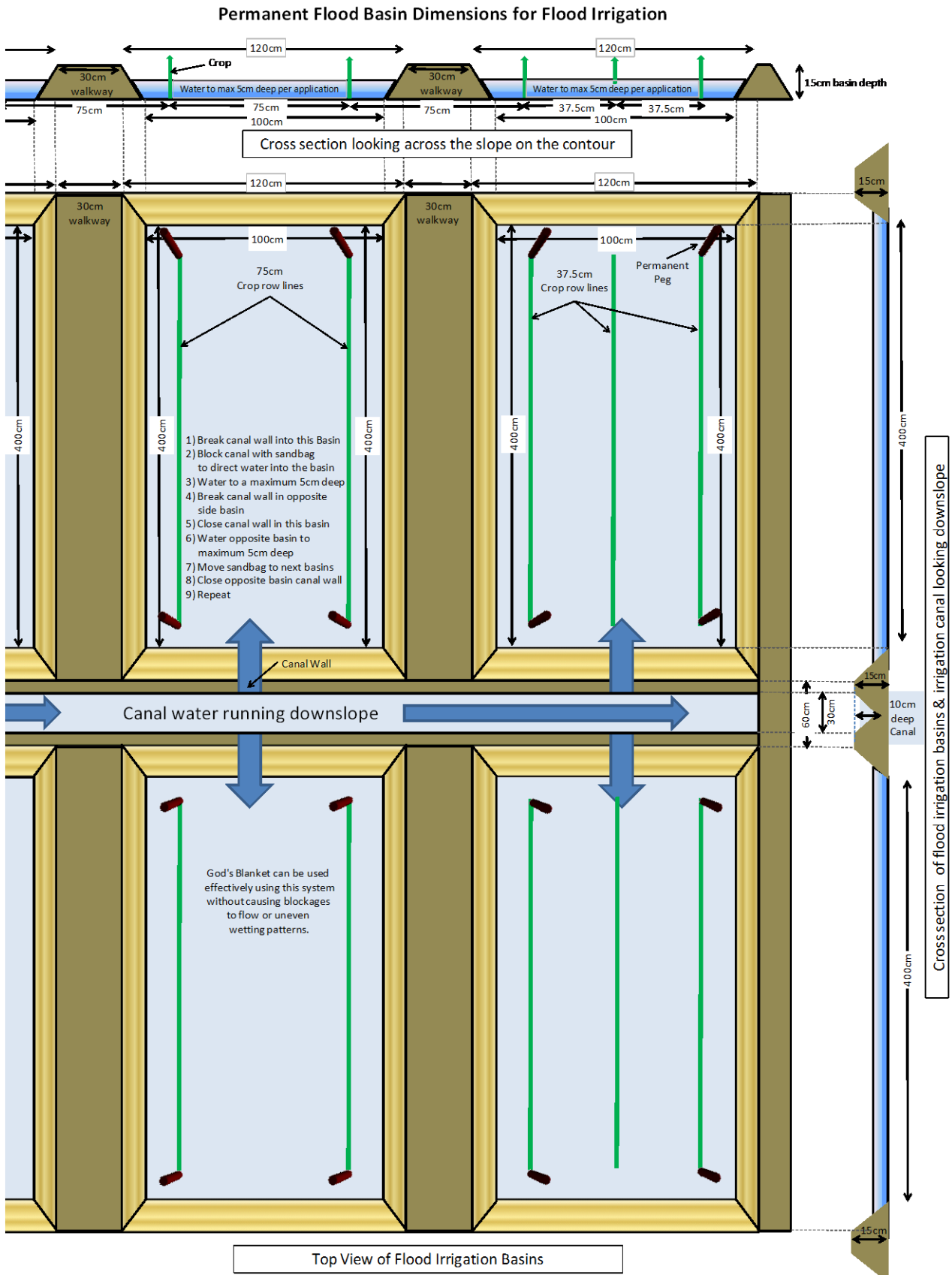
Although this is highly contrary to the principles of no ploughing, if you design this properly the first time at establishment, then these beds should be kept as permanent beds forever. God’s Blanket is used on top of the raised bed in the same way as when doing flat planting.



Permanent Raised Bed Dimensions

1.3. Design for Flood Irrigation

Many small scale farmers are getting access to treddle pumps and even canalised water, which when used correctly with canals and sunken basins, can allow for very successful vegetable farming to be done.



This basin flood irrigation system is very useful in the dry seasons where no risk of waterlogging occurs.

1.4. Small Scale Home Nutrition Gardens

1.4.1. Soil Preparation in Establishment Year

Soil Fracturing

In the first season, remove any surface stones and loosen compact/hard soils to fork depth of about 15cm deep, across the row lines you will be planting. Place the fork 15cm deep and gently pull backwards until you see the soil loosen or fracture. Remove any stones or rocks that you feel with the fork, but don't be tempted to lift or turn the soil, you should be merely fracturing it. Keep on repeating this every 5-10cm depending on how hard the soil is, down the row line. You should only be loosening the soil in a fork width or 20cm band on top of the row lines you are going to plant. This is to allow for first season/establishment year "effective rooting", but does not need to be done hereafter if compost inputs and God's Blanket are maintained. Finally, level off the bed with a rake.

Correcting Acidic Soils

Acidic soils bind up plant available nutrients, such as phosphates, and cause all kinds of limitations to vegetable growth. To correct acidic soils and allow for readily available plant nutrients we need to apply woodash, bonemeal or lime.

It is difficult to speculate on the rates of application without appropriate soil ph testing, but once an initial application has been done and provided the composting practise is continued annually, no further applications should be necessary, due to the composts' high buffering effect.

A rule of thumb would be to evenly sprinkle 20 litres of woodash/bonemeal (approximately 500ml per m²) on a 6*6m nutrition garden, over the entire previously fractured soil surface area. If using dolomitic lime you would use approximately 10 litres per 6*6 nutrition garden (250ml per m²). If the soil has a very high clay content, then you could up the rate by 1.5 times.

The great advantage of using either woodash or bonemeal is that they supply many other micronutrients which assist the plant's health, fruit colouration and vitality.

Surface Composting

Generally speaking, vegetables do better with compost than any other organic input type. Manure can burn sensitive vegetables (if it is not mature enough and touches seed or stems) and anthill soil is too low in nutrients (although some of the leafy vegetables would do fine). When we refer to compost, it is to high quality, nutrient rich, mature, aerobic compost, made from appropriate ingredients. (See section 6 Compost, on how to make good quality compost, noting the decreased woody (10%) vs dry (35%) ratios specific to vegetable production where we are wanting more bacteria dominated vs fungal dominated compost). Compost is best sieved through a fine 2cm wire mesh when growing vegetables, to ensure a fine seedbed without too many woody chunks.

