

MODULE 6

EFFICIENTLY MAKING AND USING COMPOST



**CLIMATICALLY, ENVIRONMENTALLY AND
ECONOMICALLY SMART FARMING PRACTICES**



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INTRODUCTION

Module 5 (Seeds and Seedling for Sustainable Fruit and Vegetable Production), discussed why having healthy planting material is an essential first step in sustainable climate resilient farming. This module explains another essential component of sustainable climate resilient farming, that of good quality compost.

Once again, the experience and lessons learned at the Tutu Rural Training Centre (TRTC) on Taveuni are drawn on. At TRTC, composting has become part of the cropping system that is used to sustainably improve the yields and quality of the crops grown – both for the Centre and the course participants' home farms. The cropping system used focuses on increasing the organic matter in the soil, improving the soil's physical properties, and supplying the essential nutrients for plant growth.

1.1 What is compost and composting?

- Composting is a recycling process of dead organic material that is faster and more efficient than the normal natural decomposing of dead organic material in soil and which can lead to the loss of the released nutrients.
- Compost is the decayed organic material added to the soil to improve soil structure through the addition of carbon and to provide plant nutrients. In addition to being a source of plant nutrients such as nitrogen (N), phosphorus (P) and potassium (K), it improves the physico-chemical and biological properties of the soil.
- By improving/supporting the soil structure and organic matter, compost improves the soil's ability to 'manage' water, thereby conserving moisture and at the same time, enabling drainage. Having well-functioning soil on your farm greatly improves the climate resilience of that soil and the food system it supports. Improving the water-holding capacity and filtration of soil means that it can better withstand drought, heat waves, and heavy rains, all of which are becoming more severe and frequent due to climate change. Additionally, compost improves overall soil health and biodiversity, resulting in healthier crops that are more resistant to disease and pests.

Father Isaia Wairoga, in Fiji TV 'Green Pillars', talks [here](#)  about the importance of 'giving back' to the soil.

1.2 Aerobic composting - introducing air into process:

1.2.1 A simple, less expensive method, by introducing air through frequent turning

The process involves:

- Mixing organic materials : **browns (carbon rich)** are more difficult to decompose, but provide important stable dark organic matter (humus) to the soil; **greens (nitrogen rich)** are easier to decompose and give a quick start to the decomposing process of the compost heap
- Placing the mix of materials in a pile
- Keeping the pile moist
- Regular turning of the pile to allow the circulation of oxygen – which allows microorganisms to quickly break down the organic materials in the pile.

This simple composting method is the system most commonly adopted by farmers because it costs much less to establish – although it is quite labour intensive



Compost browns (Photo Fr. Isaia)



Compost green (Photo Fr. Isaia)



Mixing green and brown organic material to make compost at the Tutu Rural Training Centre (Photo Fr. Isaia)

1.2.2 A more complex system (using a continuous air flow system)

A more complex composting system is to place your compost inside a sealed structure which provides for the continuous flow of air, and thus oxygen, through the compost pile. Thus, more heat is generated through the entire pile during the composting process which can kill plant pathogens and weed seeds. It also means that it takes a shorter time to fully decay organic matter and complete the composting process. It also requires less labour to operate than the system described in 1.2.1. However, it is more demanding and complicated to establish.

