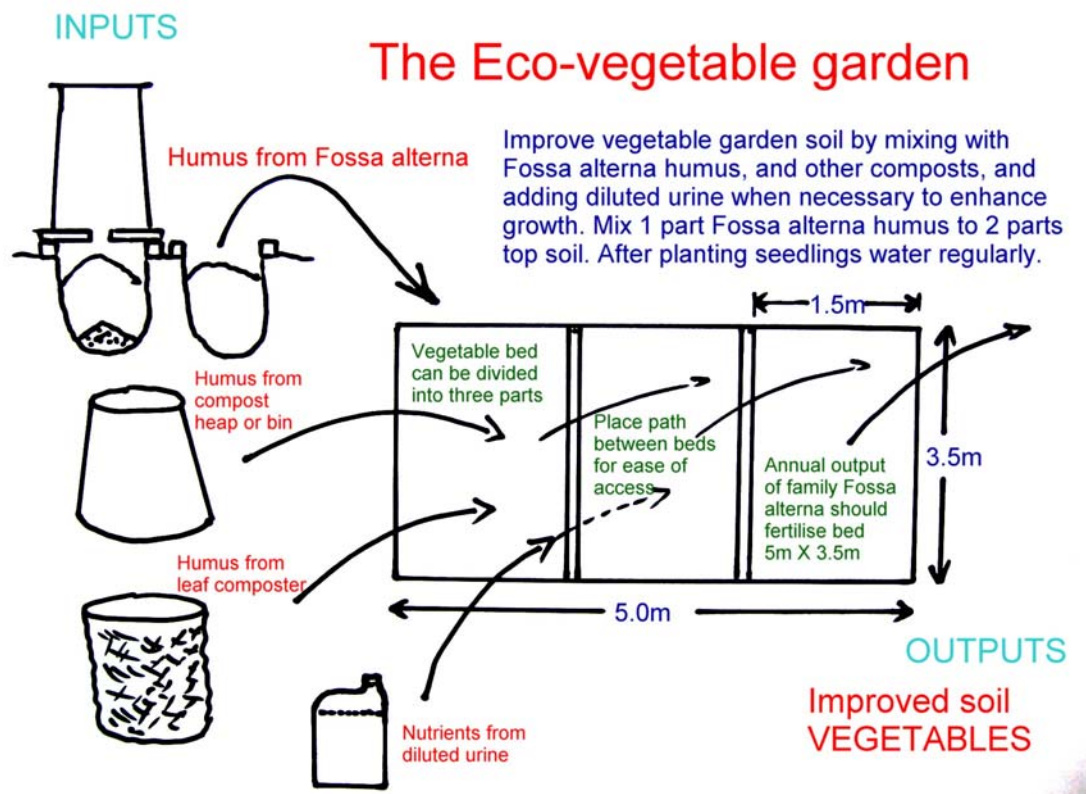


9. The *Fossa alterna* and the vegetable garden

We now combine the use of the eco-toilet and the vegetable garden so they can operate with one common aim – to provide more food for the family.

This chapter describes practical ways of using the eco-humus derived from the *Fossa alterna* and coupling this with other valuable composts and urine to provide more food for the family. To get the most effective production from a small vegetable garden it is wise to take advantage of all these various products if they are available. The small vegetable garden is built to use the materials derived from the toilet with humus being added every year to restore what nutrients the plants have withdrawn. The vegetable garden is linked not only to the toilet, but also to the compost heap, the leaf composting basket and to any source of urine the family can produce. The aim is to bring all these parts of organic gardening together – compost, eco-humus, urine, for the best production of vegetables. Growing vegetables in small containers is also a practical method, especially where space is limited. Buckets or cement basins are ideal.



The requirements of the plants must be taken into consideration. Most plants require more phosphorus at first to enhance their root and early shoot growth. Then they require more nitrogen to add vegetative growth. This must be combined with potassium to ensure a healthy plant and potassium is also essential for the fruiting of tomatoes and the best growth of onion, potato and beans. Fruit trees also require plenty of potassium.

