

# Hortus

## Plant Propagation from Cuttings

A Guide to Using Plant  
Rooting Hormones by  
Foliar and Basal Methods

**Special Edition**

This book includes the label for  
Hortus IBA Water Soluble Salts®

**Hortus USA Corp.**

Propagation of plants from cuttings is the most popular way to produce cloned copies of the stock plant. Natural substances from the leaves of plants stimulate root formation. Some cuttings are can produce roots with their own substances. Most cuttings require additional stimulation. In the 1930's the natural root forming substance and its bio- simulators were identified, they are called 'rooting hormones'. The most used rooting hormone, IBA, is the active ingredient in Hortus IBA Water Soluble Salts and Rhizopon AA products.

This book gives essential information on stock plant preparation, selection and timing of taking cuttings, rooting hormone products and five methods of application. All are important to produce successful new roots and superior new plants

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**Hortus IBA Water Soluble Salts & Rhizopon AA  
are products of**

**Hortus USA Corp.**

**support@hortus.com**

**rooting-hormones.com**

**Mobile Device Website: m.hortus.com**

**Hortus IBA Water Soluble Salts and Rhizopon AA Plant Rooting  
Products are available from your favorite horticultural suppliers.**

*For distributor purchasing and distributor referral*

*contact master distributor:*

**Phytotronics 314-770-0717 sales@phytotronics.com**

# Products Used to Make Rooting Solutions

Hortus IBA Water Soluble Salts and Rhizopon AA Water Soluble Tablets are used to make fresh Rooting Solutions. Mix in ordinary water. Use by Basal and all Foliar Methods.

## Hortus IBA Water Soluble Salts® (20%)

- Active Ingredient: Indole-3-butyric acid (IBA) 20%
- Measure Hortus IBA Water Soluble Salts using a scale then mix into ordinary water.
- Hortus IBA Water Soluble Salts are water soluble to over 100,000 ppm IBA, remain in solution at any concentration, and are buffered close to neutral.



- For foliar methods, Hortus IBA Water Soluble Salts Rooting Solutions are specially formulated to allow entry through open stomata into the plant's vascular system.
- Hortus IBA Water Soluble Salts are used by any method and rate where technical IBA and K-IBA and pre-mix rooting products are used.

## Rhizopon® AA Water Soluble Tablets



- Active Ingredient: Indole-3-butyric acid (IBA) 20%
- Count Rhizopon AA Water Soluble Tablets then mix into ordinary water.
- Rhizopon AA Water Soluble Tablets are water soluble to 1000 ppm IBA.
- Rhizopon AA Water Soluble Tablets are useful when a scale is not available to measure and to mix small amounts of Rooting Solution or low rates.

# Products Used by the Basal Dry Dip Method

Rhizopon AA #1, #2 and #3 Dry Dip Rooting Hormones are always ready to use. Use by the Basal Dry Dip Method.

## Rhizopon® AA #1 (0.1)

- Active Ingredient 0.1% Indole-3-butyric acid (IBA)
- **Color identified Pink Color Powder.**
- Use on easy to root cuttings.

## Rhizopon® AA #2 (0.3)

- Active Ingredient 0.3% Indole-3-butyric acid (IBA)
- **Color identified Green Color Powder.**
- An intermediate all purpose product.
- Use on easy to more difficult to root cuttings.

## Rhizopon® AA #3 (0.8)

- Active Ingredient 0.8% Indole-3-butyric acid (IBA)
- **Color identified White Color Powder.**
- Use on more difficult to root cuttings.



# Foliar Methods

Use Hortus IBA Water Soluble Salts and Rhizopon AA Water Soluble Tablets to Make Rooting Solutions



## SPRAY DRIP DOWN METHOD

- Stick cuttings.
- Spray the Rooting Solution onto leaves until drip down.



## TOTAL IMMERSE METHOD

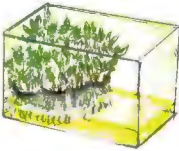
- Total immerse the cuttings a few seconds in the Rooting Solution.
- Drain.
- Stick cuttings.

# Basal Methods



## BASAL QUICK DIP METHOD

- Immerse basal end of cuttings a few seconds in the Rooting Solution.
- Stick cuttings.



## BASAL LONG SOAK METHOD

- Immerse basal end of cuttings a few hours in the Rooting Solution.
- Stick cuttings.



Use Rhizopon AA #1, #2 and #3 Dry Dip Rooting Hormones

## DRY DIP METHOD

- Dip basal end of cuttings in the Rhizopon AA rooting powder.
- Stick cuttings.



## *Questions you want to ask before reading this book*

### ? **About the Products**

#### *How much Hortus IBA Water Soluble Salts do I need?*

- **To make a Rooting Solution, for one gallon at 1000 ppm you need 19 grams of Hortus IBA Water Soluble Salts.**
- **By the Basal Long Soak and Basal Quick Dip Methods** one gallon of Rooting Solution can treat many thousand cuttings.
- **By the Spray Drip Down Method** one gallon of Rooting Solution can treat 175-225 square feet of propagation trays.
- **Annual cuttings** require 100 ppm or less. You need 1.9 grams of Hortus IBA Water Soluble Salts per gallon.

#### *Can I make a concentrated stock mix?*

**Rooting Solutions made with Hortus IBA Water Soluble Salts can be made to 100,000 ppm IBA using ordinary water.** Growers can make up concentrated Rooting Solutions in the production office. The concentrated Rooting Solution can be added to the production tank in the work area then add water to bring the solution to full rate.

#### *What is the keeping life of a Hortus IBA Water Soluble Salts Rooting Solution?*

- **An un-used Rooting Solution can be used for several days after make-up if you store it at normal room temperature and light.** Solutions made for the Spray Drip Down Method are un-used until sprayed. *See page 16 for notes.*
- **The Total Immerse, Basal Long Soak and Basal Quick Dip Methods** use the Rooting Solution on each treated plant lot. Dispose **used** Rooting Solutions between production lots to avoid cross contamination.

#### *What is the keeping life of dry Hortus IBA Water Soluble Salts, Rhizopon AA Water Soluble Tablets and un-used Rhizopon AA dry powder rooting hormones?*

**Un-used, dry, in the original container, sealed, and at room temperature, the products will retain close to their full potency for many years.** Refrigeration is not required. Do allow them to become damp or wet. *See page 16 for notes.*



***What is the cost of Hortus IBA Water Soluble Salts compared with so called 'pre-mix' rooting products? How is Hortus IBA Water Soluble Salts different from a pre-mix?***

- **Hortus IBA Water Soluble Salts cost about 1/3 to 1/5 the price of 'pre-mix' rooting solutions.**
- A gallon of Hortus IBA Water Soluble Salts Rooting Solution, at 100 ppm IBA, costs about 65¢; a gallon at 10,000 ppm IBA cost about \$65. (The same 'premix' IBA rate costs over \$210!)
- Hortus IBA Water Soluble Salts can be shipped by ordinary means. 'Pre-mix' rooting solutions can incur 'hazardous shipping charges'.
- Hortus IBA Water Soluble Salts Rooting Solutions are made by the grower using ordinary water; the Rooting Solutions can never cause solvent toxicity. Alcohol based 'pre-mix' rooting solutions may cause alcohol toxicity to the cuttings especially at high concentrations.