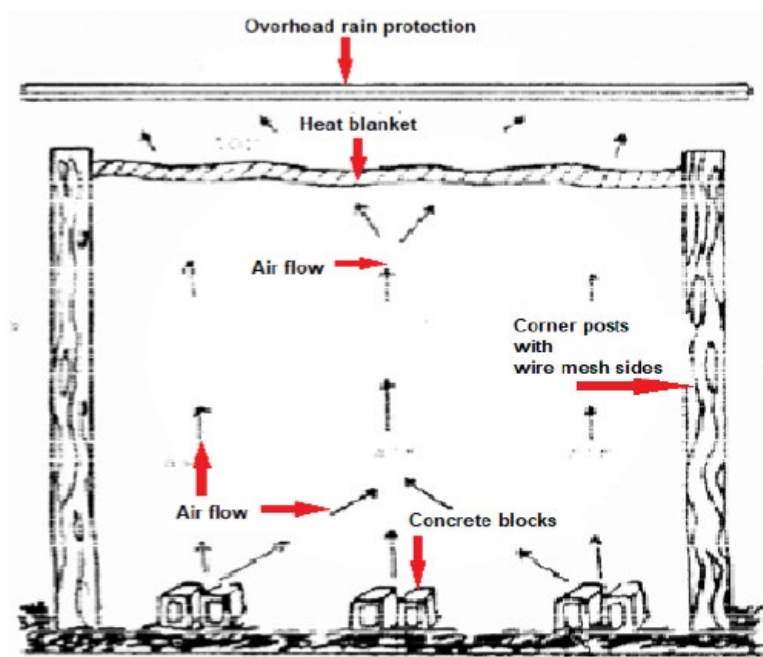


Fig 1 Composting using a continuous air flow system¹

1.3 Mulching of green material left on the farm - a natural form of aerobic composting

Mulch is a layer of material applied to the surface of soil to conserve soil moisture, improve fertility and health of the soil, and reduce weed growth. The mulch material also protects soil from rain drops, slowing down runoff velocity, and controlling erosion. Mulching also protects the soil from the blast of the sun. As the frequency and intensity of extreme events (that is, rainfall, drought and heat) are forecast to increase, any protection that can be provided for the soil, can only add to the climate resilience of the soil, and therefore the food production system. Mulch will eventually break down into compost through natural decomposition. Organic mulches can rot down to provide soil nutrients and encourage beneficial soil organisms and worm activity.

¹ van Santen, 2020, Crop Nutrition and Fertilization
<https://drive.google.com/file/d/1Fr9hXOUlb7DvzdeJmhu-zROx4TtDNOGM/view?invite=CKe47o0J&ts=62cbdf56>

Mulching would include such things as:

- Cutting sugar cane green and leaving the trash on the ground
- Cutting the mucuna beans before you plant your dalo
- Pruning *Glyricidia* (Bai ni cagi) in an agroforestry cropping system and leaving the branches on the ground.

Over time this trash will act as a natural compost, enriching the soil, conserving moisture and suppressing weeds.



Mulch from mucuna bean planted prior to the planting of yaqona (Photo Fr. Isaia)

1.4 Anaerobic composting

Anaerobic composting is composting that occurs in the absence of oxygen (O). It is the same decomposition process used for making biogas and gives off a bad rotting smell. Sophisticated expensive equipment is needed for quality anaerobic composting.

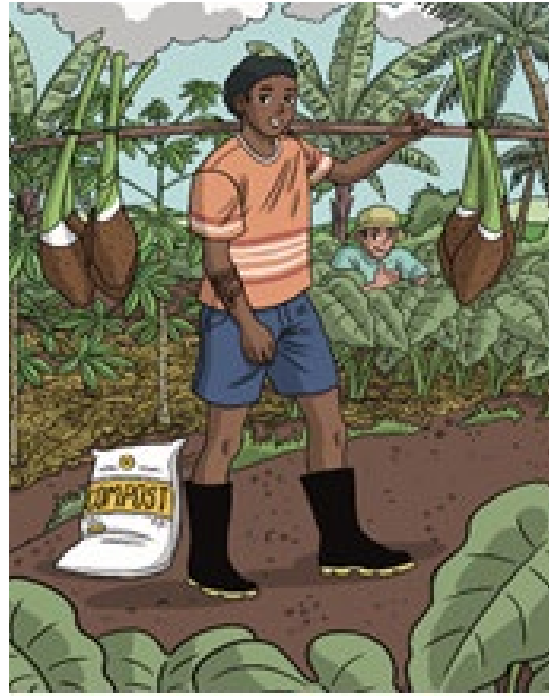


Fig 2 Using compost to produce more climate resilient crops²

Good composting provides soil health and moisture conservation in a stable organic way. The resulting benefits to the farmer are:

- An improvement in crop yields and quality through healthier soil which is maintained into the future. The farmer benefits from increased income which continues through time.
- Added micro-element nutrients which are not found in the regular fertilizers
- Less money is spent on purchasing fertilizer and other chemical inputs resulting in an increased net income. As discussed in Module 1, the cost of these inputs have increased significantly in the last year or so.
- Making additional income by selling the surplus of good quality compost to other farmers who value the importance of compost.
- Improving the health of your family and the community (if you sell your produce) through better quality, more nutritious food produce
- Improving the health of the environment by: reducing water runoff and soil erosion; attracting beneficial microorganisms; and decreasing the use of fertilizers.
- Enhancing the climate resilience of your farm by helping the soil to retain moisture, while at the same time supporting good drainage; soil treated with compost is able to retain carbon better and sequesters more carbon dioxide from the air³