Place 10cm of compost on top of the vegetable bed surface at establishment phase. It is unnecessary to work the compost in to the previously fractured soil below. This should ideally be done at least **one month before planting** to allow for biological and structural stability before planting – remember the significance of being "On Time".

This is a great concept and in-line with Farming God's Way principles of minimal soil disturbance. Although your first year crop performance will not be at full potential, surface composting will give your soil a great head start towards God's healing of the land.

1.4.2. Soil Preparation in Second and Subsequent Years

The heavy applications of organic matter will effectively act as a buffer to control soil pH in a range that is stable and healthy for vegetable growth, therefore no further applications of lime should be necessary, unless your area has a serious problem with acidity.

Ensure you remove God's Blanket before putting on the next layer of compost and replace it again after planting (see section 1.6). Burying the blanket which has not yet decomposed, could cause the soil to go through a negative nitrogen period and have disastrous effects on the following crop. The blanket is not a problem at all, but burying it under the compost layer is. So simply remove the blanket or move it to the downslope side, reapply the compost, rotate fruit, leaf and root crops, replant and replace the blanket again.

The only composting required after establishment year is the **surface layering of 5cm** over the whole area. **It is essential to repeat this diligently each season to guarantee high plant available nutrients for future crops.** However, this does not apply when planting carrots or onions next season in that area, as the residual nutrients will be sufficient to get them through.

1.4.3. Planting

After one month the 10cm layer of compost applied at establishment, will have bedded down nicely to about 7cm, creating a firm seedbed for good germination and will not need any further compaction before planting.

If you have not prepared "on time", then place a flat 20cm wide wooden plank on the composted bed and walk on it, repeating this process all over the garden, hereby pressing the compost down to firm it up before preparing the correct planting depths.

Direct planting – Lay the same straight edge wooden plank on its side next to the row line, and press down firmly, to establish an accurate and even planting depth e.g. 2cm for spinach. Alternatively dig the shallow furrow or planting station holes into the surface compost to the required depth. Place the seeds directly onto the compost layer and cover with compost, even "pressing it down lightly afterwards" with the flat side of the wooden plank to ensure good germination.

Seedlings – See also section 5 "Seedling nurseries"

Before transplanting seedlings, ensure you "harden off the seedlings" in your covered seedling beds for a week, by reducing watering frequency and amounts, as well as exposing them to more direct sunlight.



Dibble Stick - T shaped

An essential tool for transplanting is the dibble stick, which is a rounded stick used to make a small hole in the ground into which you will plant your seedlings. The dibble stick should be pointed on the end and slightly wider than that of your seedlings, but can be made with many shaped handles such as straight, T shaped or bent. With larger scale plantings a waist high dibble stick with a depth gauge would be advantageous, but in most cases vegetable gardeners simply use a 20-25cm straight, wooden dibble stick made out of a broom handle with some grooves in the handle side to prevent it from slipping.

Simply push the dibble stick into the surface compost at the teren rope marker, to the required depth, then remove it and place the seedling in the hole. While still holding the seedling in place, press the dibble stick into the compost again close to the seedling and push the compost/soil gently towards the seedling roots. This allows the seedling to be well set and ensures that there are no airspaces around the root zone. The small dibble stick hole left in the compost near the seedling can be covered by foot or hand or left to fill naturally.

1.5. Field Scale Soil Preparation

On field scale, unless you have mega tons of compost on hand, it is best to use your compost only in the planting stations or the furrows as per standard Farming God's Way technical procedure. Choosing between planting stations or furrows is determined by the crop you will be planting – see the recommendations for each crop type in section 3.

1.5.1. Soil Preparation in Establishment Year

Soil Fracturing

In the first season, loosen compact/hard soils to fork depth of about 15cm deep across the row lines you will be planting. Place the fork 15cm deep and gently pull backwards until you see the soil loosen or fracture. Do not be tempted to lift or turn the soil, you should be merely fracturing it. Keep on repeating this every 5-10cm down the row line depending on how hard the soil is. This is to allow for first season/establishment year “effective rooting” but does not need to be done hereafter if compost inputs and God's Blanket are maintained. You should only be loosening the soil in a fork width or 20cm band on top of the row lines you are going to plant.

Inputs

For crops best grown with planting stations e.g. tomato, peppers and eggplant, dig holes to 10cm deep, place a tablespoon of woodash/bonemeal per hole or a teaspoon of lime per hole, then place 500ml compost and backfill soil to level surface in readiness for using the dibble stick and transplanting seedlings.

For furrow crops like spinach, rape, amaranth etc., dig furrows on the row lines to 8cm deep, then add a tablespoon of woodash/bonemeal or else a teaspoon of lime per 60cm. Add 3 to 4 litres of compost per meter. This is way higher than normal field crop recommendations of 350-500ml per meter, because vegetable's have such a short growing season and heavy requirements for nutrients.

Your soil row lines will soon be transformed into high quality, well textured, highly fertile fields, which will feed your family for generations to come. Cover the furrow with soil from the downslope heap, leaving only the required depth for planting.

1.5.2. Soil Preparation in Second and Subsequent Years

Continue as per the recommendations of establishment years in furrows or planting stations.

Simply move the blanket to the downside of the furrow/planting station, re-apply woodash or lime, then your compost, cover to required depth of planting and after germination once again shift the blanket back into place (see section 1.6). If using fertiliser or manure, you will need to apply woodash/lime annually, but if using compost, apply for 2 years and then shift to alternate years, observing crop responses.

1.5.3. Planting

Place the seed in the furrows or planting stations according to the recommendations and cover with fine loose soil from the remaining downslope heap. When planting seedlings use the same methods as per small scale home nutrition garden description, using the dibble stick.

1.6. God's Blanket

God's Blanket should be continually on our fields whether growing vegetables or field crops, irrespective of whether you are doing 1m² or 100,000m². You can use any organic material at your disposal including thatch grass, banana leaves, palm fronds, bulrushes, forest leaves etc., however the finer materials are easier to handle on vegetable gardens. This will encourage the biology of the soil, prevent UV light sterilisation, reduce runoff and erosion, reduce evaporation and improve soil moisture holding capacity amongst many other reasons (see pg 92-101 - Trainers Reference Guide).

In the 1960's a lady by the name of "Mrs Mulch", Ruth Stout, clearly documented her very simple system of heavy mulching (60cm of straw) in the autumn and planting directly into the decomposing material near the soil level in the spring, with almost a 20cm wall of mulch on either side of the rows. She did no applications of anything else, no compost or fertiliser or manure, no green manure cover cropping, simply heavy mulching. She appropriately honoured God by saying in her book, "Gardening without Work" – "I never invented mulch, God did!!!"