***What is the difference between Hortus IBA Water Soluble Salts or Rhizopon AA Water Soluble Tablets and technical IBA/KIBA?***

- Hortus IBA Water Soluble Salts and Rhizopon AA Water Soluble Tablets are both registered by the US EPA for 'sale and use' by plant growers. Technical IBA/K-IBA are not US EPA registered for use by plant growers.

***Hortus IBA Water Soluble Salts and Rhizopon AA Water Soluble Tablets replace technical IBA/K-IBA for use in plant growing!***

- Hortus IBA Water Soluble Salts and Rhizopon AA Water Soluble Tablets are soluble in ordinary water. Technical IBA is only soluble in active solvents that can cause plant fatality and 'burns'.
- Hortus IBA Water Soluble Salts can be dissolved in water to over 100,000 ppm IBA and Rhizopon AA Water Soluble Tablets to 1000 ppm IBA; they will remain in solution indefinitely. Technical K-IKA can only be dissolved in water to about 10,000 ppm IBA and drops out of solution.
- Hortus IBA Water Soluble Salts and Rhizopon AA Water Soluble Tablets have US EPA labels for foliar and basal methods. They are specially formulated for these methods.

*What is the WPS re-entry interval (REI) for Hortus IBA Water Soluble Salts and Rhizopon AA products?*

**Hortus IBA Water Soluble Salts and all Rhizopon AA products have US EPA labels with ZERO hour REI.**

*How do I select Hortus IBA Water Soluble Salts or Rhizopon AA Water Soluble Tablets?*

Both products are used in both foliar and basal methods.

• **Hortus IBA Water Soluble Salts:**

- Soluble in water to over 100,000 ppm IBA.
- Measured using a scale.
- Cost effective for commercial growers.

• **Rhizopon AA Water Soluble Tablets:**

- Soluble in water to 1000 ppm IBA.
- Measured by counting tablets. Counting is useful where a scale is not available.
- Useful when growers require low concentrations or small liquid volumes.
- Economical for small commercial users or consumer users.

## **About the Rooting Solution Methods**

*Why would I want to use ‘Foliar’ compared to ‘Basal’ Rooting Solution methods?*

Foliar methods are used on leafy plants in the growing season. Basal methods are used all year. Foliar methods treat cuttings uniformly. Basal Quick Dip Method may have variable treatment. Foliar methods use less labor than Quick Dip.

*When can I turn on misters after treating by the Spray Drip Down Method?*

Growers usually wait 30-45 minutes or until the Rooting Solution dries on the leaves.

*Do I need special equipment to do foliar methods?*

**Most growers use standard spray equipment such as backpack sprayers, hydraulic sprayers, or hand sprayers.** Boom sprayers can be used, but, they might require too much trouble to set up for one time use. Production greenhouses and nurseries where spray is done regularly have made custom spray carts to meet needs.



## About the Dry Dip Rooting Hormones & Comparison with Rooting Solutions



*How many cuttings can be treated using Rhizopon AA dry powders?*

**One pound of Rhizopon AA dry powder rooting hormones can treat about 30,000 cuttings.**

*Is there a difference in rooting between using ‘Rooting Solutions’ or ‘dry powder rooting hormones’?*

To be honest, makers who offer one type of product or another will say their product is the best. Growers always say some plants root better with Rooting Solutions or rooting powders. This is based upon the variety, time of the year, maturity of the cuttings and quality of the stock plants. In the US many growers prefer Rooting Solution methods. In Europe the growers prefer Dry Dip powder rooting hormones.

*How are Rhizopon AA dry powder rooting hormones different from other brand dry powder rooting products?*

Rhizopon AA #1, #2 and #3 are made with high loft talc resulting in uniform coverage of the treated cutting. The powders are color coded to identify the product: **Rhizopon AA#1 is pink, Rhizopon AA#2 is green and Rhizopon AA#3 is white.** Color coding helps the production workers to pick and use the proper product. All production lots are laboratory tested to assure they have uniform mix and meet the required concentration.



*Why do I need to use rooting hormones when I propagate ‘easy-to-root’ cuttings?*

**The use of rooting hormones is NOT a waste of time; cuttings will rapidly produce high root mass and uniform roots!**



# Hortus IBA Water Soluble Salts

Water Soluble to Over  
100,000 ppm IBA

ROOTING  
SOLUTIONS  
MADE USING  
ORDINARY  
WATER



# Rhizopon AA Water Soluble Tablets

Pre-measured - Count and Mix



# Rhizopon AA Dry Powder Rooting Hormones

READY  
TO USE  
DRY  
POWDER  
ROOTING  
HORMONES

The Most Popular Concentrations



SPRAY DRIP DOWN METHOD



TOTAL IMMERSE METHOD



BASAL QUICK DIP METHOD



BASAL LONG SOAK METHOD



BASAL DRY DIP METHOD



**NATURAL ROOTING HORMONES** are produced in the **LEAVES** of plants

Rooting Hormones are applied to leaves using **WATER based ROOTING SOLUTIONS**. The Hormones enter the plant through open stomata

Water is the natural carrier for Rooting Hormones

Mass Flow moves the Natural and Applied Rooting Hormones to the **BASAL END** of the cutting. The Basal End is a sink point

**ROOTS** are induced to form at the Basal End by action of the Natural and Applied Rooting Hormones

# Methods to Propagate Plants from Cuttings

## Cutting Types and Methods

USE ON TYPE OF CUTTINGS	Dry Dip	Spray Drip Down	Basal Quick Dip	Total Immerse	Basal Long Soak
<b>LEAFY CUTTINGS</b> <ul style="list-style-type: none"> <li>• Ornamental plants</li> <li>• Herbaceous plants</li> </ul> <i>In the Growing Season</i>	✓	✓	✓	✓	✓
<b>LEAFLESS CUTTINGS</b> <ul style="list-style-type: none"> <li>• Ornamental plants</li> <li>• Herbaceous plants</li> </ul> <i>All Year Including Winter Cuttings</i>	✓		✓		✓
<ul style="list-style-type: none"> <li>• <b>EASY-TO-ROOT</b></li> <li>• <b>HARD-TO-ROOT</b></li> </ul> <i>In the Winter</i>	✓		✓		✓