2 PHAMA Plus, 2020 Managing the Impact of Climate Change on Root Crop Production and Value Chains: Option Paper. <https://phamaplus.com.au/wp-content/uploads/2021/12/Root-Crop-Market-Study-FINAL-v1.0-15-Nov-21.pdf>

3 <https://www.ucdavis.edu/climate/news/compost-key-sequestering-carbon-soil>



MAKING YOUR COMPOST

3.1 The brown and green materials used to make compost

Before you start making compost, you need to understand that both brown and green organic material is required to make good compost.


- **Brown materials** provide the stable material for creating humus.
- **Green materials** provide the material for early and quick decomposition.

To make the best compost you will need to start with a little bit more brown material than green material. Table 1 below provides examples of brown and green material for making compost. What you use will depend on the materials that are readily available on and around your farm. There are also certain materials that should not be used for making compost. They are **no go** because they can be harmful for crops, the environment and human health.

Table 1: Some examples of brown and green materials that can be used for making compost and no go materials you should not use (Source: Livai Tora)

| Browns (carbon rich) materials that can be used for making compost | Greens (nitrogen rich) materials that can be used for making compost | No go materials that should not be used for making compost |
|--|--|--|
| Pruned, dried and cut up woody plant material | Table and food scraps | Chemically treated timber |
| Debris from post-harvest planting materials | Vegetable trash and scraps | Diseased plants |
| Dried leaves and grass (including mucuna beans) | Fresh grass cuttings | Human waste |
| Dried and shredded coconut fronds | Fresh leaves (particularly from nitrogen fixing trees such as Ba ni cagi and <i>Calliandra</i>) | Meat and dairy products |
| Dried and shredded coconut husks | Seaweed and fresh chicken manure | Animal bone |
| Shredded dry wood and cuttings | Cocoa pods | Fats and oils |
| Untreated saw dust | | Glossy paper Plastic |
| Wood ash | | Weeds and seeds |
| Newspaper and shredded paper | | |
| Shredded cardboard | | |
| Egg shells | | |

3.2 The Tutu Rural Training Centre (TRTC) compost making system

The composting system used by TRTC is a proven system that can be adopted on a small scale or on a larger commercial scale. This system will take 8 weeks to complete. TRTC has developed its composting system over the last decade with technical assistance from international and regional experts who have shared their knowledge. It has helped TRTC's Oceania farm to maintain high yields without the use of chemical fertilizer or pesticides and has become an integral part of the Centre's training and outreach program. See [here](#)  the Fiji TV "GreenPillars" presentation by TRTC trainer Lusiana Lasaqa on why and how you should make compost (including compost tea).

3.2.1 The composting ingredients at TRTC

Green materials

- Seaweed
- Chicken manure
- Fresh grass cuttings
- Vegetable trash

Brown materials

- Dried shredded coconut fronds
- Sawdust
- Shredded dry wood and cuttings
- Pruned materials from around the farms
- Debris from post-harvest planting materials

Around 60 per cent brown material and around 40 per cent green materials are used in the compost mix.

The shredding of the larger brown material

To enable the composting process to be completed in eight weeks the larger brown material (coconut fronds and dried wood cuttings) are first shredded. Green and brown leaves are also usually shredded. Due to the size of TRTC's composting operation, they use a commercial mechanical shredder. A small farmer composting operation would need to use a cane knife for shredding.



