Organic Farming in the
Tropics and Subtropics

Exemplary Description of 20 Crops

Vanilla

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Franz Augstburger, Jörn Berger, Udo Censkowsky,
Petra Heid, Joachim Milz, Christine Streit.

The cultivation guidelines are available in English, Spanish and German for the following crops:

banana, brazil nut, cashew nut, cocoa, coconut, coffee,
cotton, hibiscus, macadamia, mango, papaya, peanut,
pepper, pineapple, sugar cane, sesame, tea, vanilla.

The cultivation guidelines for Bananas, Mangoes, Pineapples and Pepper were revised in 2001 for the United Nations Conference on Trade and Development (UNCTAD) by Udo Censkowsky and Friederike Höngen.

In 2002 two more guidelines, for rice and date palms, were published in English.

All the authors emphasize, that the cultivation recommendations at hand can just provide general information. They do not substitute technical assistance to the farmers with regard to the location.

All indications, data and results of this cultivation guidelines have been compiled and cross-checked most carefully by the authors. Yet mistakes with regard to the contents cannot be precluded. The indicated legal regulations are based on the state of the year 1999 and are subject to alterations in future. Consequently all information has to be given in exclusion of any obligation or guarantee by Naturland e.V. or the authors. Both Naturland e.V. and authors therefore do not accept any responsibility or liability.

Furthermore the authors kindly call upon for critical remarks, additions and other important information to be forwarded to the address below. The cultivation guidelines will be updated regularly by Naturland e.V.

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Organic Cultivation of Vanilla

1. Introduction

Vanilla (*Vanilla planifolia L.*) originates from the tropically-humid regions of Mexico and Central America, yet also grows wild in the virgin forests of South America. The native populations use it as a spice and also as perfume. Vanilla arrived in Europe during the Spanish conquest, and was later spread throughout Africa and Asia. It is particularly popular for fine, aromatic taste. Towards the end of the 50's, expensive, natural vanilla became increasingly supplanted by inexpensive, synthetic vanillin, manufactured from eugenol or guajacol, resulting in cultivation of the natural product coming almost to a standstill. It was only at the beginning of the 80's that demand for natural vanilla increased, on account of its superior aroma. Synthetic vanillin is not allowed to be used in organic foodstaff (e.g. chocolate, ice-cream).

1.1. Botany

The vanilla genus belongs to the family of tropically climbing orchids. It is the only genus in the orchid family which produces edible fruits. Vanilla is a volubilate plant with aerial rootlets, thick, fleshy leaves, yellow-white to cream-coloured blossoms and only one stamen. The green fruit capsules of the marketable varieties can attain a length of 15 to 20 cm, which become yellow as they mature, and open lengthways. The seeds are extremely small, while substances within the capsule hinder germination, so that on commercial cultivations, propagation is performed vegetatively via shoot seedlings .

1.2. Varieties and producing countries

Of the 100 species among the genus vanilla, three in particular are cultivated:

- *V. planifolia*, Mexican or Bourbon vanilla, different varieties of which exist. It is cultivated in Mexico, on the islands in the Indian Ocean, and also in Indonesia.
- *V. pompona Schiede*, vanilla originating from the West Indies, is cultivated on the Lesser Antilles.
- *V. tahitensis J.W. Moore*, Tahiti vanilla, grown on Tahiti and the other Polynesian islands[1].

[1] ACHTNICH, W. in Rehm (1989): Handbuch der Landwirtschaft and Ernährung, Band 4.

The principle vanilla producers today are Madagascar, the Comoros, the Mascarene Islands and the Seychelles, as well as Java and a few Pacific islands west of Central America and the Lesser Antilles.
Vanilla cultivated organically mostly stems from Madagascar, the Comoros, the Bourbon Islands, the Philippines, Indonesia, Haiti, Uganda, and to a lesser degree, Mexico and Costa Rica.

1.3. Uses and contents

Natural vanilla is mainly used for high-quality confectionery and for baking, it is also becoming increasingly popular in manufacturing ice-cream. Expensive brands of chocolates made of organically cultivated ingredients are also flavoured with vanilla. In addition to the processed capsules (vanilla sticks), the ground down fruits are also marketed as vanilla powder, or, mixed with sugar, as vanilla sugar. Other products include vanilla extract, an alcoholic extract (35% alcohol) made with sugar and binding substances, which is used in a variety of dilutions. Along with vanillin (0.75-3.7%), vanilla also contains vanillic acid, alcohols, ester of cinammic acid, p-hydroxybenzaldehyde and other taste and odour substances, in addition to sugar, resins, mucilage, tanning agents and fat. Besides vanillin, *Vanilla tahitensis* also contains piperonal, which is mainly used in the manufacturing of perfumes.