# Basal and Foliar Methods

METHOD		PRODUCT TYPE	PRODUCT
BASIL METHODS	DRY DIP METHOD	<p><b>Dry Dip Powder</b></p> <p>Dip basal end in rooting powder then stick.  <i>Powders stay on cuttings a long time.</i></p>	<p><b>RHIZOPON AA #1, #2 &amp; #3</b></p> <p>Dry Powder Rooting Hormones  <i>Use dry &gt; not used to make rooting solutions</i></p>
	BASIL QUICK DIP METHOD	<p><b>Rooting Solution</b></p> <p>Dip basal end in rooting solution then stick.</p>	<p><b>HORTUS IBA WATER SOLUBLE SALTS</b></p>
	BASIL LONG SOAK METHOD	<p><b>Rooting Solution</b></p> <p>Dip basal end of cuttings in rooting solution about 12 to 48 hours (nominal) then stick.</p>	<p><i>or</i></p> <p><b>RHIZOPON AA WATER SOLUBLE TABLETS</b></p> <p><i>Use to make rooting solutions</i></p>
FOLIAR METHODS	SPRAY DRIP DOWN METHOD	<p><b>Rooting Solution</b></p> <p>Stick then spray leaves of cuttings with rooting solution until the solution drips down.</p>	
	TOTAL IMMERSE METHOD	<p><b>Rooting Solution</b></p> <p>Totally immerse cuttings in rooting solution then stick.</p>	

# Using Rooting Solutions made with Hortus IBA Water Soluble Salts

## PREPARING A ROOTING SOLUTION

- **Weigh** the required amount of Hortus IBA Water Soluble Salts. **Measure by weight not volume** (*no scoops*).
- **Use tap water** at about 65-90°F; measure less than the final volume of water. *See page 16 for notes.*
- **Do not dissolve Hortus IBA Water Soluble Salts in liquids other than water.**
- **Mix:** dissolve Hortus IBA Water Soluble Salts in water.
- **Add water** to the mixing container to bring the Rooting Solution to the final volume.
- **Apply the solution** by the selected method.
- **After use**, dispose of the solution as described in the 'Storage and Disposal' statements on the label. *See page 55, inside back cover.*

## AVOID CROSS CONTAMINATION OF SOLUTIONS

- For the Total Immerse, Basal Quick Dip and Basal Long Soak Methods dispose of Rooting Solutions between plant lots to avoid cross contamination.
- Using the Spray Drip Down Method the Rooting Solution is used one time and there is no cross-contamination. Solutions can be used completely. *See page 16 for notes.*

## STOCK SOLUTIONS

Hortus IBA Water Soluble Salts mixed in water to make stock Rooting Solutions can be made in any concentration up to 100,000 ppm IBA!

## METRIC SYSTEM

Use the metric system when calculating the ppm IBA for Hortus IBA Water Soluble Salts Rooting Solutions. The system allows for easy calculation of liquid volume to concentration.

## WETTING AGENTS

Rooting Solutions made with Hortus IBA Water Soluble Salts are specially formulated to have a low surface tension needed for foliar methods. Additional wetting agents are not recommended.

# Rooting Solution Rate Chart: Hortus IBA Water Soluble Salts

To make 100 ppm IBA dissolve 0.5 grams in 1 liter water

Parts per million IBA (ppm IBA)	Hortus IBA Water Soluble Salts	
	gms/liter water	gms/gallon water (1 gal = 3.8 liter)
50 ppm IBA	0.25 grams	.95 grams
100	0.5	1.9
200	1.0	3.8
250	1.25	4.7
300	1.5	5.7
400	2.0	7.6
500	2.5	9.5
600	3.0	11.3
700	3.5	13.2
750	3.75	14.2
800	4.0	15
900	4.5	17
1000	5.0	19
1500	7.5	28.5
2000	10.0	38
2500	12.5	47
5000	25.0	95
10,000	50.0	190
<b>MAKE ANY RATE</b>		
100,000	500	1900

## Using Rooting Solutions made with Rhizopon AA Water Soluble Tablets

- **Count** the required amount of Rhizopon AA Water Soluble Tablets as shown in the chart below. For example: to make 100 ppm IBA dissolve 2 Rhizopon AA Water Soluble Tablets in one liter of water.
- **Use tap water** at about 65-90F; The higher temperature improves ability of the Tablets to dissolve. Measure less than the final volume of water. **Do not dissolve Rhizopon AA Water Soluble Tablets in liquids other than water.** See page 16 for notes.
- **Mix:** dissolve Rhizopon AA Water Soluble Tablets in the water. A small amount of undissolved particles in the solution is normal and does not affect results. If precipitation occurs with tap water then dissolve in distilled, demineralized, or filtered water. **Add water** to the mixing container to bring the solution to the final volume.
- **Apply the solution** by the selected method.
- **After use,** dispose of the solution as described in the 'Storage and Disposal' statements on the label. See page 55, inside back cover (same as Hortus IBA Water Soluble Salts).
- **Avoid cross contamination of solutions.** For the Total Immerse Method and basal methods, dispose of solutions between plant lots to avoid cross contamination. Using the Spray Drip Down Method the solution is used one time and there is no cross-contamination.

### Rooting Solution Rate Conversion Chart:

Parts per million IBA (ppm IBA)	Rhizopon AA Water Soluble Tablets per liter water	Hortus IBA Water Soluble Salts	
		gms/liter water	gms/gallon water (1 gal = 3.8 liter)
50 ppm	1 tablet	0.25 grams	0.95 grams
100	2	0.5	1.9
200	4	1.0	3.8
300	6	1.5	5.7
400	8	2.0	7.6
500	10	2.5	9.5
600	12	3.0	11.3
700	14	3.5	13.2
800	16	4.0	15
900	18	4.5	17
1,000	20	5.0	19



# Handling Dry Products & Rooting Solutions

## STORAGE OF DRY PRODUCTS

- Rhizopon AA #1, #2 & #3 Dry Dip Rooting Hormones, Hortus IBA Water Soluble Salts and Rhizopon AA Water Soluble Tablets are provided dry. Store dry products at room temperature. They do not require refrigeration. The dry products will be fully active for many years.
- Hortus IBA Water Soluble Salts and Rhizopon AA Water Soluble Tablets are sensitive to humidity. Store them dry to avoid caking and difficulty to dissolve.
- *Store the dry products in their original sealable containers with labels.*

## ROOTING SOLUTION WATER QUALITY

- Ordinary tap water usually used to make Rooting Solutions.
- If the Rooting Solution is clear, having a small amount of particles, then the active ingredient is in solution and ready to use.
- Hard, well or pond water may reduce solubility; in those cases use another source such as filtered or demineralized water.

## AVOID CONTAMINATION OF SOLUTIONS

- The **Spray Drip Down Method** uses the Rooting Solution one time. The Rooting Solution cannot be contaminated by the dragging-in of organic materials. *For storage see below.*
- The **Basal Quick Dip, Total Immerse, and Basal Long Soak Methods** use the Rooting Solution by having the plant material dipped into them. To avoid cross-contamination, use fresh Rooting Solutions between production lots.
- *Dispose the used Rooting Solutions at the end of the production day. Do not store used solutions.*

## DISPOSAL

- See page 55, inside back cover, same as Hortus IBA Water Soluble Salts.

