



**RATES PROJECT**  
**Improvement of Rural Agricultural Technology  
Extension System in Asia**

**TECHNICAL PROCEDURE**  
**COLLECTION AND PROCESSING OF DRAGON FRUIT BY-PRODUCTS**  
**FOR ORGANIC FERTILIZER PRODUCTION**



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# **TECHNICAL PROCEDURE COLLECTION AND TREATMENT OF DRAGON FRUIT BY-PRODUCTS FOR ORGANIC FERTILIZER PRODUCTION**

## **PART I. GENERAL INFORMATION**

### **1. Authors**

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### **2. Origin of the Technical Procedure**

This procedure is derived from the results of the research “Development of a technical process for collecting and treating dragon fruit by-products to produce organic fertilizer, reduce environmental pollution, and support sustainable dragon fruit production.”

The procedure was introduced to farmers in Binh Thuan province through the “Improvement of Rural Agricultural Technology Extension System in Asia – RATES” project. It was tested and adapted to suit the local production conditions with support from AFACI before being transferred to farmers.

### **3. Scope and Application Area**

This technical procedure for collecting and treating dragon fruit by-products for organic fertilizer production is applicable at both household and centralized scales.



## PART II. TECHNICAL PROCEDURE DETAILS

### I. GENERAL PROVISIONS

#### 1.1. Scope of Application

This technical procedure for the collection and treatment of dragon fruit by-products for the production of organic fertilizer can be applied to various agricultural models, ranging from smallholder farms to large-scale commercial farms and centralized production facilities.

#### 1.2. Target Users

Organizations and individuals engaged in the production and business of organic fertilizers, as well as those reusing dragon fruit by-products to support sustainable agricultural practices in Binh Thuan province and neighboring regions with similar ecological conditions.

#### 1.3. Terminology Explanation

**Dragon fruit by-products:** Include parts of the plant not used as primary commercial products, such as branches, flowers, and low-quality or discarded fruits. The main chemical components of these by-products are: moisture (87.25%), organic carbon (36.68%), total nitrogen (1.22%), and a carbon-to-nitrogen (C/N) ratio of 33.6. These by-products have high potential as raw materials for organic fertilizer production or biological treatment.

**Organic fertilizer:** Refers to fertilizers made primarily from natural organic materials (excluding synthetic organics), processed through physical methods (such as drying, grinding, screening, mixing, moisturizing) or biological methods (such as composting, fermentation, extraction). Depending on their composition, function, and quality indicators, organic fertilizers are classified into standard organic fertilizers, soil-improving organic fertilizers, and multi-component organic fertilizers as defined in the National Technical Regulations.

**Cellulose-decomposing microbial preparation:** A product containing one or more selected and cultured strains of live microorganisms with a standardized population density capable of degrading cellulose under aerobic or anaerobic conditions. These preparations convert hard-to-decompose organic matter into absorbable forms, enhancing soil fertility, improving crop yields, and increasing



agricultural product quality. They are safe for human, animal, and plant health and do not negatively affect the environment or food safety.

## **II. GENERAL REGULATIONS**

### **2.1. Scope of Application**

The technical procedure for the collection and treatment of dragon fruit by-products for the production of organic fertilizer can be applied to agricultural models of various scales, ranging from smallholder farms to large-scale farms and centralized production facilities.

### **2.2. Target Users**

Organizations and individuals involved in the production and business of organic fertilizers and in the reuse of dragon fruit by-products for sustainable agricultural practices in Binh Thuan province and neighboring areas with similar ecological conditions.

### **2.3. Terminology Explanation**

**Dragon fruit by-products:** Include plant parts not used as primary commercial products such as branches, flowers, and substandard or discarded fruits. The main chemical components of these by-products are: moisture (87.25%), organic carbon (36.68%), total nitrogen (1.22%), and a carbon-to-nitrogen (C/N) ratio of 33.6. These by-products have the potential to serve as raw materials for organic fertilizer production or biological treatment.

**Organic fertilizer:** Refers to fertilizers produced from natural organic materials (excluding synthetic organic substances), processed through physical means (drying, grinding, sieving, blending, moisturizing) or biological means (composting, fermentation, extraction). Depending on the composition, function, and key quality indicators, or production process, these fertilizers are categorized in accordance with national technical regulations into standard organic fertilizers, soil-improving organic fertilizers, or multi-component organic fertilizers.