The commercial shredder us at Tutu (photo Andrew McGregor)

3.2.3 The composting process: combining the green and brown material

All composting at Tutu is done in a large open old shed to provide shelter from the weather. The piles of the various green and brown ingredients are assembled in separate piles, before the composting process commences

The creation of 65 kg composting heaps

The composting is undertaken in 65 kg composting heaps. These heaps start with six layers of organic material:



• **Layer 1** (bottom layer): Green leaves (15 kg)



• **Layer 2:** Shredded brown material (5 kg) Adding the layer of shredded brown material to the bottom layer of green material



• **Layer 3:** Seaweed (5 kg) Adding a layer of seaweed to the pile



• **Layer 4:** Chicken manure (20kg) Adding a layer of chicken manure to the pile

(photos Fr. Isaia)



• **Layer 5:** Top soil (5kgs) Adding top soil to the pile (photos Fr. Isaia)



• **Layer 6 (top layer):** Shredded green leaves (15kgs) Adding the final layer of shredded green leaves (photos Fr. Isaia)



Covered piles of compost at different stages (photo Fr. Isaia)



Completed black compost ready for bagging (photo Fr. Isaia)

The 8-weeks of composting

The first week: After the final layer (shredded green leaves) has been added, the pile is covered with plastic and left to stand for one week.

The next seven (7) weeks: After one week, all the layers are mixed together and some water is added to keep the pile moist. It is then covered again. Then once a week, for the next 7 weeks, the pile is: uncovered; water added if needed to keep the pile moist; mixed; and, covered again. The turning of the compost pile involves bringing the material in the centre of the pile to the outside edges and the material from the bottom to the top. This process ensures that composting occurs evenly throughout the pile. At the end of this period the compost is bagged ready for use.

3.3 Why do you need to regularly mix your pile of organic matter to make good compost?

By mixing (turning) the organic matter and keeping it moist, you are encouraging the establishment of millions of microorganisms who make the compost. At TRTC mixing is carried out once a week over a seven (7) week period. The turning of the compost is simply done with a shovel or a postal spade



Turning a compost heap with a shovel (photo Fr. Isaia)

3.4 What are the characteristics of good quality ready-to-use compost?

Texture and colour: Good compost should have moist small soil-like particles, with a rich black-brown colour

Smell: Good compost has a nice earthy /mouldy smell just like good quality top soil. It should not have an unpleasant odour

Temperature: Good compost, when completed, is cool and moist. If it is still warm, the composting process has not yet been completed. It should be stirred again and left for longer

It is recommended that you send your compost to the MoA's Koronivia Research Station for soil testing.


3.5 How long does it take for the compost to be ready for use?

It can take anywhere from a month to several years to complete the composting process. The time taken will depend on:

- The raw materials you use for making the compost and the extent that they have been prepared (shredded and cut up), for composting.
- The rate at which you turn and mix the composting heap.

Generally, the warmer the environment in which the composting is undertaken, the shorter the time period for the process to be completed. For the TRTC example, given above, it takes eight weeks for the compost to be ready to use. The TRTC experience is a guide as to how long it should take to make good compost in a Pacific Island tropical environment.

3.6 A summary of the Tutu composting system

A summary video of the Tutu composting system is provided [here](#)  by Waisea Turaga in Fiji TV "Green Pillars"

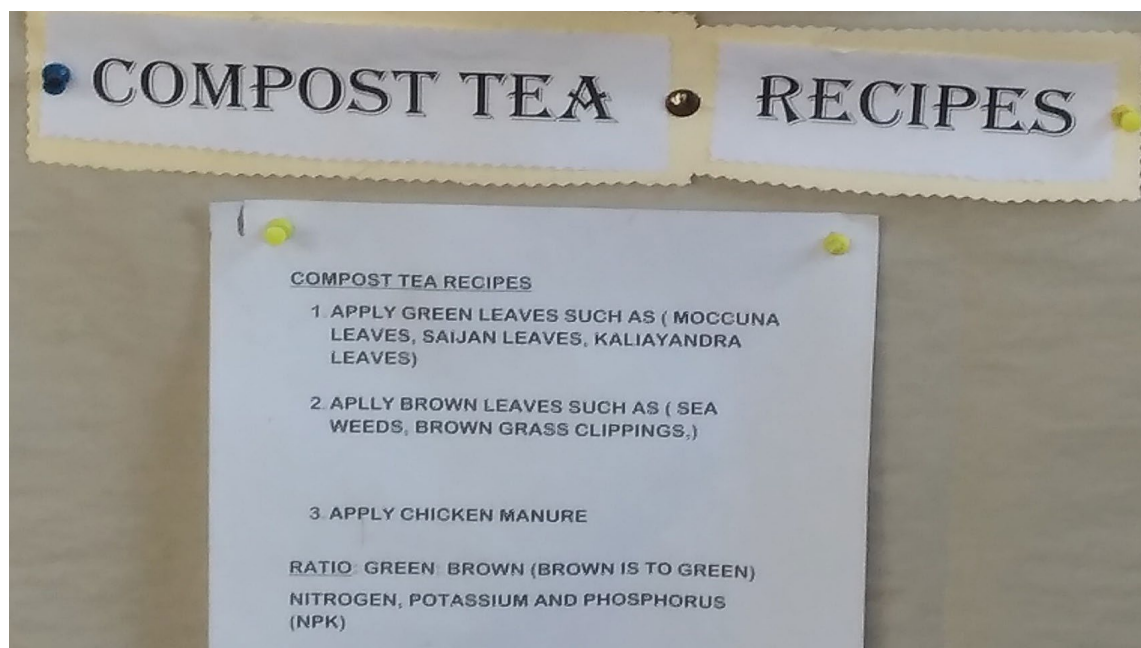
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MAKING COMPOST TEA