## STORAGE OF UN-USED ROOTING SOLUTIONS:

**Stock and production Rooting Solutions made with Hortus IBA Water Soluble Salts and Rhizopon AA Water Soluble Tablets maintain full potency for several days when kept in a closed container, at room temperature, and normal light.**

***For safety, label the Rooting Solution container.***

# Overview of Foliar Methods

- **The Foliar Spray Drip Down and Total Immerse Methods are used on cuttings that are leafy in the growing season.**
- Foliar methods *are not* used on dormant or leafless cuttings.
- Rooting Solutions are applied to the leaves of cuttings.
- Foliar methods use Rooting Solutions that are made using water only, applied by spray onto foliage or totally immerse.
- **For foliar methods only use Rooting Solutions made with water and Hortus IBA Water Soluble Salts or Rhizopon AA Water Soluble Tablets.**
- Never use other 'Rooting Solutions' made with active solvents since they will dehydrate and kill plant cells.

## ROOTING PRODUCTS USED

To make Rooting Solutions:

- **Hortus IBA Water Soluble Salts.**
- **Rhizopon AA Water Soluble Tablets.**

## MODE OF ACTION

Water-based Rooting Solutions are applied to leaves of cuttings. The Rooting Solutions enter the plant through stomata, the minute openings in the leaf. The stomata allow entry into the plant of gases and liquids such as the Rooting Solution. After entry into the vascular system of the plant, the rooting hormones in the Rooting Solution move by mass flow to the basal end of the cuttings. Plants store rooting hormones at the basal end where they are slow released to induce roots.

METHODS	PRODUCTS TO USE
TOTAL IMMERSE METHOD	Use Rooting Solutions made with Hortus IBA Water Soluble Salts
SPRAY DIP DOWN METHOD	<i>or</i> Rhizopon AA Water Soluble Tablets
<b>The selection of a method, either the Spray Drip Down or Total Immerse Method, usually depends upon the number of cuttings in a lot. Large homogenous lots may be easier to treat by the Total Immerse Method. Many small lot sizes may be easier to treat by the Spray Drip Down Method.</b>	

## **USE A SECOND FOLIAR TREATMENT**

- Overcome slow root development
- Improve transplanting of rooted cuttings.
- Level the production crop.
- Improve roots of cuttings which were already treated by any method, either rooted or un-rooted.

**Stimulate rooting by using the Spray Drip Down Method with one or two weekly additional applications. Use Hortus IBA Water Soluble Salts at 80-200 ppm or the initial foliar rate.**

## **STOCK PLANT PREPARATION FOR FOLIAR METHODS**

The stock plants must be adequately fertilized and kept in light during the days before the cuttings are taken. These factors allow the plant to store carbohydrates necessary for root formation.

## **ADJUSTING THE FOLIAR RATE**

- Use as low a rate as possible to achieve rooting.
- When root formation is **slow** in formation trial at a higher rate.
- When foliar methods produce leaf spotting, leaf curl, or leaf drop it may be caused by inadequate stock plant preparation or too high a rate.

## **SCIENTIFIC GROUNDWORK ON FOLIAR APPLIED IBA ROOTING HORMONES**

**Foliar applied rooting hormones on the leaves of cuttings had positive rooting results when used by Thimann & Went (1937). Dr. Fred T. Davies (co-author of 'Plant Propagation Principles and Practices') did successful plant rooting trials using foliar applied IBA in aqueous solution. Dr. Davies' landmark studies, published in 1980-2, detailed the physiology of rooting of the cuttings.**

Thimann & Went. *Phytohormones*. 1937

Davies & Joiner. Initiation and development of roots in juvenile and mature leaf bud cuttings of *Ficus pumila* L. *Amer. J. Bot.* 69(5): 804-811. 1982.

Davies, Lazarte & Joiner. Growth regulator effects on adventitious root formation in leaf bud cuttings of juvenile and mature *Ficus pumila*. *J. Amer. Soc. Hort. Sci.* 105(1):91-95. 1980.



# The Spray Drip Down Method



Using the Spray Drip Down Method you stick the cuttings into trays or any other way into media. You spray the Rooting Solution onto the leaves of the cuttings until there is a drip down. You wait about 45 minutes or until the solution dries on the leaves, then turn on your misters

The Spray Drip Down Method can be used on any lot size. The solution is used one time. There

can be no cross contamination of the Rooting Solution between plant lots.

The Spray Drip Down Method has low labor cost. Workers who do sticking do not apply rooting products and do not need PPE. Spraying, performed by a trained operator, assures that the plant cuttings receive a uniform application of the Rooting Solutions.

The time for spraying is only a few minutes.



Typical backpack sprayer suitable for application

## EQUIPMENT

Use a hand, backpack or power sprayer. These sprayers give uniform flow over a directed area. Overhead boom sprayers may be used however setup time may not be cost effective. Do not use proportional solution mixers; they might not give uniform Rooting Solution quality and distribution.

## ROOTING PRODUCTS USED

To make Rooting Solutions:

- Hortus IBA Water Soluble Salts.
- Rhizopon AA Water Soluble Tablets



## HOW TO USE THE SPRAY DRIP DOWN METHOD

### STICKING & SEPARATION OF LOTS BY RATE

- Stick the un-treated cuttings in the media.
- Keep the cuttings hydrated by keeping misters on.
- It is useful to separate the plants into rooting solution rate groups. Plants with the same solution rate can be treated at the same time.

### ROOTING SOLUTION

- For foliar methods, only use Rooting Solutions made with Hortus IBA Water Soluble Salts or Rhizopon AA Water Soluble Tablets. The aqueous solutions are specially formulated to allow entry into the plant's vascular system.

### TREATMENT

- Spraying should be done the same day of sticking or soon after.
- Spraying should be done when the stomata in the leaves are open. If the propagation area is hot, do spraying at cool times, such as early mornings.
- Turn off the misters.
- **Spray the Rooting Solution onto leaves until the liquid drips down. If the leaves are wet from misters at the time of spraying, use an excess of Rooting Solution to overcome dilution of the solution.**
- To assure adequate treatment, apply enough solution to both the top and bottom of the leaves.

### SPRAY RATE

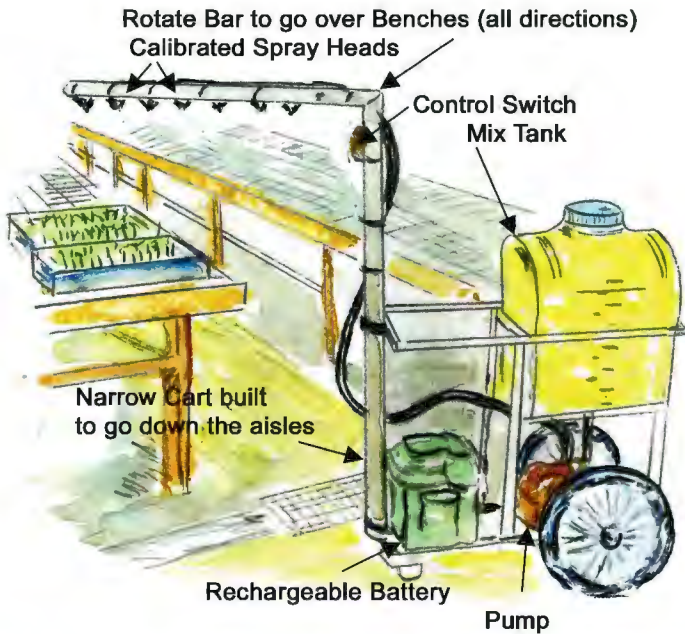
- Use about one gallon of rooting solution per 175 to 225 square foot of cuttings.