**Cellulose-decomposing microbial preparation:** A product containing one or more strains of live microorganisms that have been selected and cultured to reach standard density levels, capable of degrading cellulose under aerobic or anaerobic conditions. These preparations help convert complex organic matter into more easily absorbed forms, thereby improving soil fertility, increasing crop productivity, and



enhancing the quality of agricultural products. Additionally, these products are safe for human, animal, and plant health and do not adversely affect the ecological environment or agricultural product quality.

**Heavy metals:** A group of metallic elements with an atomic mass greater than 40 g/mol or a density greater than 5 g/cm<sup>3</sup>. Many heavy metals have the potential for bioaccumulation and can be toxic even at low concentrations, negatively impacting biological health and the environment.

### **III. PREPARING THE DRAGON FRUIT BY-PRODUCT COMPOSTING SITE**

To ensure effective organic composting while maintaining biological and environmental control, the composting site should be designed and prepared as follows:

#### **1. Selecting the Composting Site Location**

- Choose a dry, flat area with good drainage, convenient for material transportation and post-composting handling.
- Maintain a minimum distance from potable water sources.
- Avoid low-lying or flood-prone areas.

#### **2. Preparing the Composting Base**

- Level and compact the ground properly.
- Line with a PE plastic sheet to prevent leachate seepage into the soil, reducing environmental contamination.
- Construct drainage channels and a leachate collection pit for easy treatment.

#### **3. Covering and Protecting the Compost Pile**

- Cover the entire pile with a PE plastic sheet to control moisture, temperature, and protect against adverse weather (sun, rain, wind).
- Ensure the cover is sealed to prevent rainwater infiltration while allowing proper aeration for aerobic composting.

#### **4. Preparing Equipment and Supporting Materials**

- Equip necessary tools such as shovels, mixing rakes, microbial solution tanks, and temperature/humidity sensors.

### **IV. PREPARATION OF EQUIPMENT, MACHINERY, TOOLS AND COMPOSTING MATERIALS**



## 4.1 Equipment and Tool Preparation

- **Tarpaulins/plastic sheets:** Used to cover compost piles, protecting them from sun/rain and maintaining optimal composting temperature (approximately 8m<sup>2</sup> per ton of material).
- **Scales (100kg and 20kg capacity):** For precise measurement of composting components.
- **Mixing tanks/specialized blending equipment:** For uniform application of microbial inoculants and water to maintain moisture and dispersion.
- **Turner machines (industrial-scale) or hoes/shovels (small-scale/household use):** For periodic compost pile turning and mixing.
- **Dragon fruit branch shredders** or equivalent chopping machines with minimum capacity of 1,000 kg/hour: To process dragon fruit by-products into uniformly sized materials.
- **Soil thermometer:** For monitoring temperature of both raw materials and compost piles.
- **Soil moisture meter:** For measuring moisture content in raw materials and compost piles.
- **pH meter:** For testing pH levels of straw materials and compost piles.

## 4.2. By-product Preparation

Dragon fruit branches collection and mixing ingredients

### Step 1: Gather and Prepare Dragon Fruit By-products

- Diseased/old dragon fruit branches are collected and transported to a designated collection area, which has been selected and arranged appropriately for the subsequent composting process.
- Sort and remove unwanted impurities mixed in with the by-products, including nylon packaging, pesticide bottles, plastic ties, and other foreign materials, to ensure the purity of the raw input material.





- The volume of dragon fruit by-products is prepared and measured to meet usage requirements.

**Step 2: Prepare Mixing Ingredients** The quantities of ingredients used to process **1,000 kg of dragon fruit branch by-products** are as follows:

- Chicken/cow manure: 500 kg – 800 kg
- Agricultural lime powder: 15-18 kg
- Ash/rice husk: 150 - 180 kg
- Urea fertilizer: 10 kg
- Powdered superphosphate fertilizer: 15-18 kg
- **Microbial product for pathogen treatment (Trichoderma + Chaetomium)** (density  $10^6$  CFU/g): 10 liters of 1st-generation liquid (100ml original microbial solution – with attached technical instructions for 1st-generation propagation).
- **Microbial product for plant residue decomposition (Trichoderma + Bacillus subtilis + Lactobacillus plantarum)** (density  $10^6$  CFU/g): 10 liters of 1st-generation liquid (100ml original microbial solution – with attached technical instructions for 1st-generation propagation).