Although this heavy mulching is a proven system, it takes some years to be fully productive. We only advocate the use of mulch layers from 2.5 to 5cm thick.

With vegetable seeds, ensure that the blanket is not covering the furrows at planting and until germination has taken place, as some seeds are not strong enough to make it through the blanket. A narrow space of 5cm is sufficient on top of the furrow or planting station to allow for good germination. Thereafter the blanket can be brought up against the plant bases.

In cooler climates or seasons, germination is better with higher soil temperatures. Under these circumstances, leave the blanket off and reapply after germination has taken place.



Coriander

2. Home Nutrition Gardens

In modelling it is really important to advocate crops that work in real world conditions. Crop selection should be limited to those that are easily managed, supply good dietary nutrients and are resilient against pests and disease.

2.1. Rotations

Divide your garden into 3 equal portions for **Fruit, Leaf and Root** vegetables. These three crop types can be easily rotated each year to allow for all the benefits of rotation discussed in the Trainer Reference Guide, including breaking of disease and pest cycles, fixing of nitrogen as well as other soil improvements.

Also **avoid follow on crop rotations from the same families** as they are usually susceptible to the same pests and diseases. An example of potential problems with inter-family rotation could be if you followed up Cruciferae plants such as cabbages (leaf) with broccoli (fruit) in the following year.

A very simple recommended selection based on the above criteria and availability of seed would be:

Fruit – beans, tomato, eggplant, squash

Leaf – spinach, rape, amaranth

Root – sweet potato, carrots, beetroot, onion

2.2. Simple Home Nutrition Garden Model



Simple home nutrition garden example

The 3 crops above can be planted nearly all year round in most African climates, are excellent nutritionally, well liked culturally and easy to manage successfully.

2.3. Planting Schedule for a Home Nutrition Garden

A simple planting schedule is to plant in alternate week cycles, hereby ensuring that the vegetables are not all ready at the same time. This ensures a steady stream of income as well as home grown wholesome nutrition.

An example of an alternate week cycle planting schedule could look like this:

First Planting

<i>Portion A: Fruit - September</i>	Week 1 – Plant 1 st bed, 2 rows beans;
	Week 3 – Plant 2 nd bed, 2 rows beans;
	Week 5 – Plant 3 rd bed, 2 rows beans
<i>Portion B: Leaf - September</i>	Week 1 – Plant 1 st bed, 2 rows spinach;
	Week 3 – Plant 2 nd bed, 2 rows spinach;
	Week 5 – Plant 3 rd bed, 2 rows spinach
<i>Portion C: Root - October</i>	Week 1 – Plant 1 st bed, 3 rows beetroot;
	Week 3 – Plant 2 nd bed, 3 rows beetroot;
	Week 5 – Plant 3 rd bed, 3 rows beetroot

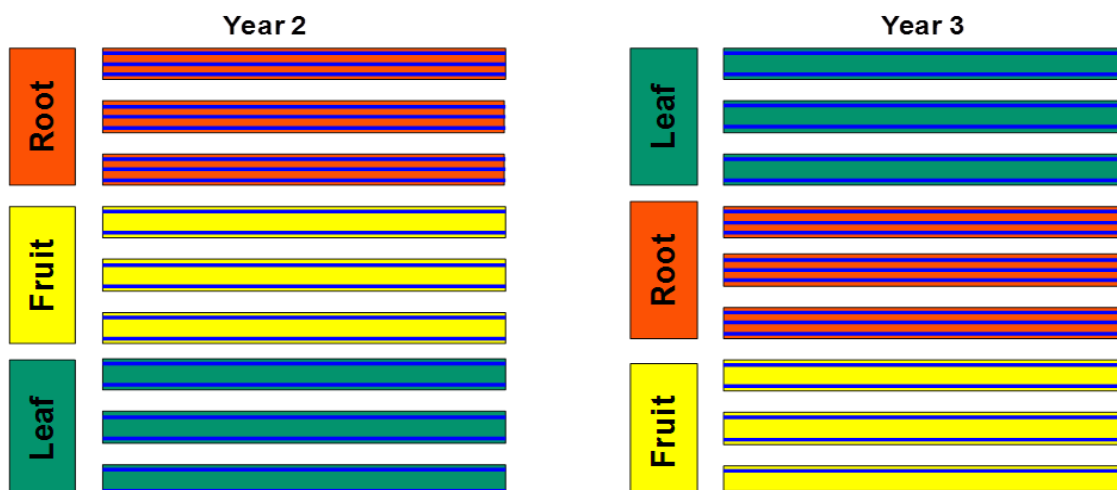
Second Planting

<i>Portion A: Fruit - January</i>	Week 1 – Plant 1 st bed, 2 rows beans;
	Week 3 – Plant 2 nd bed, 2 rows beans;
	Week 5 – Plant 3 rd bed, 2 rows beans
<i>Portion B: Leaf - January</i>	Week 1 – Plant 1 st bed, 2 rows spinach;
	Week 3 – Plant 2 nd bed, 2 rows spinach;
	Week 5 – Plant 3 rd bed, 2 rows spinach
<i>Portion C: Root - February</i>	Week 1 – Plant 1 st bed, 3 rows beetroot;
	Week 3 – Plant 2 nd bed, 3 rows beetroot;
	Week 5 – Plant 3 rd bed, 3 rows beetroot

Subsequent Year Rotations

In the spring of the following year the process would begin again, with the fruit crops going to portion B; the leaf crop to portion C and the root crop to portion A. In the 3rd year the root crop would move to portion B; the fruit crop to portion C and the leaf crop to portion A, and so on.

Simple Home Nutrition Garden Rotation



2.4. More Advanced “vegetable basket” Plantings

If a vegetable grower plants a successful garden, then they will be encouraged to repeat it and once the easy vegetables have been mastered, then other vegetables can be swapped out of this original design.

Spacings for Nine recommended Vegetables for nutrition gardens



Examples of various recommended vegetable spacings

See section 3 below for some more detail on these and other crops.

It is not intended that all of these vegetables be grown at once as per this diagram but the basket could certainly include more than just 3 crops as in the simple home nutrition garden.

3. Vegetable Guidelines

This guideline assumes you have been diligent to make high quality compost, essential for good soil and plant health. Given that assumption and the generous volumes used in this guideline for surface composting, there is no reason why your vegetables would need any other form of input.

Initially, if you don't have compost, you can use well matured manure for **most of the leaf and some fruit and root vegetables**, but you cannot use it in the same way as it will cause seed and stalk burning. It must be placed in the furrow/planting station at rates of 500ml/m or planting station then covered with 3cm of soil before planting and covering with soil.

This guide cannot provide details on each vegetable disease and pest control mechanism. There is a lot of existing information available on pest control. A particularly interesting one is "Producing food without pesticides. L J Fuglie, 1998".