So care is required in using the various possible nutrient providers in the best possible sequence. Too much urine at first can stunt the growth of young vegetables which require plenty of phosphorus for their early root growth. Whilst phosphorus is present in urine, the proportion is small compared to nitrogen. The eco-humus has a much more balanced series of

major nutrients and when mixed with topsoil makes an ideal medium in which to plant young vegetables. The generous phosphorus content of the eco-humus is particularly valuable for root and early shoot development of the plant. The eco-humus/topsoil combination alone may be able to support the crop until it is harvested. When extra production is required, especially for leafy vegetables, then urine, mixed with water can and should be applied to the soil. Urine normally takes between 1 and 2 weeks to act and the most obvious effect is for the leaves to turn a darker shade of green and for leaf growth to be enhanced. But the urine must be applied with care. On each 3.5 X 1.5m bed, a weekly application to the soil of 2 litres urine diluted with 10 litres water (dilution 1:5, total volume 12 litres) is adequate for leafy vegetables.

The effect of the eco-humus and also urine on plant growth is very variable, depending much on the existing state of the soil on which it is placed. If the soil already holds sufficient nutrients to provide what the plants require, then the additional effects of adding eco-humus or urine will be less noticeable. Where the soil is deficient, then the effects will be most noticeable. For very poor sandy soils, it is desirable to add more eco-humus, perhaps a ratio of 1:1 with the topsoil, and even better if leaf or garden compost can also be added. Where the soil is part of an existing vegetable garden, then the soil will already have benefited from a certain degree of composting. For vegetable beds use the following sequence:

1. Improve the soil by mixing eco-humus (and compost if available) to the vegetable garden to increase humus content and availability of a good mix of nutrients. Humus which contains plenty of phosphorus is very important at this stage. This is essential for good root growth and also the growth of early shoots above ground level.
2. **Application of eco-humus.** Eco-humus from the *Fossa alterna* can be mixed with the existing topsoil soil at the rate of 2 parts topsoil to 1 part eco-humus on vegetable beds. Using the size of one bed illustrated above (3.5m X 1.5m) the *Fossa alterna* humus is applied to each of the three beds by distributing 12 piles, each of 15 litres over the bed with 0.5m between each pile. Thus 12 piles of 15 litres each can be made over each 3.5 X 1.5m bed. That is a total of 12 X 15 litres = 180 litres. This is about 35 litres humus per square metre of bed. The total annual production of humus from a family (0.5-0.6cu.m.) should be sufficient to distribute over 3 such beds totalling about 15sq.m. Once deposited in a measured way from the buckets, the humus is spread out over the surface with a hoe (badza) and then dug in and thoroughly mixed with the local soil to a depth of about 10cm. This application rate will give an approximate mix of 1 part humus to 2 parts topsoil.
3. If the top soil is very poor and sandy, then the humus should be mixed with the topsoil with a higher proportion of humus. A mix of approximately equal parts of topsoil and humus is best. This can be done by applying about 14 X 20 litre buckets full of humus over each 3.5 X 1.5m bed and mixing in. The annual output of the *Fossa alterna* will then be enough for about 2 X 1.5m X 3.5m beds. Better still to mix the humus with some leaf compost or garden compost and then mix in.
4. If leaf compost or garden compost is available, this can and should also be mixed in too to make a mix of about 2 parts topsoil to 1 part *Fossa* humus + compost (50/50 mix). Thus for each 1.5 X 3.5m bed, 90 litres of humus is mixed with 90 litres compost, making a total of 180 litres, which is then applied to the bed. This is applied with a 15 litre bucket (12 X 15 litre buckets). In fact this will make any *Fossa* humus which is produced go further. With garden compost being available, humus from the

family toilet combined with an equal volume of compost could fertilise up to six 1.5m X 3.5m beds. The overall aim of applying ecological sanitation for the enhancement of vegetable production is to use all the available forms of nutrient rich material to fertilise and invigorate the soil of the eco-garden.