### MISTERS

- **After application of the Rooting Solution wait at until the solution dries, about 3/4 hour, before turning misters on.**

### UN-USED ROOTING SOLUTIONS

- **Un-used Rooting Solutions in the production tank or concentrate container can be stored at room temperature for several days without losing potency.**
- **For safety, label the Rooting Solution container.**



**Custom Built Cart Used to Apply Rooting Solutions by the Spray Drip Down Method**



Sprayer used by Bailey Nurseries.  
Photo: Bailey Nurseries

# The Total Immerse Method



Using the **Total Immerse Method**, you total immerse dip the cuttings in the Rooting Solution for a few second then drain. You can stick at any time.

The Total Immerse Method can be used for large homogeneous lots of plants or small lots. Since you will drag in biologicals from the cuttings into the solution, you should change the Rooting Solution frequently so that you do not

cross contaminate production lots. Total Immerse is useful for large leaf cuttings and cuttings whose leaves have stomata on the bottom of the leaf where spray drip down is difficult to use.

The Total Immerse Method uses simple equipment for treatment, a tank and a basket. Uniform treatment is done on large batches of cuttings is done in a few seconds. Since all cuttings are submerged in the Rooting Solution every cutting is treated. After treatment the cuttings can be stored in a plastic bag and stuck later.



Hedera (Ivy) Holland. Total immerse tank for Ivy.  
Dip basket not shown. Photo: Rhizopon

## EQUIPMENT

Use a solution tank. A dipping basket is useful.

## ROOTING PRODUCTS

To make Rooting Solutions:

- Hortus IBA Water Soluble Salts.
- Rhizopon AA Water Soluble Tablets

## HOW TO USE THE TOTAL IMMERSE METHOD

- Total Immerse the cuttings, using a basket, into the Rooting Solution for a few seconds. Drain.
- Stick the treated cuttings in the media, or put in plastic bags and store until sticking or planting out..
- Turn on misters as required.
- After treatment discard used Rooting Solution.

# Overview of Basal Methods

- The Basal Quick Dip, Basal Long Soak and Basal Dry Dip Methods are used on
  - leafy cuttings in the growing season or dormant
  - leafless cuttings
  - dormant cuttings
- Basal methods can be used all year.
- Rooting Solutions or rooting hormone powders are applied to the basal end of cuttings.

## ROOTING PRODUCTS USED

### Dry Dip Rooting Hormones

- Rhizopon AA #1, #2 and #3.

### To make Rooting Solutions:

- Hortus IBA Water Soluble Salts.
- Rhizopon AA Water Soluble Tablets.

## MODE OF ACTION

Rooting Solutions or dry powder rooting hormones are applied to the basal end of the cuttings. The rooting hormones absorbed into the plant's vascular system where they are stored; they are slow released by the plant to induce root formation.

METHODS	PRODUCTS TO USE
BASAL QUICK DIP METHOD	Use Rooting Solutions made with Hortus IBA Water Soluble Salts <i>or</i> Rhizopon AA Water Soluble Tablets
BASAL LONG SOAK METHOD	
DRY DIP METHOD	Use Rhizopon AA #1, #2, or #3 Dry Dip Rooting Hormones
<p>The selection of a method, either Dry Dip or by Rooting Solution, usually depends upon the plant variety. Many plants have successful rooting with Dry Dip methods and/or Rooting Solution methods.</p>	



# The Quick Dip Method



Using the **Basal Quick Dip Method** you can propagate plants from cuttings from easy to difficult to root. You dip the basal end of the cuttings into the Rooting Solution for about five seconds then stick.

## USE ON MANY TYPES OF PLANT CUTTINGS

<b>In the Growing Season</b>	<b>Leafy cuttings: Tropical plants. Annual and perennial plants. Woody ornamental plants. Forestry plants.</b>
<b>All Year</b>	<b>Leafy and leafless cuttings: Tropical plants. Annual and perennial plants. Woody ornamental plants. Forestry plants.</b>
<b>Winter Dormant Cuttings</b>	<b>Leafless cuttings: Woody ornamental plants. Forestry plants.</b>
<b>All Year</b>	<b>Leafy &amp; leafless cuttings: Hard-to-root cuttings.</b>

## EQUIPMENT

Dispense Rooting Solutions into small cups.

## ROOTING PRODUCTS USED

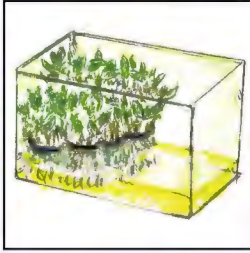
To make Rooting Solutions:

- **Hortus IBA Water Soluble Salts.**
- **Rhizopon AA Water Soluble Tablets**

## HOW TO USE THE BASAL QUICK DIP METHOD

- Wound woody cuttings by making a 3/4 inch slit at the side of the basal end is optional. Herbaceous cuttings are not wounded.
- Immerse the basal end of the cuttings about 3/4-1 inch into the Rooting Solution for about five seconds.
- Stick the treated cuttings in the media, or put in plastic bags and store until sticking or planting out.
- Turn on misters as required.
- After treatment discard the used Rooting Solution.

# The Basal Long Soak Method



Using the **Basal Long Soak Method** you can propagate plants from cuttings that are difficult to root. It is also used on easier to root cuttings. Both hard to woody plant cuttings and herbaceous cuttings benefit. Low Rooting Solution rates are used. Basal Long Soak eliminates high rates by the Quick Dip Method rates or Dry Dip rooting powders.

<b>In the growing season</b>	<b>Leafy cuttings: annuals, perennials, ornamental and forestry plants.</b>
<b>All year</b>	<b>Ornamental and forestry plants.</b>
<b>Winter dormant cuttings</b>	<b>Ornamental and forestry plants.</b>



Dutch nursery. Stem rose propagation using the basal long soak method. Photo: Rhizopon

## EQUIPMENT

Use a tank.

## ROOTING PRODUCTS USED

To make Rooting Solutions:

- Hortus IBA Water Soluble Salts.
- Rhizopon AA Water Soluble Tablets.