4.1 What is compost tea?

Compost tea is a well-balanced and nutrient rich fertilizer that you can make by brewing compost in water. This can then be used as a foliar fertilizer for flowering plants and vegetables. It is particularly valuable for use in seedling nurseries. Compost tea also provides an excellent way to quickly deliver organic nutrients that are available in the compost to a plant's root zone.

4.2 How to make compost tea: The Tutu Rural Training Centre Method



The ingredients for a batch of Tutu's compost tea are:

- 200 litres of water
- 3 kg of compost
- 2 litres of molasses.

4.2.1 Procedure for making compost tea at Tutu

The brewing process to make compost tea at TRTC is completed in 24 hours, using the following two step procedure:

- **Step 1:** In a plastic drum, 200 l of water is mixed with 3 kg of well-matured compost and 2 l of molasses. The role of the molasses is to facilitate the brewing process through the rapid spread of good bacteria.
- **Step 2:** A mini water pump is used to aerate the tea as it brews

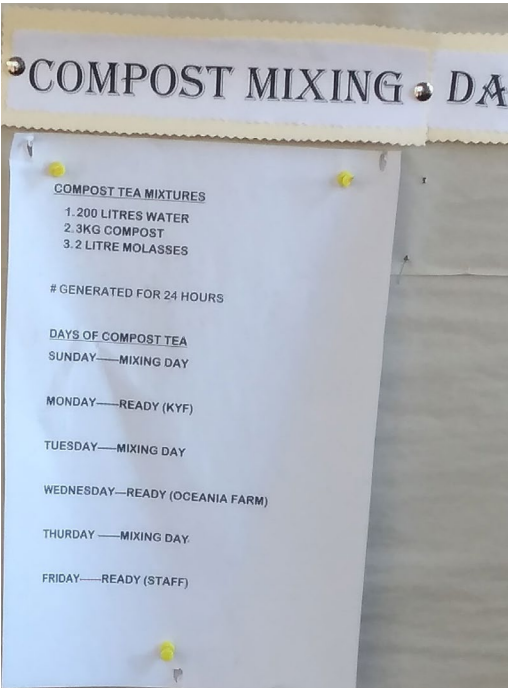
The end product is a well-balanced and nutritionally rich liquid fertilizer that is used for vegetable production at the TRTC – particularly for seedlings and off-season vegetable production.



Making of compost tea (photo Andrew McGregor)



Equipment used to make compost tea (photo Andrew McGregor)



The compost tea mixing schedule at Tutu (photo: Andrew McGregor)

5

USING THE COMPOST THAT HAS BEEN MADE

Once you have made your high quality compost or compost tea you have a valuable organic fertilizer that you need to put to best use. It is unlikely that you will have enough compost to use throughout the entire farm. Therefore, the compost needs to be focused in the areas where it will have the greatest impact. Such areas are:

- Nursery seed and seedling production
- High value off-season vegetable production.
- High value fruit crops such as papaya, dragon fruit and rambutan

Examples of how compost is used

The Tutu Rural Training Centre

The standard mix for using the compost made at TRTC is **3 parts rich top soil and 1 part compost**. The compost made at TRTC is being used in the following ways :



i) Raised-bed vegetable production (photo Fr. Isaia)



ii) Vegetable seedling nurseries (photo Fr. Isaia)





iii) Yaqona planting material nursery (photo Fr. Isaia)



iv) In off-season vegetable production tunnel— compost and rich top soil is used as the planting medium (photo Fr. Isaia)



v) Vegetable garden production (photo Fr Isaia)