5. This combination of composts and humus, or even humus alone may be quite sufficient to provide all the plant's requirements through to harvest time without any further requirement for liquid plant food (including diluted urine). However, the careful application of urine can enhance the growth of green vegetables further. But over application of urine must be avoided, otherwise the nitrogen and salt content of the soil may rise too high and adversely affect plant growth and health. Regular watering is essential at all times.
6. **Application of urine on vegetable beds.** For leafy vegetables grown on beds (spinach, rape, covo etc), the addition of urine to the bed one month after planting may be beneficial. For each 1.5 X 3.5m bed (5 sq.m.), 12 litres of a mix of 5 parts water (10 litres) to 1 part urine (2 litres), making a total of 12 litres (5:1) can be applied to the soil of the bed once a week. This can be done slowly in a single application allowing time for the liquid to soak in or in two applications of 6 litres spaced a little apart. A third application of water the same day helps to wash off any urine held on the leaves and dilute the urine further. This application should help to enhance green leafy crop production noticeably. But this depends on the fertility of the existing soil. If the soil is already fertile, urine application may not be necessary, and over application may be harmful. If the soil is deficient and *Fossa* humus or compost is not available, then urine may have a noticeable effect. The diluted urine should be applied to the soil directly. If the mix falls on the plant leaves it should be watered down with plain water to avoid burning.
7. It is essential to keep the bed watered at all times and particularly between urine applications. During the rainy season, the rain may be adequate, but artificial watering may also be required. When urine is applied, the additional diluting effect of water will also be required. In any case, watering vegetables is a standard procedure essential to maintain plant health and survival.
8. For crops like tomatoes, potatoes, onions and beans, extra potassium is required, particularly during the second part of the growth cycle, This should be available from leaf or garden compost or from *Fossa alterna* humus. Extra potassium can also be applied in the form of wood ash applied to the soil directly by sprinkling the ash around the plants and digging in. It can also be applied together with diluted urine - a mug full (120gms) of ash per 2 litres urine mixed with 10 litres water. Or 5gms (level tablespoon) ash in 0.5 litres of 5:1 water/urine mix per 10 litre container for every 3 plants. It can also be applied as a mulch of comfrey leaves on soil around each plant. Tomatoes require very special attention and a generous supply of potassium if they are to fruit well (method described later). Fruit trees also require generous potassium to give their best harvests (method also described later).
9. Overall crops will benefit from the addition of leaf mulch and also organic liquid plant foods. These are discussed later. Regular watering and weeding helps to increase the harvest. The weeds compete for plant food, and the less the weeds the more the vegetables.

The simple steps for vegetable beds

1. Prepare a vegetable bed measuring 5m X 3.5m
2. Dig out the humus from the toilet and distribute over the bed evenly
3. Mix in extra compost if available
4. Dig in and mix the added humus and compost
5. Plant vegetables as required
6. Water and weed regularly
7. For extra nutrients add diluted urine to the bed
8. Dilute one part urine (2 litres) with 5 parts water (10 litres)
9. Apply to the soil around the plants once a week
(this may need 2 or 3 X 12 litre mixes)
10. Use plain water at all other times
11. Green vegetables like rape and spinach like lots of
nitrogen
12. Tomatoes like lots of potash (wood ash) as well as
nitrogen
13. Crops benefit by adding leaf mulch
14. Keep the soil dug, weeded, watered and aerated

Preparing and managing an eco-garden linked to the *Fossa alterna*



Preparing the bed of the eco-vegetable garden. In this case an old vegetable bed is being prepared by weeding, digging down and mixing the soil over an area of approximately 15 sq.m. The vegetable garden was divided into three beds, each of about 5 sq.m. each. In the background on the left photo the humus from the *Fossa alterna* is being dug out. On the right two heaps of *Fossa alterna* humus have been excavated. The 360 litres of humus was divided into two piles of 180 litres each. This volume of humus was sufficient to enrich two of the three beds in this vegetable garden.



Three beds were prepared each 1.5m X 3.5m in area (5.25 sq.m.). The eco-humus was mixed with the existing soil in two of the beds and the same amount of local red topsoil was mixed in the central bed (for comparisons). The humus was applied to each bed by distributing 12 piles, each of 15 litres over the bed with 0.5m between each pile. Thus 12 piles were made over each bed (12 X 15 litres = 180 litres). The humus was spread out over the surface with a hoe (badza) and then dug in and mixed with the local soil to a depth of about 10cm.