2. Aspects of plant cultivation

2.1. Site requirements

Vanilla is a climbing plant that is always planted in combination with tutor trees in organic cultivation systems. *Gliricidia sepium*, *Erythrina spp*. and *Inga spp*. are to be especially recommended. A variety of native palm trees are also suitable.

The plant usually grows in thinned out areas on natural sites (fallen trees, natural forest clearings, such as, e.g., river banks and lakes). Here, it grows alongside the secondary forest vegetation, or populates certain areas of meadow forest systems. Once vanilla has become established, it will grow to reach the crown region of the medium-sized trees in a forest. These natural site requirements must be considered in agroforestry systems, and are more important than the type of tutor trees used. The most important aspect is to integrate a wide variety of trees into the agroforestry system, which includes combining trees from the lower and mid levels need to be combined in the process with those of the canopy. Combining vanilla with only one other tree variety, for example *Inga spp.* or *Glyricidia sepium* is not recommended. Such systems are susceptible to disease, as the secondary forest trees will have reached or surpassed their age limits after 15-30 years. Moreover, they only produce a mediocre quality of biomass.

Vanilla needs a humid climate with average temperatures of 25°C and 1500-2500 mm of rain. Cooler temperatures of down to 5°C can be withstood for a short period. A short drought lasting 2-3 months, or spells of cooler temperatures, will stimulate blossoming. Cultivation is possible up to latitudes of 20°. Light, humus-rich soils without danger of water-logging, and with pH values around 7, are best.

2.2. Seeds and seedlings

Among the different varieties of vanilla, there are plants that drop 80-100% of their fruits before harvesting begins. Others produce fruits with a very low vanillin content. When choosing plants, care should therefore be taken to select seedlings from healthy, productive plants, which yield good quality vanilla. Before the seedlings are cut off, the parent plant's productivity should be tested and noted down.
The seedlings must be healthy, and not longer than 80 cm, as otherwise, it will take longer before they begin to produce. Damaged leaves must be removed, along with the lower three leaves at the shoot's base. After being cut down, the seedlings should be left in the shade for 5-8 days, to allow the cutting wounds to heal and prevent fungi infection at a later date.

2.3. Planting methods (new cultivations)

The vanilla seedlings are planted 6-12 months after the site has already been planted with trees. The best time to plant is directly before the rainy season, on sites which lay slightly higher, and are in no danger of becoming water-logged.
Two seedlings are planted beside each tutor tree. The seedlings should be planted in rills that are 30 cm long and 10 cm deep, and then covered over with top soil. Finally, the planting hole is covered over to an area of at least 1 m² with a layer of organic material mulch. The seedling is then attached to the tutor. The density of plants can be up to 400 and 800 plants/ha.

2.4. Diversification strategies

Vanilla is particularly suitable as an additional crop on diversified agroforestry sites, and can be easily integrated into the systems of organic banana and cacao plantations. Combinations with Copuazú (*Theobroma grandiflora*), rubber (*Hevea brasiliensis*), avocado (*Persea americana*), tea (*Camellia sinensis*) and many other species with similar eco-physiological site requirements are also possible. Developing the agroforestry system along pure forest and vanilla production lines is also feasible.

2.5. Supplying nutrients and organic fertilisation management

Neither information concerning nutrient demand, nor fertiliser recommendations are available for vanilla. Production on conventional plantations is also impossible without large quantities of organic materials. The production of sufficient amounts of mulch within the plantation is therefore decisive to the successful cultivation of vanilla. One of the central objectives in organic cultivation systems is the continual production and transformation of high quantities of organic material. It is thereby important that the organic material is stemming from a great variety of plant species produced on the plantation. This helps to guarantee the long-term survival of the system, and also to keep production costs at an economical level.

2.6. Biological methods of plant protection

2.6.1. Diseases

A range of **fungus diseases** occur on vanilla cultivations, the most important of which are:

Fungus	Description of disease and cause
Fusarium oxysporum	Is the most frequent disease of roots and shoots. Infection results from wounds in the roots, which can be caused by stepping on them, or when the plants are pruned.
Anthracnose *(Colletotrichum vanillae)*	Affects leaves, shoots and fruits. Irregular brown flecks, the affected parts die and fall off, leaving indentations. Occurs most often on poorly maintained plantations with proper shading control.
Puccinia sinamononea (honguillo, roya)	Small, prominent, dark yellow blisters on the bottom of the leaf. When the blisters join up, large, dark irregular flecks form, and the plant eventually dies off. Occurs mostly on poorly maintained plantations during the wetter seasons.