#### **IV. PROCESSING, MIXING, AND COMPOSTING OF MATERIALS**

##### **Step 1: Material Processing and Mixing**

Dragon fruit by-products are collected and prepared through the following steps:

- **Size Reduction:**

Dragon fruit branches are shredded into 3–5 cm segments to increase surface area, facilitating microbial decomposition of cellulose and lignin during composting.

- **Layered Mixing Method:**

Materials are mixed using an alternating layer technique to ensure uniform distribution and optimal organic decomposition:

1. **Base Layer:** Spread a 5 cm layer of rice husk at the bottom to improve aeration, absorb excess moisture, and prevent leachate seepage.
2. **Dragon Fruit Branches:** Add a 5–10 cm layer of shredded branches (50–60% of total compost volume).



3. **Mature Manure:** Apply a 5–10 cm layer of composted cow dung to provide nitrogen, stimulate microbial activity, and adjust the C:N ratio.

4. **Lime Treatment:** After each full cycle (husk → manure → branches), dust the surface with powdered lime (CaO) to neutralize pH and eliminate pathogens.

5. **Repeat:** Stack layers until reaching the optimal pile height (1.2–1.5 m), then cover with a PE sheet to retain moisture and stabilize temperature.



#### • Initial Composting:

Compost for **5 days** under cover.

#### Step 2: Pathogen Control with Antagonistic Fungi

To address persistent pathogens (e.g., *Neoscytalidium dimidiatum*, *Colletotrichum* spp.), treat the pile after 5 days by:

- **Mixing and spraying** with **primary biomass** of *Trichoderma* spp. and *Chaetomium* spp. (Appendix 2) to suppress pathogens and enhance decomposition.
- Re-covering and composting for **another 5 days**.

#### Step 3: Cellulose-Degrading and Nutrient-Solubilizing Microbes

After antagonistic fungi treatment:

- Add **cellulolytic microbial inoculants** (*Bacillus* spp., *Trichoderma* spp., *Streptomyces* spp., *Lactobacillus* spp.) to break down lignin/cellulose.
- Supplement with **nitrogen-fixing** (*Burkholderia tropica*) and **phosphate-solubilizing** (*Enterobacter cloacae*) bacteria.
- Re-cover and compost for **15 days**.

#### Step 4: Mineral Nutrient Supplementation

After 15 days:

- **Mix uniformly** into the pile:
  - **Urea:** 7 kg/ton (for nitrogen).



- **Phosphate:** 10 kg/ton (for phosphorus).
- Use **concrete-mixing techniques** (thin-layer turning) to ensure even distribution.
- Re-cover with waterproof material (PE sheet) to retain nutrients and prevent pollution.
- Compost for a **final 5 days**.

**Step 5: Complete after 30 days.**

## **VI. CHECKING AND MAINTAINING THE BALANCE OF COMPOST PILE INDICATORS**

### **6.1. Indicators and Testing Methods**

- **Periodically check** every 5 days to monitor moisture, temperature, pH, C/N ratio, and signs of microbial activity, specifically as follows:
  - **Check the compost pile temperature** using a thermometer. The optimal compost pile temperature ranges from 50 to 75°C.
  - **Check on-site moisture** using a moisture meter to ensure an optimal moisture content of 40-60%.
  - **Check on-site pH** using a specialized pH meter to maintain a pH of 5-7.
  - **After 30 days of composting**, check the maturity of the compost pile based on its appearance (color) and temperature stability. If it meets the applicable standards, the composting process is complete.

### **6.2. Techniques for Maintaining the Balance of Compost Pile Indicators**

- **Check and balance the moisture of the compost pile** after shredding by mixing materials and ensuring the optimal compost pile moisture is 40-60%.
- **Check and balance the temperature** by turning the pile to achieve an optimal temperature of 50-75°C (at least 20°C higher than ambient temperature).
- **Check and balance the pH of the compost pile** by adding pre-prepared lime water or powdered lime (CaO) or other neutralizing chemicals (NaOH, KOH) to maintain a pH of 5-7.
- **Periodically turn the compost rows** at least 3 times using turning equipment or manually, ensuring uniform dispersion of the microbial biomass within the



substrate. Turning can be done immediately if the temperature is higher than the permissible level during periodic checks. Continuously monitor the activity of microorganisms in the compost pile. During turning, monitor the moisture content of the compost pile to prevent it from becoming too dry or too wet.