This was then spread out over the surface as evenly as possible with a rake. This application rate is thus 180 litres humus to 5.25 sq.m. of bed (35 litres per square metre. If we calculate that the depth of the improved soil is 10cm, the total volume of the mix is 100 litres per sq.m. To make up with 100 litres about 35 litres humus has been mixed with 65 litres topsoil. That is a ratio 2 topsoil (65 litres) to 1 humus (35 litres). A ratio of 2:1. After watering, the seedlings are planted. In this case spinach and rape. 50 plants were sown in each of three beds making a total of 150 plants.



An example of the eco-vegetable garden just planted with seedlings with the *Fossa alterna* toilet behind. On the right another view from the toilet side when the vegetables were growing. A family should provide enough excreta, when combined and composted with soil, leaves and wood ash to make 0.5 – 0.6 cu.m. eco-humus per year. This is enough to apply to an eco-garden 3.5m X 5m.



After 4 weeks a good harvest of green vegetables has grown ready for the first cropping. Spinach and rape can be harvested at least twice and covo several times. On the right spinach plants look very healthy.



The first crop of spinach and rape being harvested at 4 weeks. The vegetables in this case were prepared for sale in neat bundles. Further crops can be harvested. When the crops are finished, the old plants are removed and the soil dug down and aerated. Additional compost can be added if required. New seedlings are then planted. The vegetable garden is maintained in the same way as any other vegetable garden.

Regular weeding and watering is essential to obtain maximum crop output. Research work on eco-gardens linked to the *Fossa alterna* continues.

Using *Fossa alterna* humus in the flower bed

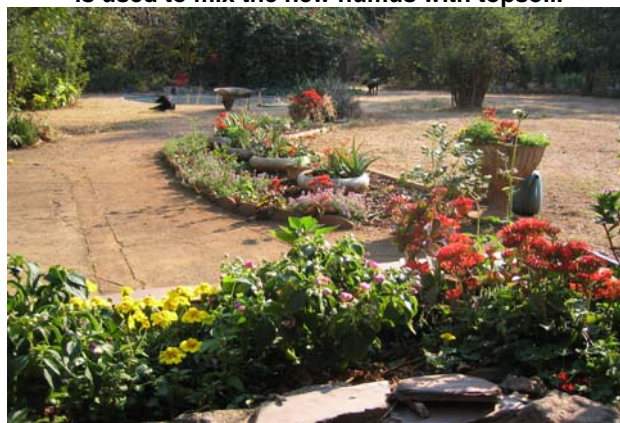
Fossa alterna humus can also be used to enhance all soils including those used for ornamental purposes in flower beds. This may be the preferred method if there is some resistance at first to applying the humus on to vegetable beds. The same technique is used as on the vegetable beds. Humus from the toilet, once well composted can be applied with a bucket to the soil, at the rate of about 35 litres humus per square metre soil. Humus can be held in sacks before application, and this tends to improve the quality and safety of the product, since it involves aeration, turning and greater storage. The new humus is spread out and then mixed in with the existing topsoil, making a new soil which is more organic and fertile. Seedling flowers can then be sown and the resulting colour will be a great pleasure for the householder. Once established, urine can also be applied to the beds by mixing with water (10:1) and apply weekly in a watering can. Nutrients derived from human excreta can assist in the growth of all plants – and that includes flowers and other decorative ornamentals.



The *Fossa alterna* humus is carried to the bed in buckets and spaced so that about 3 to 4 ten litre buckets of humus covers a square metre of bed area. The piles are then spread out and mixed with the existing topsoil with a hoe.



The Dutch hoe is a fine gardening tool and valuable for many jobs of the vegetable or flower bed. Here it is used to mix the new humus with topsoil.



The new bed with enhanced growth of flowers

Growing vegetables on containers

Several types of vegetables can effectively be grown in containers – either 10 litre buckets or basins. The most economical way of making the basins is to use a plastic basin as a mould and to cast replicas in concrete with cement and sand. These turn out to be more durable and cheaper per unit than the original plastic basins. About 50 X 10 litre basins can be made with a single bag of cement. The method of making cement basins is described in a later chapter.