2.6.2. Pests

Generally, pests barely play a role on organic vanilla cultivations. Occasionally *Clysia vanillana,* a butterfly, may appear, whose caterpillars eat the capsules, also, bugs (*Spinas floridulos, Nezara spp*.), beetles and dwarf cicadas can cause a certain amount of damage. Snails that damage shoots and leaves turn up in some regions of Mexico.

Crop measures are the first method of regulation (comp. 2.6.3.) (shade management, trimming, rejuvenation). Plant protection preparations are only permitted in emergency cases on organic plantations. Also, infusions made of chilli peppers (*Capsicum spp*.) and the leaves of *Gliricidia sepium* (madre de cacao) be poured over the plants[2].
If the plantations are located near to dwellings, free-roaming pigs and chickens may cause considerable damage to the crops. Therefore, it is important that these animals are kept out of the plantation.

2.6.3. Recommendations to prevent and counteract diseases

- Choice of site (no water-logging, abundance of organic material);
- Plant vanilla only after tutors and support vegetation have been established;
- Gaps between plants must be large enough;
- Only plant healthy plants; plant seedlings after wounds have healed; eventually disinfect with Bordeaux mixture[3];
- Remove diseased plants;
- Management of light/shade and enrichment of organic material through tree trimmings;
- Avoid damaging the vanilla plants' roots by not stepping in their vicinity;
- Constant rejuvenation of the plantation (see below);
- Lignin-rich mulch material stimulates the actinomycetes in the soil, which are in turn antagonists of Fusarium;
- Do not pollinate too many blossoms, as this will weaken the plant;
- Application of plant strengthening preparations, such as plant infusions that function as fungicides[4].

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[2] 5oo g Chilli ground with water. Mix 1 l of this mixture with 15 l water, and spray over the infected plant parts. Effect is increased when soap is included.
Grind down fresh *Gliricidia sepium* leaves with water, and leave to stand for one night. Dilute 2.5 l of the liquid with 15 l of water, and spray over the infected plant parts.

[3] According to the European Regulation for Organic Agriculture (EEC) 2092/91 the use of copper preparations for plant protection (e.g. Bordeaux Mixture) is allowed for a transitional period which will end at the 31st of March 2002. However, any use of copper preparations until 2002 has to be approved by the certification body. In case copper preparations have to be applied it is recommended to use preparations which contain less copper and therefore to reduce the accumulation of copper in soils (e.g. tribasic copper sulphate, copper hydroxide).

[4] Mix 1 kg onions with 250 g of garlic in water. Leave it to ferment for 4-5 days, uncovered. Pour 1 l of this liquid through a sieve, and mix with 15 l of water. Regularly pour over the roots, and spray the entire plant with it.
Grind 1 kg papaya leaves and add to 1 l of water. Strain, and mix in 4 l of soapy water. Spray leaves against a variety of fungus diseases.

2.7. Crop cultivation and maintenance

2.7.1. Young plantations

If their growth is unchecked, vanilla plants can reach up into the crown region of the medium-sized forest trees (15 m and more). This height is undesirable for cultivated plants, as it makes harvesting and pollination more difficult. As soon as the tip of the shoot has attained a height of 1.60 to 1.80 m, it should be bent over a suitable branch, stuck into the ground, then covered with soil to encourage it to take root. The shoot is then re-attached to the tutor. Through this method, the vanilla plant is continually rejuvenated and will be less susceptible to disease. This also helps to protect the plant against root diseases, as there are also several stems available with their own root system.
Another method of controlling growth is to cut off the shoot when it reaches a height of around 60 cm, and to plant this new part – after the wound has healed – next to the same tutor tree.
Shoots that have already borne fruits can be cut off and used to plant with. This method of trimming will encourage the growth of new shoots, rejuvenate the plant and improve the overall health of the whole plant.