**Note:** Emergency turning can be performed if temperature or pH do not meet applicable standards to balance the monitored indicators. After checking or turning, the compost pile should be covered tightly using nylon, tarpaulin, torn sacks, or mud.

- **Compost pile turning methods** include using specialized machinery or manual mixing with hoes and shovels. Technical requirement for turning: turn the pile evenly, then spread or heap it back to a height of 1.2-1.5m.

## VII. CHECKING COMPOST MATURITY

To determine if the compost pile has reached full maturity (finished), a combination of sensory and technical criteria can be applied:

### Sensory

- **Color:** The compost pile turns dark brown or black, with a uniform appearance.
- **Odor:** It has a characteristic earthy or humus-like smell; no longer any foul, sour, pungent, or ammonia odors.
- **Texture:** It is loose and friable, with no recognizable original materials (branches, leaves, etc.).
- **Temperature:** Close to ambient temperature, no longer generating significant heat during turning.

## VIII. FERTILIZER QUALITY CHECK

- Fertilizer samples are taken to determine the content of quality indicators and limiting factors according to **TCVN 9486:2018 Fertilizers – Sampling methods** and **TCVN 12105:2018 Microbial fertilizers – Sampling**.
- The quality indicators and limiting factors for fertilizers are regulated in **QCVN-01-189:2019/BNNPTNT: National Technical Regulation on Fertilizer Quality**.



## IX. ENVIRONMENTAL PROTECTION GUIDELINES IN THE PRODUCTION OF ORGANIC FERTILIZER RAW MATERIALS FROM DRAGON FRUIT BY-PRODUCTS

- To ensure surrounding environmental conditions, the chosen organic composting site must be at least **500m away** from domestic water sources and concentrated residential areas.
- **Wastewater Treatment:**
  - Facilities producing organic fertilizer raw materials from dragon fruit by-products must install a **wastewater collection system** to re-irrigate the compost pile, ensuring fertilizer quality and environmental protection.
  - In cases where discharge into the environment is necessary, wastewater from fertilizer production is classified as industrial wastewater and must be treated according to **QCVN 40:2011/BTNMT**.
- **Odor Control:**
  - Workshops must be **well-ventilated** to ensure good air circulation.
  - For large-scale centralized production facilities, a **system for collecting, treating, and discharging exhaust gases** must be built to ensure that emissions from organic fertilizer production facilities using dragon fruit by-products comply with **QCVN 21:2009/BTNMT**.

## X. GUIDELINES FOR USING ORGANIC FERTILIZER PRODUCT

- The composted product can be used as an **organic nutrient source** for crops or mixed with inorganic fertilizers or beneficial microorganisms to create **organic-mineral fertilizers** or **microbial organic fertilizers**. The amount of mixed fertilizer depends on the nutritional needs of each crop variety, the soil's nutrient supply capacity, and the fertilizer use efficiency of the crop.
- When using organic fertilizer, it's important to consider **weather, soil, and crop factors**.
- **Maintain moisture** in the fertilizer.
- **Apply to the root development zone** of the plant.
- **Only use matured organic fertilizer**.

## APPENDIX 1:

### DIAGRAM OF THE DRAGON FRUIT BY-PRODUCT COLLECTION AND PROCESSING PROCEDURE FOR ORGANIC FERTILIZER PRODUCTION

# Chuẩn bị nguyên liệu

● ● ● ● ●

**Lựa chọn vị trí bãi ủ:**

Bãi ủ nên được đặt tại nơi cao ráo, bằng phẳng, thoát nước tốt, thuận tiện cho việc vận chuyển nguyên liệu và xử lý sau ủ. Khoảng cách tối thiểu đến nguồn nước sinh hoạt. Tránh đặt bãi ủ ở nơi trũng thấp hoặc dễ bị ngập úng.

**Xử lý nền bãi ủ:**

Nền bãi ủ cần được san phẳng và nén chặt. Có thể lót bạt nilon PE để tránh hiện tượng thấm dịch rỉ vào đất, góp phần kiểm soát ô nhiễm môi trường.