Once again the success of growing vegetables in containers much depends on the soil itself. The better the soil, the better the result. Containers may be a convenient way of growing vegetables if space is limited, but this will rarely be the case where ecological sanitation is used. But containers do have other benefits and some disadvantages. The benefits are that the soil can be well chosen and mixes of *Fossa alterna* humus and topsoil may go a long way. The soil can be used for the crop and then later moved to a soil recycling pile and fresh soil added for the new crop. Thus a supply of recycled and rejuvenated soil can be used. The disadvantage of container gardening is that the soil volume is small – often only 10 litres. Thus the supply of nutrients in the 10 litres of soil is finite and limited. This means that a supply of nutrients, best applied in liquid form, must be supplied to get the best production of crops. Also the quantity of water available in 10 litres of soil is also finite and limited and basins of vegetables need far more frequent watering than vegetable beds. So in practice, vegetables growing in containers need a more constant supply of plant nutrients and a regular supply of water. The use of containers is thus ideally suited to the application of liquid plant foods including diluted urine.

For 10 litre containers use the following sequence:

1. *Fossa alterna* humus can be used unmixed with other soils, as in the case of tomatoes grown in containers, but it is best mixed with other soils or composts. Prepare planting soil using a mix of topsoil, *Fossa alterna* humus and garden or leaf compost if available to get plenty of humus. A 50/50 mix of *Fossa alterna* soil and topsoil (5 litres of each) is suitable. Or make up 40 litres in a wheel barrow using 20 litres topsoil, with 10 litres *Fossa alterna* soil and 10 litres garden or leaf compost. Mix thoroughly and add 10 litres of the mix to each basin.
2. The seedlings should be prepared beforehand. If possible plant seeds in seed trays and water regularly. Leaf compost liquor (see later) can also be used for watering seedlings. When two or three weeks old transfer seedlings to the 10 litre basins, at the rate of three plants per basin for plants like spinach, rape and covo. For tomato which is best grown as a single plant in a 10 or 15 litre bucket, plant in a mix of *Fossa alterna* humus, topsoil and compost if available. For good drainage the final soil mix should be crumbly and humus like.
3. Keep young plants watered and under shade out of hot sun (containers can be moved) for one to two weeks before applying any diluted urine.
4. When plants are well established the application of diluted urine can begin. If leaf compost liquor has been used for seedlings this can be continued. The liquor is more balanced but has less nitrogen compared to the diluted urine. A ten litre container will accept about 0.5 litres of plant food per application.
5. Liquid plant food like leaf compost liquor can be applied at the rate of 0.5 litres per container at least twice a week with all other applications being water only. Liquid plant food can be obtained in several ways. One is to drain water over composting leaves, including urine fed comfrey leaves. The resulting liquor (which looks like tea) can be watered directly on the soil without dilution. It has a good balance of nutrients and a very positive effect on plant growth. Its effect is milder than diluted urine, but produces succulent green vegetables. Such liquor can be applied to containers for long periods without the fear of over nitrification or salt build up.