3.1. Fruit Vegetables

1) Green Beans

Besides being high in protein, which is especially important in poor communities where there is a dominant carbohydrate portion in the diet, green beans also provide vitamins A, B, C and K, antioxidants and trace elements for healthy living. Green beans prefer a spring to late summer planting.

Home Garden Scale: Prepare 3cm deep furrows with 37.5cm rows. Plant seeds 10cm apart and cover with loose fine soil level or even with a raised furrow surface for good germination.

Field Scale: Prepare 8cm deep furrows with rows 37.5cm apart. Apply 1 tablespoon of woodash and 3-4 litres compost per meter of each furrow, leaving a 3cm planting depth. Apply inoculum to the seed wherever possible to guarantee good nitrogen fixation.

Plant seeds at 10cm spacing within rows and cover with fine loose soil, ensuring an even or preferably slightly raised furrow surface, for good germination.



2) Tomato

Tomatoes are the most popular of all the vegetables and are full of healthy ingredients including vitamins A, C and E as well as anti-oxidants.

Tomatoes prefer a spring to early summer planting time. Prepare planting stations in 75cm rows at 60cm spacing in-row. Indeterminate varieties climb a lot more and set fruit over a much longer timeframe, so plant these in 150cm rows and 60cm in row. Some large scale growers may decide to grow even determinate varieties at this spacing, for better light penetration & ease of movement, however on home nutrition garden scale the space is very limited and should be maximised.

Home Garden and Field Scale: Apply 1 tablespoon of woodash and 500ml of compost in each station and fill remainder with soil. Transplant seedlings when about 10-12cm tall. Use a dibbler stick to create the correct depth hole and place the seedling directly into it, whilst gently firming the soil around the seedling to ensure there are no airspaces in the root zone. Tomato fruit is very heavy and the plants are prone to lodging, therefore it is advised to build a trellis network on the row lines for the plants to gain support. Tomatoes are prone to many diseases and it is essential to rotate tomato fields with preferably a 2 year gap between growing seasons.

3) Eggplant

Although Eggplants are relatively low in vitamins and minerals, they have a high anti-oxidant concentration.

Eggplant prefers a spring or early summer planting time. Prepare planting stations in 75cm rows using 60cm spacing between each station in-row.

Home Garden and Field Scale:

Apply 1 tablespoon of woodash and 500ml of compost in each station and fill remainder with soil. Once seedlings are at about 10-12cm tall they are ready for transplanting. Use a dibbler



stick to create the correct depth hole and place the seedling directly into it, whilst gently firming the soil around the seedling to ensure there are no airspaces in the root zone.

4) Squashes – Pumpkin, Butternut and Gemsquash

Squashes are excellent sources of Vitamins A, C and E as well as a diverse group of anti-oxidants. Plant squashes in spring to early summer.



Home Garden and Field Scale:

Prepare planting stations every 3rd row at 2.25m apart and at 1.8m spacing in-row. Dig a large hole 30cm wide and 20cm deep. Refill the hole with soil mixed with 2 spadeful's of compost or well matured manure. Plant 5 seeds, approximately 10cm apart, at 3cm deep per planting station, separating them evenly. After germination thin down to 3 per station.

3.2. Leaf Vegetables

1) Spinach

Spinach has the highest level of anti-oxidants of all vegetables, with high levels of vitamins A, B, C and K, and is rich in iron amongst other essential minerals. This leafy vegetable is not only an essential part of healthy nutrition, but is surprisingly easy to grow and manage.

Plant spinach from spring until autumn, although it doesn't do well in temperatures over 27 °C. Prepare beds either in furrows or preferably with surface applications of 5cms of compost.



Home Garden Scale: Prepare furrows 2cm deep with 37.5cm rows. Use either a straight edge of a wooden plank or else a rake or hoe. Plant seeds 20cm apart directly into the surface compost. Cover with compost and press down lightly with the broad side of the wooden plank.

Field Scale: Dig furrows 8cm deep on 37.5cm row lines and fill with 3-4 litres of compost per meter, leaving 2cm remaining. Seeds should be planted 2cm deep every 20cm and the furrow lines covered with soil from the down slope heap.

When harvesting, break off the two largest spinach leaves, allowing the other leaves to fill out. The plants will continue to produce leaves for long periods of time.

2) Rape/Kale/Collard Greens

This leafy vegetable is popular in Africa and variants thereof occur from more traditional Kale to Sukuma wiki in Kenya. They are all from the Brassica oleracea family and although similar to



cabbage, they are much easier to grow. They are similar to spinach in that they also produce leaves which can be harvested for long periods of time, in Rape's instance the plant just continues to grow taller and taller. The leaves are very high in Vitamin C as well as Vitamin K and anti-oxidants.

Plant Rape in spring and again in autumn, as they do not handle extremely high temperatures as seedlings. Prepare beds either in furrows or preferably with surface applications of 5cms of compost.

Home Garden Scale: Prepare furrows 2cm deep with 37.5cm rows. Use either a straight edge of a wooden plank or else a rake or hoe. Plant seeds 30cm apart directly into the surface compost. Cover with compost and press down lightly with the broad side of the wooden plank.

Field Scale: Dig furrows 8cm deep on 37.5cm row lines & fill with 3-4 litres of compost per meter. Seeds should be planted 2cm deep every 30cm and the furrow lines covered with soil from the downslope heap.

3) Amaranth

Amaranth can be grown for both its leaf and grain value. The leaves are very nutritious and high in Vitamins A, B and C, with higher levels of Calcium and Iron than spinach leaves. Amaranth is a very hardy plant and tolerant of poor soil fertility, high temperatures and dry conditions, making it far more suitable for summer leafy greens than spinach or rape.



Plant Amaranth in spring through summer. Prepare beds either in furrows or preferably with surface applications of 5cms of compost. Plant seed 1cm deep, with 15cm between plants and with 37.5cm row intervals, to get frequent leaf cuttings. If plants get too rank cut them down to 15cm tall to get small fresh leaf production again.

Home Garden Scale: Prepare furrows 1cm deep with 37.5cm rows. Use either a straight edge of a wooden plank or else a rake or hoe. Plant seeds 15cm apart directly into the surface compost. Cover with compost and press down lightly with the broad side of the wooden plank.

Field Scale: Dig furrows 8cm deep on 37.5cm row lines & fill with 3-4 litres of compost per meter. Fill the furrow leaving 1cm remaining, then plant the seeds on top of the furrow line 15cm apart and cover with 1cm of soil from the downslope heap.

3.3. Root Vegetables

1) Carrots

Carrots are a very healthy addition to any nutrition garden as they contain very high levels of beta carotene (source of Vitamin A), Vitamins C, K and B6, anti-oxidants and minerals. Carrots are easy to grow and can be sown nearly all year round, ideally in growing temperatures between 15-24°C.