## HOW TO USE THE BASAL LONG SOAK METHOD

- Wounding of woody cuttings is optional. Herbaceous cuttings are not wounded.
- Bundle cuttings so they are erect in the tank.
- Immerse the basal end of the cuttings about 3/4-1 inch into the Rooting Solution. (See photo page 26)
- Soak about 12-48 hours.
- Stick the treated cuttings in the media, or put in plastic bags and store until sticking or planting out.
- Turn on misters as required.
- After treatment discard the used Rooting Solution.

## **USE THE BASAL LONG SOAK METHOD TO IMPROVE ROOTING OF HARD-TO-ROOT CUTTINGS**

When propagating plants from cuttings, if roots do not form, some growers unsuccessfully apply plant rooting hormones at high concentrations. They may use rates above 5000 ppm IBA and perhaps get variable results. If alcohol based Rooting Solutions are used they will cause burns and plant mortality.

### **SOLUTION**

**Use the basal long soak method to replace other high concentration methods.**

High plant rooting hormone concentrations may inhibit root formation. For difficult to root cuttings, the Basal Long Soak Method can successfully replace the Basal Quick Dip or Dry Dip Methods. The Basal Long Soak Method uses very low concentrations of Rooting Solution.



**Bundle cuttings, then immerse basal end 3/4-1 inch into the Rooting Solution for 12-48 hours, then plant or store.**

### **MODE OF ACTION**

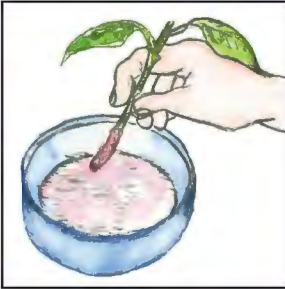
Using the Basal Long Soak Method, cuttings slowly absorb the Rooting Solution. The plant stores the plant rooting hormones at the basal end where it slow releases them for root formation.

### **TIMING**

The Basal Long Soak Method is used all year on all types of cuttings. Used in the fall, cuttings can be kept in cold storage and planted out in the spring. They can also be treated before planting

**The Basal Long Soak Method is as important as ever! Developed in the 1930's, the Basal Long Soak Method was one of the first successful ways growers used rooting hormones to propagate plants from cuttings.**

# The Dry Dip Method



Using the **Dry Dip Method** you can propagate plants from cuttings from easy to difficult to root. **Rhizopon AA #1, #2 and #3** rooting powders are used. When treating cuttings with different rate needs, simply switch powders. Color coding assures that the proper product is used.

## USE ON MANY TYPES OF PLANT CUTTINGS

In the growing season.	Leafy cuttings: annuals, perennials, woody ornamental and forestry plants.
All year.	Tropical plants annuals, perennials, woody ornamental and forestry plants.
Winter dormant cuttings.	Woody ornamental and forestry plants.
All year.	Hard to root cuttings.

## THE METHOD

### EQUIPMENT

Rooting powders are taken from the stock container and put into small cups.

### ROOTING PRODUCTS USED

#### Dry Dip Rooting Hormones:

- **Rhizopon AA #1 (0.1% IBA) is PINK color**  
*for easier to root cuttings*
- **Rhizopon AA #2 (0.3% IBA) is GREEN color**  
*for root many types of cuttings*
- **Rhizopon AA #3 (0.8% IBA) is WHITE color.**  
*for more difficult to root cuttings*



## HOW TO USE THE DRY DIP METHOD

- Take off a small portion of the powder for your immediate use. Do not contaminate the stock container by returning used portion to the container.
- Take plant cuttings, usually 4-6 inch stem cuttings, from the current year's growth.
- Wound woody cuttings by making a 3/4 inch slit at the side of the basal end is optional. Herbaceous cuttings are not wounded.
- Dip the basal end of the cuttings 3/4-1 inch into the Rhizopon AA powder. Tap off the excess powder.
- Avoid contact between the powder and foliage and other over ground parts of the stem. A small amount of powder on the leaves will not affect the quality of the rooting.
- Stick the treated cuttings in the media, or put in plastic bags and store until sticking or planting out. A dribble hole is useful to allow entry of the cutting into the media without pushing off the rooting powder.
- Turn on misters as required.
- After treatment discard used rooting powder.



# Trial Rates: Foliar Methods

## Total Immerse Method

## Spray Drip Down Method

A wide solution trial rate range is indicated for the Total Immerse and Spray Drip Down Methods. Your ideal rates will vary according to specific plant variety, season, quality of the cuttings, and local growing conditions. Prior to large scale production, test a few plants at several rates within the range. If foliar application causes phytotoxicity, try basal applications and/or decrease rates. Use the lowest rate to produce the desired effect.

### TYPICAL SPRAY LIQUID USE

**Spray Drip Down Method: 175-225 sq. ft./gallon**

Trial rates are *ppm* IBA using Hortus IBA Water Soluble Salts or Rhizopon AA Water Soluble Tablets (see conversion chart pg.15)

CUTTING TYPES	Hortus IBA Water Soluble Salts ( <i>ppm</i> IBA)
Annuals, perennials, chrysanthemum	80-250
Herbaceous and hard to root perennial plant cuttings	250-1500
Woody ornamental cuttings	300-1500



Plant cuttings vary in quality. Trial rates shown are from specific lots under the grower's particular facility and environmental controls. Your growing facility and plant lots are different; always perform your own trials for your plants and facility.

## Trial Rates: Woody Ornamental Plants Propagated by Spray Drip Down or Total Immerse Methods

Trial rates are *ppm* IBA using Hortus IBA Water Soluble Salts  
or Rhizonon AA Water Soluble Tablets (see conversion chart pg.15)

Acer	1000-1500	Rhus	500-750
Cotoneaster	500-750	Spirea, Japonica	500-750
Diervilla, paniculata	500-750	Syringa	500-750
Hydrangea	500-750	Thuja	1500-2000
Juniperus, horizontalis	1000-1500	Viburnum	1000-1500
Physocarpus, opulifolius	1000-1500	Weigela	1000-1500
Rosa, varieties	1000-1500		

## Trial Rates: Annual Plants Propagated by Spray Drip Down or Total Immerse Methods

Trial rates are *ppm* IBA using Hortus IBA Water Soluble Salts  
or Rhizonon AA Water Soluble Tablets (see conversion chart pg.15)

Pelargonium geranium		Petunia sp.	150-200
sp. like "Balcon"	50-100	some colors	200-300
zonale	200-300	Osteospermum	150-200
peltatum	300-400	Verbena	200-300
Impatient New Guinea	15-50	Poinsettia	25-100
Fuchsia	15-50		



# Trial Rates: Perennial Plants Propagated by Spray Drip Down or Total Immerse Methods

**Trial rates are ppm IBA using Hortus IBA Water Soluble Salts**  
or Rhizopon AA Water Soluble Tablets (see conversion chart pg.15)