6. Urine diluted with water can be applied at various dilutions and rates to containers. The stronger the mix (say 3:1) and the rate (say 3 times per week) the more pronounced the growth of the plant will be - up to point. But over application can be harmful to plants. Plants will survive quite a strong application in the short term provided water is also added regularly to the basin to maintain plant health. This can produce an impressive result in the short term, say over one or two months for green vegetables like rape and spinach. But care is required. Although plants like rape, spinach and covo can accept an application of urine diluted with 3 parts of water, up to three times a week (0.5li application per 10 litre container), this may lead to weakening of the plants within 2 months due to potassium deficiency caused by the over application of nitrogen in the urine. But too little urine will have little effect. On rape, for instance, a 5:1 mix applied once per week may have little effect, especially if the soil has not been fertilised before. So a good balance is required and adjusted through the life of the plants.
7. 0.5 litres of a 3:1 mix of water and urine applied twice a week will provide 0.25litres of urine per week per basin (normally containing 3 plants like rape or spinach). A 5:1 application twice a week will provide 0.166 litres of urine a week. A 3:1 mix once a week will provide 0.125litres of urine a week. A 5:1 application once a week will provide 0.083litres of urine a week. Compared to the 5:1 application, once per week, the 3:1 application once per week provides 1.5 times the urine, the 5:1 application twice per week provides 2 times the urine and the 3:1 application twice per week provides 3 times the urine.
8. **A good standard procedure for green vegetables like rape and spinach growing in 10 litre containers is to apply a 3:1 mix twice a week for the first month, with intermediate watering. Reduce this to a 5:1 mix twice a week for the second month with intermediate watering. From then on apply a 5:1 mix once per week with intermediate watering.** A 3:1 mix can be made up with 2 litres of urine and 6 litres of water in a 10 litre bucket. A 5:1 mix can be made up with 2 litres of urine and 10 litres water in a 20 litre bucket. The diluted urine can then be applied to the soil in the container with a 0.5 litre jug. The best rate to suit the individual gardener can only be discovered with experience.
9. **Also for longer term onion (6 months to harvesting) in basins, apply a 3:1 mix twice a week for the first month, with intermediate watering. Reduce this to a 5:1 mix twice a week for the second month with intermediate watering. From then on apply a 5:1 mix once per week with intermediate watering.** The diluted urine is applied with a 0.5 litre jug to each container. Onions also benefit from wood ash being added.
10. **Tomatoes (3 – 4 months to harvesting) grown in buckets do not require an excess of nitrogen. Only apply diluted urine after the first small fruits appear. Then apply 0.5 litres of 5:1, once per week. Tomato like lots of potash. It is also best to add wood ash by digging in a tablespoon per week to the bucket soil and watering in.** Plant food using liquor derived from composted comfrey & other leaves also helps to give good crops of tomatoes (see later).
11. Normal watering of vegetables in containers should continue at all times. In hot dry weather water may be required 2 or 3 times per day in basins, but under different conditions a daily application may be enough. If the plants begin to wilt, then the time is overdue for watering.
12. Liquid plant food (such as leaf compost liquor passed through composting comfrey) may be best for tomatoes, where a subtle balance of nutrients is required. Extra potassium can also be applied as wood ash and extra phosphorus as single super-phosphate (see later).
13. Weeding is always an important part of the gardening process, and weeds should be kept down in the basins as well as on the larger beds. The plants benefit from regular weeding which also aerates the topsoil. Mulching with leaves also helps a great deal, especially in containers.
14. When the plants have been harvested to their full extent (several croppings are possible from plants like spinach), the old plant stumps are discarded and placed in the compost heap. The basin soil can also be moved on to a pile and mixed with other soils to rejuvenate. It can later be reintroduced back into the basin. Alternatively, the existing basin soil can be loosened up and mixed with fresh soil, compost or humus before planting begins again.
15. Containers can be used to grow a variety of vegetables including rape, covo, spinach, onion, tomato, beans, maize, strawberry, etc. Tomatoes are best grown in 10 litre buckets. Rape, spinach & onion are best grown in basins. The concrete basins, when carefully made, can last almost indefinitely, and thus are a good investment in time and money.

The simple steps for growing vegetables in containers

1. Prepare the containers (10 litre buckets or cement basins)
2. Prepare the soil for the containers. A mix of *Fossa alterna* soil, compost, leaves, and topsoil is good. Or any fertile soil.
3. Grow the seedlings from seed in beds or seed trays
4. After a few weeks, when the seedlings are ready, transfer to the containers. For rape and spinach and covo, 3 seedlings per 10 litre basin. For onion up to 10 per basin. For tomato 1 per 10 or 15 litre bucket.
5. Water the seedlings with plain water for a week to establish
6. Plant food in the form of a urine/water mix can be applied to the basins at the rate of 0.5 litres per container, once or twice a week
7. For green vegetables like rape, spinach and covo apply:

For first month use 0.5 litres of 3:1 (6 litres water + 2 litres urine)
twice a week
For second month use 0.5 litres of 5:1 (10 litres water + 2 litres urine)
twice a week
For third month and thereafter use a mix of 5:1 (10litres water + 2 litres urine)
once a week
7. For Onion use same water/urine application as above.
8. For Tomato use liquid plant food from leaf compost with comfrey or 0.5 litres of 5:1 water urine once per week only after fruit formation. Add wood ash to the bucket soil (1 tablespoon ash per bucket, every week).
9. Water and weed often. Leaf mulch helps in containers.
10. When crop finished recycle soil in heap, bring in new soil for new seedlings.