Plant carrots in spring through to autumn. Prepare beds, preferably following after previous crops that had healthy applications of compost. Avoid using fresh compost or manure as this encourages undesirable root branching, hence it is best to follow after other crops in your cycle. The fine seeds should be planted 1cm deep, 2cm apart and in 18.75cm rows. Plant 3 rows like this and leave the 4th row empty to allow for access for this and the next beds 3 rows.

Home Garden Scale: Split the 75cm row once to 37.5cm & again to get the 18.75cm distance between rows. Prepare furrows 1cm deep using a straight edge of a wooden plank. Carrots germinate very poorly when planted too deep. Plant seeds 2cm apart directly into the surface compost. Cover with compost and press down lightly with the broad side of the wooden plank.

Field Scale: Dig over existing furrows 1cm deep on 18.75cm row lines and plant the seeds on top of the furrow line 2cm apart. Cover with 1cm of compost or soil from the down slope heap.

After germination thin down to 5cms between plant seedlings.

2) Beetroot

Beetroot is regarded as a source of excellent nutrition by dieticians, with high percentages of anti-oxidants and minerals. The leaves can also be eaten like spinach, bringing a versatility to the crop which is quite unique in cases where other leafy greens are temporarily unavailable in the garden. Beetroot has a similar growing period to carrots, ideally in temperatures between 15-24°C, but can tolerate hotter temperatures up to 35°C. Plant beetroot from spring through autumn.



Plant seeds 2cm deep, 10cm apart and in 18.75cm rows. Plant 3 rows like this and leave the 4th row empty to allow for access for this and the next beds 3 rows.

Home and Field Scale: Preparations are the same as for carrots except for the planting depth of 2cm deep.

3) Onion/Spring Onion

Onions are popular additions to most African dishes. They are high in Vitamin C and Folate and they also have a high peptide content which helps fight against osteoporosis.

Onions or spring onions are ideally grown in temperatures between 12-25°C and are more suited to cold snaps rather than extreme heat. Onions take a long time to reach maturity, from 4-7 months, therefore in a “small scale home nutrition garden” there are better crops to use in that space, including spring onions. Plant onions from the end of summer through autumn and remember they need a lot of water in their vegetative stage of growth, so in “summer rainfall regions with dry winters”, make sure you have a suitable irrigation option.

Direct seeding onions

When direct seeding onions, plant seed 2cm deep, 5cm apart, and in 18.75cm rows. Plant 3 rows like this leaving the 4th row empty to allow for easy access to this and the next beds 3 rows. After emergence, thin down to 10cm intervals between plants and use the thinned onion sets in other areas.

Direct seeding spring onions

As per onions above, except adjust the in row spacing to 2-3cm apart for spring onions and thin down to 5cm intervals after emergence.

Seedling sets

Onions/Spring Onions are best suited to planting as seedling sets, so follow the nursery guide in section 5. After about 7-8 weeks, the seedling sets will have reached pencil thickness in the nursery and can be directly transplanted. They can also be lifted and trimmed to 2cm long roots with 10cm long tops, dried and stored for the next season set plantings.

Onion seedlings: Plant seedling sets with a dibble stick 10cm apart, in 18.75cm rows. Plant 3 rows like this leaving the 4th row empty to allow for easy access to this and the next bed. Onions take long to mature (4-7 months) and should be dried properly before storing. Firstly once leaf yellowing begins bend the leaves over, without snapping them off which will speed up the drying process. After lifting the bulbs, store them in a shady, dry, airy place. Use any damaged bulbs first and inspect the drying crop frequently for storage diseases.

Spring Onions: Plant seedling sets with a dibble stick 5cm apart, in 18.75cm rows. Plant 3 rows like this leaving the 4th empty to allow for easy access to this and the next bed. Spring onions are harvested whenever you have need of them, and can therefore be added to the vegetable basket at regular intervals.

4) Sweet Potato



Sweet potato is highly regarded as one of the most nutritious root crops, with a good mix of carbohydrate and very high levels of Vitamin A, amongst others. Sweet potato should become a much larger staple crop amongst African families because of its superior nutritional value when compared to other starch crops. It is easy to grow, has a high heat and drought tolerance, is very palatable and produces 10-40 tons per hectare.

Sweet potatoes do not do well in waterlogged conditions, so where this is a risk, use the permanent raised bed system. Avoid planting in high clay content soils, as these also have poor drainage. In Uganda, the team at “Double Portion Farm” grow acres of sweet potato on the flat very successfully in well drained soils.

Sweet potato grows in temperature ranges of 15-33°C but definitely prefers temperatures averaging 25°C. In summer rainfall regions, plant in September through to

November, but due to it having a 3½-7 month growing period it is best to plant earlier rather than later. In lower lying, warmer climates and in the tropics sweet potato could be grown nearly all year round.

Sweet potatoes are best grown from virus free cuttings of vines that have been in the field for 3 months. Store the 30cm cuttings in the shade for up to 3 days to stimulate root formation before planting out. Due to the vining nature of sweet potato demarcate enough space to prevent the vines interfering with other vegetable crops. Prepare furrows 15cm deep, on 75cm rows and after correcting the soil ph, place 500ml of compost or manure per meter.

Cover slightly with soil to attain the 10cm planting depth, then lay 20cm of the cutting in the furrow, bend the cutting upwards in an L shape and cover, leaving only the top most leaves sticking out of the ground. Place the next cutting in the same way 30cm further on.

No hilling up is necessary for good tuber formation but a good blanket is. Place a very thick blanket on top of the in rows to encourage the tuber formation to take place right near the surface under the blanket.



Irish potatoes can be grown in exactly the same way except that you would be planting seed potato tubers at 10cm deep instead of cuttings.

4. Southern African Summer Rainfall Region Vegetable Planting Guide

Southern African summer rainfall region vegetable planting Guide												
	January	February	March	April	May	June	July	August	September	October	November	December
Amaranth	*	*							*	*	*	*
Artichokes, chinese								*	*	*	*	
Asparagus									*	*	*	*
Beans	*							*	*	*	*	*
Beetroot	*	*	*	*				*	*	*	*	*
Broccoli	*	*									*	*
Brussel sprouts	*	*	*									
Cabbage	*	*	*	*				*	*	*	*	*
Carrots	*	*	*	*				*	*	*	*	
Cauliflower	*	*									*	*
Celery		*	*					*	*	*		
Cucumber								*	*	*	*	*
Egg Plant								*	*	*	*	
Kale/Rape		*	*					*	*	*	*	
Lettuce	*	*	*	*				*	*	*	*	*
Marrows	*							*	*	*	*	*
Melons, sweet								*	*	*	*	
Okra								*	*	*	*	
Onions		*	*	*	*							
Peas		*	*	*	*	*	*	*	*			
Peppers								*	*	*		
Potato	*							*	*	*	*	*
Pumpkin									*	*	*	*
Radish		*	*	*	*	*	*	*	*	*	*	
Rubharb								*	*	*	*	
Spinach	*	*	*	*				*	*	*	*	*
Squashes	*							*	*	*	*	*
Sweetcorn									*	*	*	*
Sweet potato									*	*	*	
Swiss chard		*	*	*				*	*	*	*	
Tomato								*	*	*	*	
Watermelon								*	*	*	*	
This general sowing guide should be used in conjunction with specific cultivar recommendations and local farmer climate knowledge. Also collect records of your own experiences and use them to plan ahead for future seasons.												