2.7.2. Maintenance tasks

Vanilla plants have a surface root system within the first 5-10 cm of the layer of leaves and decomposed organic material. It stretches across a radius of about 1.20 m around the plant. Care must be taken not to damage the system during maintenance and harvesting tasks. Weeds should only be tilled manually, whereby grasses are removed, and other weeds cut out before they blossom with a bush knife to be used as mulch material on the plantation.
As is the case with most orchids, vanilla requires a balanced ratio of light : shade. Therefore, during the less sunny times of year, both the tutor trees and the additional vegetation should be trimmed before they blossom. Those trees among the secondary forest system in particular that do not shed their leaves should be trimmed (these include most of the recommended species of tutor trees, except the palm trees). Species that belong to the forest canopy generally do not need to be trimmed, as they are usually deciduous. The collected foliage should be cut up and spread around the plantation as mulch.
In addition to regulating the light conditions on the plantation, trimming also provides a continual supply of organic material for a sufficiently thick layer of mulch.

2.7.3. Manual pollination

After 3-4 years, vanilla plants begin to blossom. The dainty way that the blossoms are constructed means that natural pollination – although possible – can only be carried out by small Mexican bees. Therefore, in order to assure that enough fruits are set,

artificial pollination is performed. This is done by pushing up the rostellum with a thin stick or needle, and opening up the pollinium – which comprises the whole of the only stamen to contain pollen – whilst keeping one finger on the stigma. The best blossoms to pollinate are those located at the bottom and hanging downwards, as they will produce fruits after being pollinated. The blossoms located further upwards generally bear distorted fruits

The number of blossoms pollinated – and therefore the amount of fruit which can be harvested – depends on the development stage of the plant as well as the water supply, and may be between 5 and 60. Generally, a mature plant will yield 30-40 fruits for 4 or more years. This means that 2-4 blossoms per inflorescence must be pollinated, depending, of course, on the total number of blossoms.

Care must be taken not to tread on the roots during manual pollination.

The plant will be weakened if too many blossoms are pollinated, shoot development is reduced, and the fruits barely ripen, or fall to the ground. The plant is also far more susceptible to pests and diseases. Therefore, should a vanilla crop become diseased directly following pollination, this is usually because too many blossoms have been pollinated, and/or, due to the roots being stepped on during the process.

When enough have been pollinated, the remaining flower buds should be removed. 15 to 20 days after pollination, the crop should be checked again, either to continue the process once more, or to remove buds that have since grown.

2.8. Harvesting

The capsule harvest is usually picked manually when the fruits are a ripe yellow, 6-9 months after blossoming. The correct time is important, as too early, and the fruits will contain less of their important constituents, too late, and the over-ripe capsules may burst open during preparation.

3. Product specifications and quality norms

Vanilla is graded according to the size of the capsules, as well as their vanillin content.

Grading according to size:

Grade	Length of capsules [cm]	Length of capsules [inch]
A	21.84 - 22.86	8.6 - 9.0
B	20.57 - 21.59	8.1 - 8.5
C	19.30 - 20.32	7.6 - 8.0
D	18.03 - 19.05	7.1 - 7.5
E	16.76 - 17.78	6.6 - 7.0
F	15.49 - 16.61	6.1 - 6.5
G	14.22 - 15.24	5.6 - 6.0

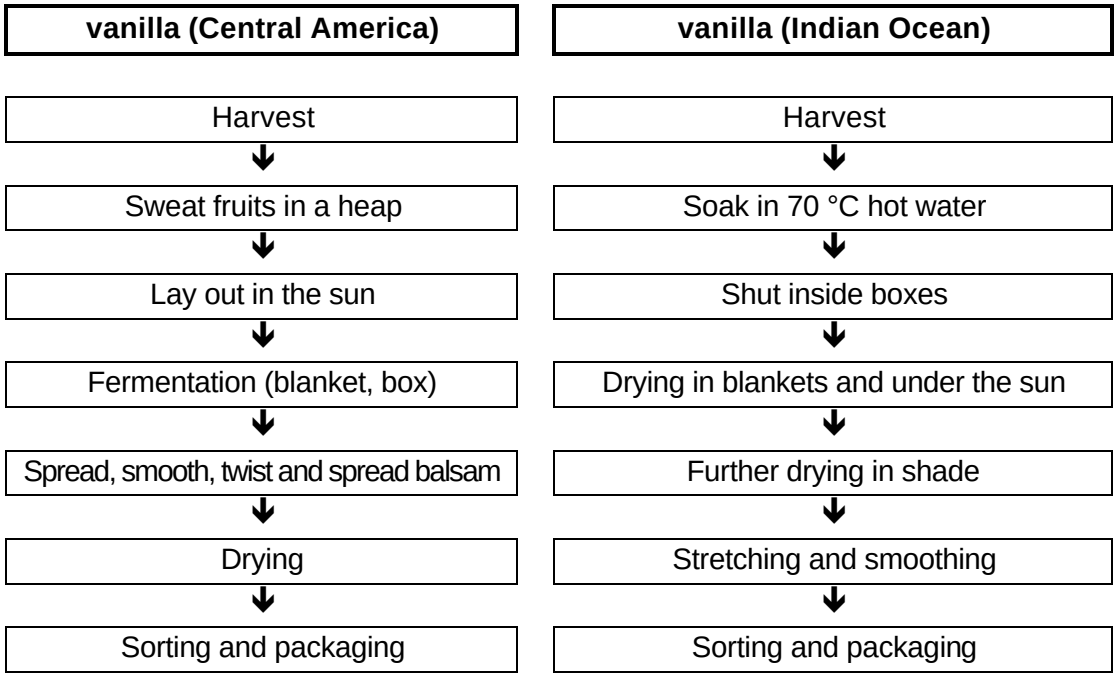
The best qualities have a moisture content of 23-25% and a vanillin content of 2.5% (in dry matter).
Other methods of grading (Mexico) are based on flexibility and shine, as well as their aroma and colour.