Examples of successful vegetable production in containers.

1. Growing plants on neat *Fossa alterna* humus

Several types of plant can be grown on unmixed, neat humus from the *Fossa alterna* pit. Here are some examples with plants growing on containers.

Green pepper

Green pepper is a valuable crop and can be grown on neat *Fossa alterna* humus or *Fossa* humus mixed with topsoil in buckets. However the best way is to mix the humus with garden or leaf compost. Pepper is normally grown in beds. When grown in containers the application of additional liquid feed also helps, like diluted urine.



Green pepper growing on buckets of undiluted *Fossa* soil (left), poor Ruwa soil (right) and a 50/50 mix of the two (centre). A 20 fold increase in yield from poor to rich soil

Sugar Bean



Sugar bean is a valuable and popular crop. Early trials show it grows well on both neat *Fossa alterna* humus and humus mixed with other composts and rich top soils. On the left sugar bean growing on neat *Fossa* humus on 23rd February - on the right same plant 30th March. However signs of nutrient deficiency are showing up in the earlier yellow leaf. Growth is enhanced by the application of diluted urine (5:1, twice a week) – see next chapter.

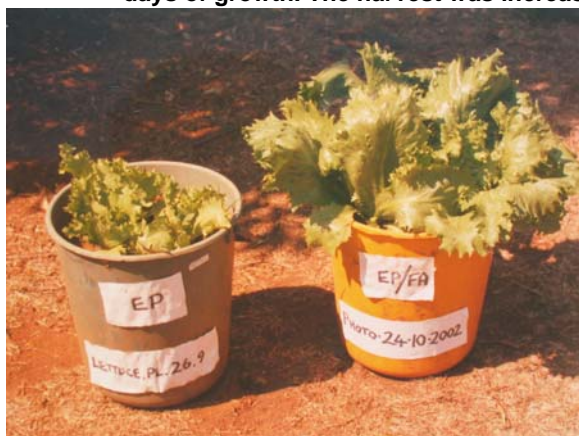
2. Effect of enhancing poor topsoil with *Fossa alterna* humus in containers

Most soils in this part of Africa are very deficient in nutrients and unless fertilised in some way, produce very poor yields. The fertility of poor soils can be increased significantly by adding compost and also cow manure, and these methods are often practiced and should be encouraged more. However, cow manure may not always be available, especially where people live in the peri-urban fringes. On this page you can see the effect of enhancing very poor soil (taken from Epworth) with *Fossa alterna* humus. In each case shown, the very poor topsoil was mixed with an equal volume of *Fossa alterna* humus (5 litres + 5 litres). The increase in growth is very significant. Poor soils, such as those used in the trial are very common in Africa. By combining poor soil and eco-humus, vegetable production can be enhanced significantly. Output of onion and leafy vegetables can be increased further by applying diluted urine in addition to eco-humus (see chapter 10).



Left Photo: The photo shows spinach grown on poor soil (from Epworth) in left bucket compared to spinach grown on the same poor soil mixed with an equal volume of *Fossa alterna* soil (right bucket) after 30 days of growth. The harvest was increased 7 times (546 gms compared to 72 gms).

Right Photo: The photo shows covo grown on poor soil (from Epworth) in the left bucket compared to covo grown on the same poor soil mixed with an equal volume of *Fossa alterna* soil (right bucket) after 30 days of growth. The harvest was increased 4 times (357gms compared to 81 gms)



Left Photo: The photo shows lettuce grown on poor soil (from Epworth) in left bucket compared to lettuce grown on the same poor soil mixed with an equal volume of *Fossa alterna* soil (right bucket) after 30 days of growth. The harvest was increased 7 times (912 gms compared to 122 gms).

Right Photo: The photo shows onion grown on poor soil (from Epworth) in the left bucket compared to onion grown on the same poor soil mixed with an equal volume of *Fossa alterna* soil (right bucket) after 4 months of growth. The harvest was increased nearly 3 times (391gms compared to 141gms). Whilst this a significant increase in onion production, the best crops are produced on very rich organic soil. Onions are hungry feeders. See next chapter on use of urine.