5. Seedling Nurseries

It is certainly easier for growers to plant seedlings directly rather than sowing seed, however designing, building and managing seedling nurseries should only be taken on by more experienced growers. The seedling system has a great advantage in that at the early stages of sensitive vegetables, you only need to manage a small area, instead of a whole field of tiny emerging plants. Once the seedlings reach 7-10cm the best of these seedlings can be transplanted and you don't have the difficulty of gapping and unhomogenous stands.

Seedling nurseries can be on raised beds of at least 15cm high or done in seedling trays on raised platforms or well drained surfaces. Good drainage is crucial either way. The seedling nursery site should be fenced off, close to a water source and in full sunlight to ensure that seedlings can be hardened off prior to planting.

Shade

Shade is very important in the early establishment phase of the vegetable seedlings. This shade can be from shade netting, palm leaves, thatch grass, bamboo or sticks. The structure should preferably be high enough for the person who will water and manage the beds to be able to have easy access, and about 2m above the ground level. Take into account the sun's movement and design the shade canopy or roof appropriately. It should be sufficiently wider than the nursery beds, to ensure that there is sufficient shade provided throughout most of the day.

Seedling Nursery Beds

Use a mixture of 1/3rd soil, 1/3rd coarse sand and 1/3rd well sieved, fine compost. Place the mixture on top of the "fractured" raised seedling bed or straight into the seedling trays. Wet the mixture thoroughly. Press the moist seedling soil mixture down firmly with a flat, wooden plank. Then use the edge of the plank to depress a 1cm furrow into the bed and space the seeds approximately 5cm apart to allow for safe root extraction and successful transplanting.

Seedling Trays

Seedling trays are very productive tools for raising seedlings. Ensure they are well cleaned before use, by cleaning with a strong bleach solution to kill off any non beneficial organisms. Fill up the seedling trays leaving 1cm remaining to the top level of the tray in readiness for planting, and wet thoroughly. After planting the seeds, fill the remaining 1cm with the remaining moist, seedling mixture, firm up the surface and scrape off any extra material.

Watering

The high compost ratio in the seedling mixture will hold a lot of moisture and the extra shade protection will prevent the seedlings from encountering moisture stress. Watering lightly once a day with a watering can with a fine nozzle will usually be sufficient, but in very hot conditions it may be necessary to water twice a day. Be careful not to over water as this can cause wilting and mislead the grower to apply more water. Observe your plants and feel soil mixture regularly to assess the moisture status and make the necessary adjustments.



Transplanting

7-10 days prior to transplanting, begin to harden off the seedlings by exposing them to more and more sunlight and decreasing their watering. This is easy to do when using shade roofing like palm branch leaves, sticks or thatch grass, as you can gradually remove more and more roof material, hereby allowing more and more light penetration. Halve the watering every second day for the first 4 days. Thereafter restrict watering by skipping a whole day every second day. However, ensure that several hours prior to transplanting that the seedlings receive plenty of water and are thoroughly turgid.

With seedling beds ensure you have a good, sharp, handheld spade to remove sufficient root and soil medium intact. Seedlings should be kept in the shade until planting out which should take place as soon as possible into the well prepared vegetable beds using a dibble stick.

6. Composting

Compost is an exceptional alternative to fertiliser, which builds up not only the organic nutrient levels in the soil, but helps to restore the natural biotic balances which occur in the soil profile.

2 Corinthians 9:8 "And God is able to make all grace abound to you, that always having all sufficiency in everything, you may have an abundance for every good deed."

God's Word is true. He has made a way for everyone to have the best quality soil supplement... Compost. By putting back good quality compost into the soil, farmers can reap the same, if not better profitability in the long term, when comparing to fertiliser usage.

What is Compost?

Compost is simply decomposed organic matter that has been broken down by micro organisms, especially bacteria and fungi. To ensure that our compost is of the highest quality we must follow strict standards and stick to the recipe. We suggest a compost pile size of 2m long by 2m wide by 2m high. This is small enough for a single person to work in a few hours, while allowing for adequate internal temperature of the pile. This amount of compost volume will easily be enough for a 10cm surface and 5cm subsequent application on a Home Nutrition Garden. It is not recommended that you reduce the compost pile size below 1.5m cubed.

When to Make Compost

Start collecting compost materials at the time when there is plenty of green materials around, which in Southern Africa would be January or February, to allow enough time for the compost to fully mature before the next spring planting season.

Ingredients

Compost is made of three main ingredients nitrogen, green and a woody/dry component. Vegetables prefer bacterial dominated compost as compared to fungal dominated, therefore compared to our field crops compost, we reduce the woody component to 10% and increase our dry component to 35%. All the other ratios remain the same. This lowers the overall Carbon to Nitrogen ratio and makes the pile finer, with a higher percentage of bacteria within it. Alternatively, you could up the amount of green to 60% and lower woody/dry material to 30%, hereby lowering the carbon to nitrogen ratio. However, practically speaking, the green component is usually the hardest to collect and makes it more difficult to get farmers to adopt if using the 60% green ratio.

1) Nitrogen Component

Nitrogen is the fuel of the compost pile and gets the bacteria going. The Nitrogen component should make up 10% of your pile and you can use 15 bags (50kg bags) of manure. If there is no manure in your area then you can use 4m³ of legumes for this and just adjust your green and woody/dry components accordingly.

2) Green Component

Green leaves are the source of sugars, which are necessary for good quality compost. The green component should make up 45% of your pile and anything that is cut when green, even if it has dried, is classified as green.

3) Woody/Dry Component

The woody material really helps to encourage the fungal growth in the pile because it breaks down so slowly and keeps the pile aerated, while the dry material adds bulk. The woody (10%) dry (35%) component equals the green component and makes up the balance of 45% of the pile. Woody materials include maize cobs, stalks, branches, cardboard and wood chips or shavings (not sawdust), while dry material includes thatch grass, leaves and weeds.