Fr. Isaia Wairoga talks about using compost at Tutu [here](#)  and [here](#) 

Bula Agro

At Bula Agro (Votualevu, Nadi), they have adopted a similar aerobic compost making system as described for TRTC. Sant Kumar uses the compost in a range of different ways:

- i) **Potting medium for the seedlings grown in the nursery.** To 30 kg of compost the same amount of sterilized soil is added plus NPK (about one tuna can) and Yates potting mix (250g)



(photo: Moko Productions)



ii) **Planting medium for dalo suckers planted in old bags.** Equal amounts of compost and sterilized river bank soil are used. This is an ideal system for backyard farmers who have limited space available.



(photo: Moko Productions)



iii) **Planting of fruit trees in drums.** Sant plants a range of fruit trees (cumquat, lemon and lime) in drums using equal amounts of compost and sterilized river bank soil. These are kept well pruned, and with the on-going addition of compost, these trees can be expected to have long and productive fruit bearing lives.

(photo: Moko Productions)



See Sant Kumar talking about using drums [here](#)  and Prakash of Johnson Road Lautoka using a similar system [here](#) . A particular advantage of this system is its resilience to cyclones. With an approaching cyclone the pots can be laid on their side until the cyclone passes as explained by Sant.

(photo: Moko Productions)

6.1 Should I cover my compost?

The more you can control the environment in which the compost is being made the better. The organic material you have mixed and piled up to make compost will heat up. This is how it should be, as it shows that the millions of microbes that make the compost are at work. You don't want to lose this heat before their job is done. You also want to keep your composting heap moist for these microbes to do their work. Retaining heat and moisture is why it is best to cover your heap while it is composting. This is commonly done by covering the heaps with plastic sheets. However, if possible, it is better to use something like burlap cloth, old blankets or cloth. These materials are better at retaining heat, moisture and nutrients and allow for better air movement so that carbon dioxide is removed, replaced by oxygen. Another alternative is to purchase plastic composting bins, particularly if you are a small backyard farmer.



Composting heaps at Tutu covered with plastic sheets (photo Fr. Isaia)



A small backyard farmer using plastic bins (photo Andrew McGregor)

6.2 How often should you turn compost?

The proper turning of the composting heap involves bringing the material that was on the outside edges to the centre and the material that was at the bottom of the pile to the top. This is to ensure that the composting process is even throughout the pile so that the quality of the compost is uniform and consistent throughout the pile. Turning is carried out regularly once a week at the TRTC. By doing so, they are able to produce good quality compost in eight weeks. Most people making compost tend to turn it less frequently and less regularly. Thus, the process takes longer and the quality of the end product is not as good - unless you build a compost heap covering structure with air movement facilities built into it⁴

⁴ van Santen, 2020, Crop Nutrition and Fertilization, pages 21-22.
<https://drive.google.com/file/d/1Fr9hX0Ulb7DvzdeJmhu-zR0x4TtDNOGM/view?invite=CKe47o0J&ts=62cbdf56>

Not turning your compost will cause anaerobic bacteria to become dominant which slows down the process and results in low quality compost with an unpleasant smell.

6.3 Can you turn compost too much?

Turning too often, such as every day, may not provide enough time for the pile to heat up and the fungi that do much of the composting work to be formed. As previously mentioned, turning your compost regularly once a week is a good guideline to follow.

6.4 Do you add water to a compost pile?

As a general rule your composting pile should be moist, but not sopping wet. A rule of thumb is: the greener material (seaweed, chicken manure, fresh grass cuttings) you put in the mix, the less water you'll need to add to maintain moisture. You can help by soaking some of your dry material before putting it in the compost pile.

6.5 Should some additional organic fertilizer be added to the compost?

The heating process which occurs when making compost results in some beneficial microorganisms being killed off. You can compensate for this loss by adding some fresh organic material such as chicken or goat manure or millmud from a sugar mill. Alternatively you can purchase some organic fertilizer, such as Alroc #3.



Adding other organic manures or fertilizers like Alroc #3 to the compost has the beneficial effect of replenishing lost micro and macroorganisms as well as micronutrients (photo Livai Tora).