Abutilon	750	Erodium		Origanum	500-750
Achillea	up to 1000	Dark Eyes	750	Paxistima	1000
Actinidia Arctic Beauty	1000	Erysimum	750	Penstemon	500
Ajuga	up to 1000	Escallonia Comp	500	Persicaria	up to 1000
Amsonia	1500	Eupatorium	500	Phlox	1000
Anisodonteia Tara's		Euphorbia	1000	Phygelius	750
Pink	750	Gaillardia	500	Poinsettia	500-1000
Antennaria	up to 750	Galium		Polemonium	
Anthemis	1000	SweetWoodruff	1500	Bressingham purple	
Arabis Variegata	500	Geranium	1000		1000
Arctostaphylos	500	Geum Rivale	1000	Prunella Loveli.	750
Armeria	1000	Gypsophila		Rosmarinus	500
Artemisia	up to 500	Viette'sDwrf	1000	Rudbeckia	750
Baptisia	3500	Hedera	1000	Ruellia	1000
Basil Kasar	500	Helenium	500	Salvia	500-1000
Buddleia	1000	Helianthemum	2000	Santolina	500
Calamintha Var.	500	Helianthus	1000	Saponaria	1000
Callicarpa	500	Helichrysum	500-1000	Saxifraga	750
Campanula	500-1000	Heliopsis	1000	Scabiosa	1000
Caryopteris	1000	Hypericum	1000	Silene	500
Ceanothus	500	Hyssop PinkDel.	500	Solly Boddy'sCh.	750
Ceratostigma	1500	Iberis	1000	Spilanthes	500
Chrysanthemum		Itea Little Henry	1000	Spiraea	1000
	500-1000	Kerria	1000	Spiraea Gold Flame,	
Chrysogonum	750	Lamiastrum		Magic Carpet, Neon	
Cistus	750	Herman Pride	1000	Flash	4000
Clematis	1000	Lamium	up to 1000	Stachys	1000
Clethra	1000	Lavandula	1000	Stevia	
Coleonema	750	Leptospermum	500	rebaudiana	500
Convolvulus	750	Linaria	500	Teucrium	1000
Coreopsis	500-1000	Lithodora	2000	Verbascum	1000
Correa	500	Lonicera	1000	Verbena	750
Cosmos	1000	Lychnis	1000	Vinca	1000
Cotoneaster		Marjoram		Viola	1500
Coral Beauty	500	Compactum	500	Vitex	1000
Delosperma	1000	Melissa	up to 500	Waldsteinia	1000
Erigeron	750-1000	Mentha	500	Weigela	1000
		Nepeta	500	Westringia	750
		Oenanthe	500		



# Trial Rates: Basal Quick Dip Method

**Make Rooting Solutions using Hortus IBA Water Soluble Salts or Rhizopon AA Water Soluble Tablets. Use the trial rate charts as a starting point.**

Use on cuttings in the growing season and winter dormant cuttings.

- Immerse basal end of cuttings approximately 1" in Rooting Solution a few seconds.
- Stick immediately or store.

**Trial rates are ppm IBA using Hortus IBA Water Soluble Salts or Rhizopon AA Water Soluble Tablets (see conversion chart pg.15)**

CUTTING TYPES	Hortus IBA Water Soluble Salts (ppm IBA)
Annuals, soft perennial, tender cuttings from ornamental plants, tropical house plants	80-200
Herbaceous, perennials, pot rose cuttings	150-1500
Difficult to root herbaceous, perennials, tropical house plant cuttings	500-1500
Softwood cuttings	500-1500
Hardwood cuttings	500-2000
Difficult to root hardwood cuttings <b>SEE THE NOTE BELOW</b>	2000-10,000

**Some cuttings are hard-to-root.** This may be caused by the condition of the cuttings, the maturity of the cuttings, or the timing when cuttings are taken. Some growers *'think'* the answer is to use a high rooting hormones rate. They usually get *in-consistent rooting or no roots at all.*

**A better answer** is to use the Basal Long Soak Method. Even though low rates are used, the cuttings have more Rooting Hormone stored at the basal end so that rooting is successful.

# Trial Rates: Basal Long Soak Method

**Make Rooting Solutions using Hortus IBA Water Soluble Salts or Rhizopon AA Water Soluble Tablets. Use the trial rate charts as a starting point.**

Use on cuttings in the growing season and winter dormant cuttings.

- Immerse basal end of cuttings approximately 1" in Rooting Solution for 12 to 48 hours.
- Stick immediately or store.

**Trial rates are ppm IBA using Hortus IBA Water Soluble Salts or Rhizopon AA Water Soluble Tablets (see conversion chart pg.15)**

CUTTING TYPES	Hortus IBA Water Soluble Salts (ppm IBA)
Hard to root annuals and perennials	25-100
Herbaceous cuttings	50-200
Woody ornamental cuttings, grape, roses	50-400

## Typical annual, perennial and other herbaceous plants using the Basal Long Soak Method

Aeonium	Dahlia	Heliotropism
Araucaria	Delphinium	Hydrangea
(Norfolk Island pine)	Dracaena	Phaseolus
Aster	Dipladenia	Pittosporum
Azalea	Gypsophila	Rosa (rose)
Cryptomeria (J. cedar)	(baby's breath)	Trachelium
Cupressus (cypress)	Hedera (ivy)	(throatwort)

## Typical hardwood and softwood, difficult to root cuttings using the Basal Long Soak Method

Apple (malus) rootstocks	Elaeagnus	Pseudotsuga (Douglas fir)
Aralia	Ficus (fig)	Rhododendron
Barberry	Forsythia	Ribes (currant)
Callicarpa	Halesia (silverbell)	Robinia (false aralia)
Calocedrus	Holodiscus	Salix (willow)
Carpinus (hornbeam)	Juniper	Redwood, coastal
Cephalotaxus (J. plum yew)	Metasequoia (sequoia)	Taxus (yew)
Centaurea (knapweed)	Nerium (oleander)	Thea (tea)
Chaenomeles (J. flowering quince)	Olive	Theobroma (cacao)
Citrus	Philadelphus (mock orange)	Thuja
Corylus (hazel)	Physocarpus (ninebark)	Thujopsis
Cryptomeria (J. cedar)	Picea (spruce)	Torreya
Cupressocyparis (Leyland Cypress)	Populus (poplar)	Tsuga (hemlock)
Cytisus (broom)	Potentilla (cinefoil)	Ulmus (elm)
Derris (rubber)	Prunus (peach rootstocks)	Viburnum
		Vitis (grape)
		Weigela
		Wisteria



Stock plant house in Holland

# Trial Rates: Dry Dip Method



## Rhizopon® AA #1

Active ingredient 0.1% IBA

**Pink Color Powder**

Use on easy to root cuttings.

## Rhizopon® AA #2

Active ingredient 0.3% IBA

**Green Color Powder**

An intermediate all purpose product.