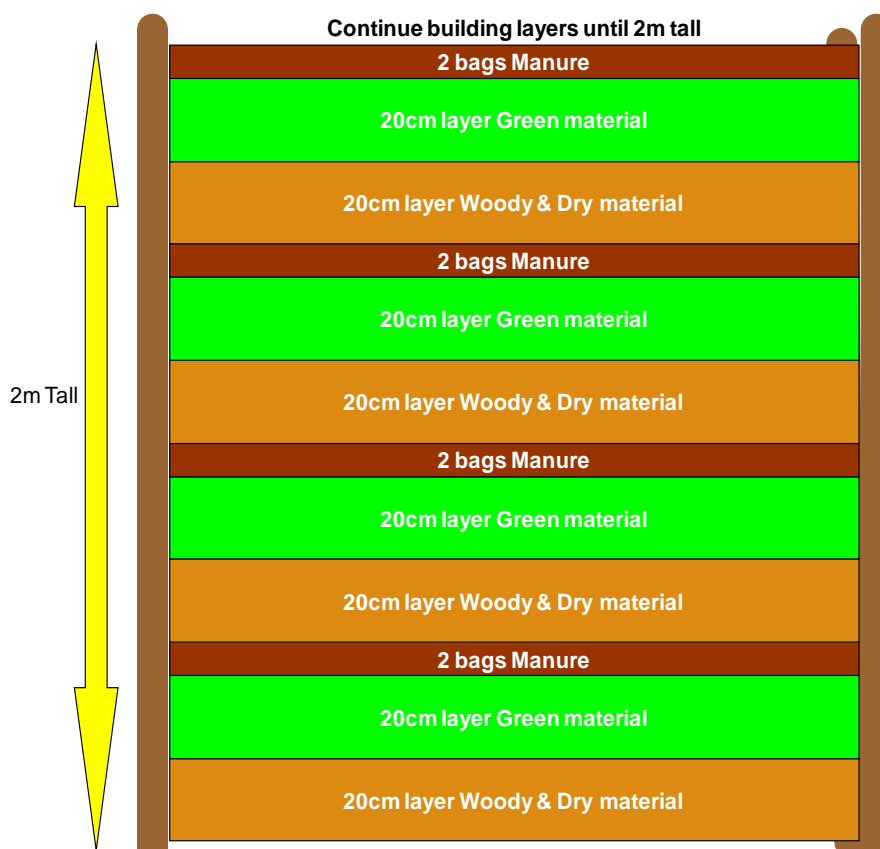
To summarise the ingredients we need: 15 bags of manure and an equal split of 45% green and 45% woody dry (woody 10% and dry 35%).

The materials should be piled separately until such time as enough of each material has been accumulated. Collecting enough material to build a pile takes time, so you must plan properly. Farming God's Way farmers should get themselves into groups of five to pray, disciple and help one another. If these groups get together when there is sufficient green material around, then they can do their compost piles together in community and fellowship.

Building the Pile

When building the pile, it is very important that the right ratios are maintained. The simplest way to achieve this is to build using alternate layers of the 3 main ingredients. Dunk the green, woody and dry materials in a container of water before you place them, so that you wet the layers thoroughly. A good wetting at the outset will mean you will probably only need to add water maybe once or twice in the 2 month process.

Start with 20 cm of woody dry, then place 20 cm of green, then 2 bags of well wetted, fresh manure on top of that. Continue layering until you get to the 2m height.

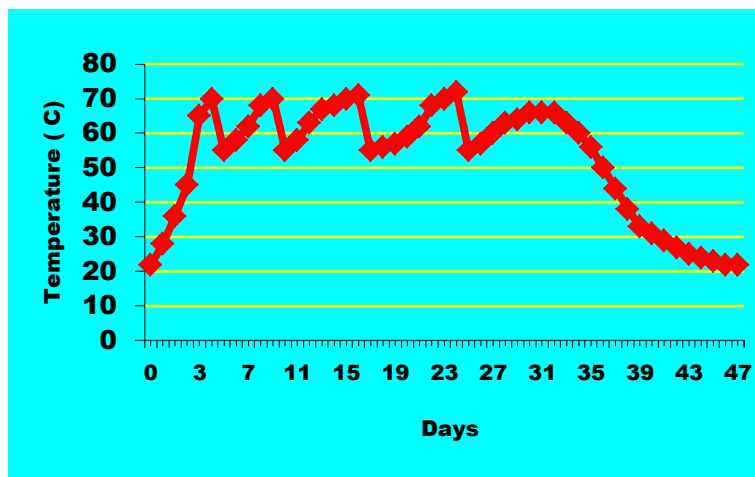


Turning the Pile

Within 3 days, the compost pile will have heated up and needs to be turned. The best way to do this is to mix the pile into the adjoining 2m*2m position, using a fork or a hoe. The turning process maintains the correct temperature, mixes all the ingredients, brings material on the outside to the inside, aerates the pile with oxygen and allows for moisture levels to be checked and adjusted if necessary. If the pile is not turned it will become anaerobic, have a bad smell and result in poor quality compost.

1. Temperature

The compost gets hot very quickly because of all the bacterial activity. The ideal temperature of the compost should be maintained between 55°C to 68°C for 3 days, to kill all seeds and unwanted pathogens. If you don't turn your compost, the temperature can easily reach well over 70°C, which is too hot and kills off the desirable microbes, as well as burning up and wasting carbon.



The most accurate way to determine the temperature is by using a temperature probe. Turn the pile before the temperature reaches 70°C. A cheap alternative would be to use an 8mm steel rod. After inserting it for a few minutes, see if you can hold on to it for 5 seconds. If you can, the temperature is less than 70, if not it's ready for another turn.

Considering we are working with the poor, a really simple guideline is to turn the compost pile every 3 days for the first 3 turns and every 10 days for the next 4 or 5 turns.

The temperature goes down after each turn and rises again until the next turn. This cycle will continue until all the nitrogen in the pile has been utilized. If you followed the guideline ingredient volumes of 15 bags of manure, then the compost will get hot enough for adequate decomposition and also will be maturing and cooling after 6-8 weeks.

2. Mixing

Mix the different materials thoroughly bringing the materials on the outside into the centre so that it also gets exposure to high temperatures.

3. Moisture Content

When turning the pile, test to see whether it is moist enough, as a lot of moisture is lost as steam and needs to be replaced. Try to keep the moisture content of your compost at 50%.

You can test this by squeezing it in your hand. If moisture drips out, it is too wet.

If no water drips out, but on opening your hand the material does not hold its shape, then it is too dry, so add water.

If squeezed, no extra moisture drips out and on opening the hand the material holds its form, then it is close to the desired 50% moisture content.

Leave a gentle slope on the top of the pile and place thatch grass or grain bags on top to keep excess rain water off the pile, which can cool the pile too much.