Phụ phẩm thanh long	Manh bạt
Phân bò	Máy băm cành hoặc máy cắt cỏ
Vôi bột dùng trong nông nghiệp	Cuốc xẻng
Tro/trấu	Thùng phi
<i>Trichoderma spp.</i> <i>Bacillus spp.</i> <i>Lactobacillus spp.</i>	
Ure/ Lân	




# BUỐC 1



# XỬ LÝ VÀ PHỐI TRỘN VẬT LIỆU



100 kg

500 kg

1.000 kg

10 kg



10-15 cm

10-15 cm

20-25 cm



1,2 – 1,5 m



5 ngày

**LƯU Ý:** chọn chất liệu mạnh bạt dày, sậm màu.

Đậy kín mạnh bạt giúp tăng nhiệt độ và không bị ảnh hưởng của tác động môi trường

## BƯỚC 2



## NGÀY THỨ 5 – XỬ LÝ MÀM BỆNH

*10 lít Trichoderma spp. + Chaetomium spp. / 1 tân nguyên liệu*

Chuẩn bị nguồn vi sinh



100 ml vi sinh gốc + 150g mật rỉ đường  
+ 150 g đường cát + 10 lít nước



Đào trộn khối ủ và bổ sung chế phẩm vi sinh



65-75°C

Đậy kín và tiếp tục ủ trong 5 ngày

## BƯỚC 3

### NGÀY THỨ 10 - Ủ VỚI CHẾ PHẨM PHÂN HUỖ XÁC BÃ THỰC VẬT



Chuẩn bị nguồn vi sinh



100 ml vi sinh gốc + 150g mật rỉ đường  
+ 150 g đường cát + 10 lít nước



Đào trộn khối ủ và bổ sung chế phẩm vi sinh lần 2

50-60°C



Đậy kín và tiếp tục ủ trong 10 ngày

# ƯU ĐIỂM



<u>Tiêu chí</u>	<u>Quy trình đang làm</u>
<b>2. Kiểm soát mầm bệnh</b>	Có bổ sung nấm đối kháng <i>Trichoderma spp.</i> và <i>Chaetomium spp.</i> , giúp ức chế các nấm gây bệnh tồn dư như <i>Neoscytalidium dimidiatum</i> , <i>Colletotrichum spp.</i>
<b>3. Phân giải nhanh, hiệu quả hơn</b>	Có bổ sung chế phẩm phân giải cellulose với mật số vi sinh đạt chuẩn ( $10^6$ CFU/g), rút ngắn thời gian ủ và tăng cường phân hủy lignin, cellulose.
<b>4. Cân bằng dinh dưỡng hợp lý</b>	Bổ sung urea và phân lân hợp lý nhằm điều chỉnh tỷ lệ C:N và nâng cao giá trị dinh dưỡng của phân hữu cơ sau ủ.
<b>5. Quản lý độ ẩm và cấu trúc khối ủ</b>	Thiết kế theo nguyên tắc trải lớp và kiểm soát độ ẩm chặt chẽ (55–60%), hạn chế phát sinh khí độc và tăng thông khí tự nhiên.
<b>6. Quy mô áp dụng linh hoạt</b>	Có thể áp dụng cho hộ nông dân, hợp tác xã, cơ sở sản xuất tập trung, đặc biệt phù hợp với vùng trồng thanh long tập trung.
<b>7. Chất lượng phân sau ủ</b>	Phân hữu cơ có độ tơi xốp tốt, màu nâu đậm, không mùi hôi, chứa vi sinh vật có lợi và hàm lượng dinh dưỡng ổn định.

# BUỚC 4 NGÀY THỨ 20



**✓ Lợi ích chung khi bổ sung ure và lân vào đồng ủ**

<u>Lợi ích</u>	<u>Vai trò của Ure</u>	<u>Vai trò của Lân</u>
Tăng tốc phân hủy	✓	✓ (hỗ trợ)
Cân bằng dinh dưỡng (C/N)	✓	✗
Cung cấp dinh dưỡng cho cây	✓ (đạm)	✓ (lân)
Kích thích vi sinh vật có lợi	✓	✓
Cải thiện chất lượng phân hữu cơ sau ủ	✓	✓

**ĐẬY KÍN VÀ TIẾP TỤC Ủ TRONG 10 NGÀY ĐỂ HOÀN TẤT QUÁ TRÌNH Ủ**

# KHÓ KHĂN GIẢI PHÁP

KHÔNG CÓ MÁY BÂM



ĐẢO TRỘN NHIỀU LẦN

Tỉ lệ bệnh thấp => bỏ qua giai đoạn xử lý bệnh

Thời gian đảo trộn rất nhanh

KHÔNG MUA ĐƯỢC CHẾ PHẨM NHƯ QUY TRÌNH