3.1. Vanilla sticks

3.1.1. Processing

Vanilla sticks have a high trading value, and are used as flavouring in baking products and confectionery, chocolates, drinks, as well as in the liqueur and essence industries and to manufacture perfume. The almost fully grown, yet not yet fully ripened, yellow capsule fruits (sticks) – which develop on the flower buds and are processed in a variety of ways – are used either whole or ground as spice.
Vanilla is produced from the still aroma-less green to light yellow vanilla fruits, by fermenting and drying them for a few months after harvesting. The following provides a schematic overview of the 'Mexican method' and the method used in the producing regions around the Indian Ocean. A fuller description follows afterwards.

Flow chart for the tasks involved in processing vanilla sticks



Mexican processing method

The harvested vanilla sticks are placed in large heaps, so that they begin to sweat, wither and ferment. After a few days, they are laid out in the sun for a couple of hours, and then covered with a blanket around midday. In the evening, the blankets and vanilla are rolled together and placed in sealed boxes to sweat further. Depending on the condition of the vanilla sticks, the process is repeated for around 8 days to a month. Regular checks are made remove mouldy sticks, the sweating – which gives rise to considerable heat – begins the aroma forming process. The vanillin is contained in the balsam-like, oily liquid that develops in the inner layer of the pod. During the process, the liquid oozes out into the capsule's interior and evenly covers the pod. Each vanilla stick is individually stretched and smoothed out in order to ensure that the seeds and oily liquid from the fleshy
interior are evenly spread throughout the pods. Drying, which takes place afterwards, needs to be interrupted at precisely the right time (learned from experience), as the amount of aroma present – and thus the vanilla's value – is dependant on this. After processing, the vanilla sticks are typically dark brown in colour, soft, pliable and smelling strongly of vanilla.

Method used in the producing regions around the Indian Ocean

Vanilla pods are processed differently in the producing regions of the Indian Ocean. After harvesting, the fruits are sorted according to length and ripeness, then placed into baskets and dipped into large tubs filled with 70°C hot water for two minutes. They are then shaken dry, and laid in boxes (air-tight if possible) lined with blankets, where they remain for one whole day. The fruits are then removed and laid between blankets placed out in the morning to midday sun. After around a week, the vanilla pods have taken on their familiar dark brown colouring and become soft and pliable. Finally, the vanilla sticks are laid out to dry on shelves in well-ventilated rooms for about a month. The pods are continually checked for mouldy ones, and turned over so that each side can be evenly dried. After drying, the pods are stretched and smoothed out with a piece of polished wood so that they regain their natural shape.
Vanilla sticks are not allowed to be treated during or after the drying process with methyl bromide, ethylene oxide or with ionising rays.

Sorting into quality grades

After drying, the vanilla sticks are first separated into two categories: in split and non-split fruits. The intact pods are then sorted into four quality grades.

1. quality:
juicy, oily, chocolate brown coloured, perfectly formed, vanilla sticks with no blemishes.

2. quality:
somewhat thinner pods with slight defects (flecks or scars).
3. and 4th quality:
depending on thickness, colour, uniformity, number of flecks and degree of dryness.
After grading, the vanilla sticks are bundled, wrapped in wax paper and packaged in aluminium or wooden crates.