Indicators of Good Compost

After 2 months the turning process is complete, but leave it to cure thoroughly for another 4 months before you use it. When complete, your compost should be a dark brown colour, smell sweet and rich, have a crumbly structure and you should be able to see thick fungal strands.

When mature, the compost can be stored as is for years without degrading or losing its nutrients. You don't need to turn it anymore, but remember to check the moisture levels regularly. At this stage your compost will be in the form of stable organic nutrients and inoculum.



Utilising the Compost

As discussed earlier, compost can be utilized as a surface application for small scale vegetable growers or in planting stations/furrows for larger field scale growers. The yield potential with good quality compost is very high and the cost of producing it is only the labour to collect the materials and to build and turn the pile. The opportunity to excel as a vegetable grower by cutting input costs and growing healthy nutritious plants depends on what we put in!!!

“Whoever sows sparingly will also reap sparingly, and whoever sows bountifully will also reap bountifully.” 2 Corinthians 9:6

Compost is the input that we should see on every farm field as we teach farmers faithfulness with what God, in His all sufficiency, has put in our hand.

7. Case Studies

7.1. Case Study 1: Martin Dower



Martin Dower amongst his vegetables

Martin has been growing baby vegetables in Muldersdrift South Africa, with Farming God's Way techniques from 2008 and we have had some interesting discussions about the variants within production. These variants include bed spacings, row and in row spacings, input application techniques and the use of God's Blanket.

Here is how he does it.

The soil in the region is heavy, red clay which is hard and has poor texture. Martin's vegetables are grown organically in soil that has been heavily composted. The composting is done to Farming God's Way standards with correct ratios of woody dry, green and manure ingredients. Martin has 5 compost piles running concurrently and second only to the Lord, he attributes this composting to be the backbone of his success. After the compost is mature, he sieves it through a wire mesh to get fine material for planting fine seeded and rooted vegetables. Any leftover woody content is later re-used in new compost piles.



Compost about to be sieved

Establishing Beds

Lands are prepared on flat, level ground, without raised beds. The beds get a raised appearance after high compost inputs, good management and traffic control between rows. With normal production vegetables like cabbages, cauliflower, beans and peas, Martin grows his crops in 2 rows across the slope.

However, Martin also grows a unique baby leaf, so he needs his staff to access and harvest leaves everyday. They plant across the beds to facilitate movement by straddling the 60cm wide beds with their feet in the 20cm walkways. (This is a unique type of vegetable production and for most cases not advised as it is such a specialist design).

After careful design and measurements, 5cm of compost is lightly worked into the top 5cm of soil a few weeks before planting. This generous sowing of compost input is done before any plantings, to replace lost nutrients and improve overall soil health. It is not a once off application at establishment, but something Martin always does after harvest is completed, in order to prepare the soil for the next crop.

Preparing Beds

At planting, furrows are dug with row spacing and depth dependant on the species and whether seed or seedlings are being planted. The compost is then placed into the furrows at a rate of 500ml per 60cm, then lightly mixed and put back into the furrow. Note the soil is not inverted and only lightly disturbed as per Farming God's Way principles.

A variation of the furrowing technique is done with some of the baby leaf vegetables, where he works 10 litres of compost per square meter into the top 5cm of soil at planting. This is because of the very narrow row and in-row spacings involved with this type of cropping system. Note in both cases, this is after the initial 5cm of compost pre-establishment gets done as explained earlier.

Some of Martin's vegetable areas are under shade cloth and others are in full sun. In all cases, the soil is fully covered either with thatch grass from the farm or with compost if there is sufficient available. In the frosty winters Martin uses small fleece lining to protect the plants against the cold.



Peas and Coriander



Broccoli

7.2. Case Study 2: Vumile Ndzululeka

Vumile is based in Nyanisweni in the former Transkei, South Africa. He is a rural pastor with Church of the Nations where they also serve the community through teaching Farming God's Way and running a pre-school. Vumile has always had "green fingers" and has latched on to Farming God's Way with both hands, doing a variety of crops including potatoes, cabbages, carrots, green mealies and sugar beans on a half acre. Of particular interest to this case study is the way Vumile plants his potatoes, where he does not plough or even loosen the soil, nor layer compost. Instead he believes the secret lies in heavy mulch covers. This has proven to be very successful the world over where farmers who have mulched the heaviest seem to do the best. Vumile says getting to the potatoes is easy as they are right at the surface or sometimes even in God's Blanket.



Vumile Ndzululeka with a variety of vegetables in the Transkei using Farming God's Way

7.3. Case Study 3: Pius Mutie

Pius is a small scale farmer in Mpeketoni, Kenya. He farms a number of different types of crops including eggplant, beans, green mealies, watermelon, okra and butternut. Pius uses manure as his primary input, but if he does not have sufficient volumes available, he also uses inorganic fertilisers in the recommended furrow or planting stations system. Pius has a strong commitment to do a thorough covering with God's blanket and has seen God restore his soil from a wasteland to a productive farm since adopting Farming God's Way wholeheartedly in 2006. What makes Pius' setup unique is his use of small "flood irrigation basins", which allows him to grow crops all year round.



Pius' Eggplants

7.4. Case Study 4: Tess Gebers

Tess Gebers is a successful vegetable farmer based in Port Elizabeth. She began using Farming God's Way in 2010 with a late planted sweetcorn variety. She has also grown cabbages, zucchini, pattipans, baby gems and others.

Tess really believes in compost and hers is bought in. Experience has shown that most locally purchased compost is very poor in nutrients and the microbiology necessary for plant growth.

Establishment Preparations

Tess prepares her field scale plots in 75cm rows. She has chosen these for the value of permanence and for the flexibility it brings with the other rotation crops she wants to grow. For cabbages, furrows were dug 8cm deep and almost filled with compost – about 3 to 4 liters per meter. This is to give her sandy, beach sand soil a head start during the first season. The soil is then brought over the furrow.



Tess Gebers' Sweetcorn

When planting cabbages, a dibbler stick was used to punch holes to the seedling root depth, in alignment with her 45cm teren rope. The seedling is then placed into the hole and firmed on the sides. The drip irrigation is laid on the upslope side of the row lines. Topdressing cabbages was done 3 times with LAN in the first 6 weeks to give the “heavy feeding” plants enough Nitrogen to get through their initial growth spurt.

Tess does not use raised beds although this winter was unusually very cold and wet which caused some waterlogging which she feels is highly infrequent in her climate. She is going to dig drainage ditches to help remove excess water from the higher fields, before it gets to her vegetable fields. Over time the soil in the permanent 75cm rows will also start to accumulate, making a natural raised bed, with the incorporation of compost and root matter as well as the compaction of the in rows from foot traffic.

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