Other gradings in the trade include Bourbon vanilla (rich, mature aroma, with up to 2.9% vanillin), Mexican vanilla (fine aroma, up to 1.8% vanillin), Tahiti vanilla (sweet, perfume-like aroma, up to 1.5 %vanillin) and Indonesian vanilla (ligneous, strong aroma, up to 2.7% vanillin).

3.2.2. Quality requirements

The following is a list of quality characteristics with minimum and maximum values for vanilla sticks that are usually required officially or by importers. Different minimum and maximum values can be agreed between importers and exporters, providing these do not clash with official regulations.

Quality characteristics	**Minimum and maximum values**
Taste and smell	Typical for variety, strong, aromatic
Purity	Free of foreign matter, i.e. sand, stones, shell parts, insects etc.
Vanillin	min. 2.0 %
Ash	max. 7.0 %
Hydrochloric acid-soluble ash	max. 0.5 %
Residues	
Pesticides	Not measurable
Bromide	Not measurable
Ethylene oxide	Not measurable
Micro-organisms	
Mould fungi	max. 100,000/g
Escherichia coli	max. 10,000/g
Bacillus cereus	max. 10,000/g
Sulphite reducing Clostridium	max. 10,000/g
Staphylococcus aureus	max. 100/g
Salmonella	Not measurable in 20 g
Mycotoxins	
Aflatoxin B1	max. 2 µg/kg
Total aflatoxins B1, B2, G1, G2	max. 4 µg/kg

In order that the quality requirements are upheld, and no contamination of the vanilla sticks occurs, preparation should take place under clean, hygienic and ideal conditions. The following aspects should be adhered to:

- Equipment (tubs, knives etc.), as well as working and drying surfaces (racks, mats etc.) and preparing and storage rooms, should be cleaned regularly.
- Personnel should be healthy, and have the possibility to wash themselves, or at least their hands (washrooms, toilets) and wear clean, washable overgarments.
- Water used for cleansing purposes must be free from faeces and other contaminants.
- Animals or animal faeces must not come into contact with the product. If the vanilla sticks are to be dried in the open, nets or fences should be erected around them to protect against freely-roaming birds and animals.

3.2.3. Packaging and storage

Bulk packaging

In order to be exported to Europe, the graded vanilla sticks are generally sealed in units of 20-30 bundles (8-10 kg) in metal tins lined with wax paper to avoid drying out.

Consumer packages

If the vanilla sticks are not to be packaged in bulk containers in the country of origin, but sealed in consumer packages, then this packaging should fulfil the following functions:

- Protect the vanilla sticks from loss of aroma and against undesirable smells and tastes from its surroundings (aroma protection).
- Protect the contents against damaging.
- Offer sufficient conservation properties, especially against loss or gain of moisture.
- Provide a surface area for advertising and product information.
- Prominent notification of the vanilla's ecological origin[5]
- Easy to open and re-seal, so that those vanilla sticks remaining in the case stay fresh.

The following materials can be used as **product packaging**:

- Plastic tubes with screw-tops
- Single-layer plastic bags (polyethylene or polypropylene)

Transport packaging

The transport packaging should display details of the following:

[5] When products from organic farms are being declared as such, it is necessary to adhere to the requisite government regulations of the importing country. Information concerning this is available from the appropriate certification body. The regulation (EEC) 2092/91 are applicable to organic products being imported into Europe.

- Name and address of the manufacturer/packer and country of origin
- Description of the product and its quality class
- Year harvested
- Net weight, number
- Batch number
- Destination, with the trader's/importer's address
- Visible indication of the organic source of the product[4]

Storage

The bundles of vanilla sticks, sealed in metal tins or wax paper can be stored for up to 1 year at a temperature of ca. 5°C.

If the organic product is being stored in a single warehouse together with conventional vanilla mixing of the different qualities must be avoided. This is best achieved using the following methods:

- Training and informing of warehouse personnel
- Explicit signs in the warehouse (silos, pallets, tanks etc.)
- Colour differentiation (e.g. green for the organic product)
- Incoming/dispatched goods separately documented (warehouse logbook)

It is prohibited to carry out chemical storage measures (e.g. gassing with methyl bromide) in mixed storage spaces. Wherever possible, storing both organic and conventional products together in the same warehouse should be avoided.

[4] Organic products must be protected from contamination by non-compliant substances at each stage in the process, i.e. processing, packaging, shipping. Therefore, products originating from a certified organic farm must be recognisably declared as such.