Use on easy to more difficult to root cuttings

## Rhizopon® AA #3

Active ingredient 0.8% IBA

**White Color Powder**

Use on more difficult to root cuttings

*Rhizopon AA #1, #2 and #3 Dry Dip Rooting Hormones are not used to make Rooting Solutions.*

### SELECT THE RHIZOPON AA ROOTING POWDER FOR MANY TYPES OF PLANT CUTTINGS

SEASON	CUTTING TYPE	Rhizopon AA Dry Powder
In the growing season	Leafy cuttings: annuals	#1 or #2
	Leafy cuttings: perennials	#1, #2, or #3
	Leafy cuttings: woody ornamental and forestry	#2 or #3
All year	Tropical plants	#1 or #2
	Annuals	#1 or #2
	Perennials	#1, #2, or #3
	Woody ornamental and forestry plants	#2 or #3
Winter dormant cuttings	Woody ornamental and forestry plants	#2 or #3
All year	Hard to root cuttings	#2 or #3



# Trial Rates for plants propagated by the Dry Dip Method using Rhizopon AA #1, #2 and #3

**After the plant name is the product number for Rhizopon AA #1, #2 and #3 Dry Dip rooting hormones.**

Various rates may be used for species dependent upon the variety, time of the year, condition of the stock plants, facility, environmental factors, and other variables.

*Rhizopon AA #1, #2 and #3 Dry Dip Rooting Hormones are not used to make Rooting Solutions.*

Abelia	#1	Chrysanthemum	#2	Fuchsia	#1
Acanthopanax	#3	Cinquefoil	#2	Gardenia #1, #2 or #3	
African Violet	#1	Clematis	#2 or #3	Geranium	#1
Ageratum	#1	Clerodendron	#1	Germander	#2 or #3
Andromeda	#1	Clockvine	#1	Ginkgo	#2
Apple, Malus	#2 or #3	Coleus	#1	Golden Chain	#2
Arborvitae	#2 or #3	Cotoneaster	#3	Grape	#3
Arbutus	#3	Crab Apple	#2 or #3	Hawthorn	#3
Ardisia	#2	Cape Myrtle	#1	Hazelnut	#1 or #2
Azalea var		Crassula	#1	Heath	#3
	#1, #2 or #3	Creeper	#1	Heather	#3
Barberry	#1	Croton	#1	Hemlock	#2 or #3
Bayberry	#1	Cryptomeria	#3	Hibiscus	#2 or #3
Beauty Bush	#3	Currant	#1	Holly, Japanese	#2
Beauty Berry	#1	Dahlia	#2	Holly, American	#3
Beech	#2	Daphne	#1 or #2	Honeysuckle	#2
Begonia	#1	Deutzia	#1	Hydrangea	#2
Birch	#3	Dew Berry	#1	Jetbead	#1
Bittersweet	#3	Dogwood	#3	Juniper var.	#2 or #3
Blackberry	#1	Douglas Fir	#3	Kerria	#1
Bluebeard	#1	Dove Tree	#1	Knotwood	#3
Blueberry	#1 or #2	Dracaena	#1	Laburnocytisus	
Bougainvillea	#3	Dutchman's Pipe	#1		#1 or #2
Boxwood	#3	Elder	#1 or #2	Lantana	#1
Broom	#1 or #2	Escallonia	#2	Laurel	#3
Butterfly Bush	#1	False Arborvitae	#2	Lavender	#2
Camellia	#3	Firethorne	#1 or #2	Leucothoe	#2
Candytuft	#1	Flowering Cherry	#1	Lilac	#3
Carnation	#3	Flowering Quince	#3	Lily Scales	#1 or #2
Catalpa	#3	Fontanesia	#1	Linden	#1
Chaste Tree	#3	Forsythia	#1	Locust	#3
Chestnut	#3	Franklinia	#2	Magnolia	#2 or #3
Chokeberry	#2 or #3	Fringe Tree	#2	Manzanita	#3

Maple, Japanese	#3	Philodendron	#1	Springscent	#2
Matrimony Vine	#3	Phlox	#1	Spruce var.	#2
Melastoma	#1	Photinia	#3	St. Johnswort	#1
Mock Orange	#1	Pine var.	#2 or #3	Stevia	#1
Mulberry	#1	Poinsettia	#1	Stewartia	#1
Ninebark	#3	Poplar	#1	Sweet Leaf	#1
Norway Spruce	#1	Prickly Pear Cactus	#1	Trumpet Creeper	#1
Oak	#3	Privet	#3	Tulip Tree	#3
Oleander	#2	Raspberry	#1	Umbrella Pine	#3
Olive	#3	Retinospora	#3	Verbena	#1
Orange, sour	#3	Rhododendron var.	#3	Viburnum	#1
Orixa	#1	Rose	#1, #2 or #3	Waxmyrtle	#1
Osage Orange	#1	Russian Olive	#3	Weigela	#1
Osmanthus	#2	Sage	#1	Willow	#1
Pachysandra	#2 or #3	Sequoia	#2	Wintergreen	#2
Pea Shrub	#1	Snapdragon	#1	Wisteria	#2
Pear rootstocks	#3	Snow Berry	#1	Witch Hazel	#2
Pecan	#3	Sourwood	#3	Yellow Wood	#2
Penstemon	#1	Speedwell	#1	Yew var.	#3
Periwinkle	#2	Spiraea	#1	Zelkova	#2
Petunia	#2 or #3				



# Trial Rates using Rhizopon AA Water Soluble Tablets

To make Rooting Solutions using Rhizopon AA Water Soluble Tablets simply count the tablets and mix in water.

- Mix into ordinary water. Rhizopon AA Water Soluble Tablets are water soluble to 20 tablets/liter (1000 ppm IBA).
- Rhizopon AA Water Soluble Tablets are useful when a scale is not available to measure, and to mix small amounts of Rooting Solution.
- Use the Rooting Solutions by the foliar and basal methods shown in this book.

## Trial rates are using Rhizopon AA Water Soluble Tablets

Hortus IBA Water Soluble Salts can be used in all cases where Rhizopon AA Water Soluble Tablets are used. To use Hortus IBA Water Soluble Salts see conversion chart pg.15.

BASAL LONG SOAK METHOD	TABLETS/liter
Hard to root annual and perennial cuttings	1/2-2
Herbaceous cuttings	1-4
Woody ornamental cuttings, grapes, roses	2-8

QUICK DIP METHOD	TABLETS/liter
Annual, perennial, tropical plants, chrysanthemums	1-4
Herbaceous, perennials, pot roses cuttings	3-10
Softwood, hardwood cuttings. More difficult to root herbaceous, perennial, tropical house plant cuttings	10-20

TOTAL IMMERSE & SPRAY DRIP DOWN METHODS	TABLETS/liter
Annual, perennial, tropical plants, chrysanthemums	1-5
Herbaceous and hard-to-root perennial cuttings	5-20
Woody ornamental cuttings	10-20

# Selecting the Cuttings



Ivy stock plants in Holland

## SELECT THE BEST POSSIBLE STOCK PLANTS

The best stock plants produce the best cuttings used for propagation. During each growing cycle, growers must select plants that exhibit the best growth characteristics; these are selected as 'stock plants'. 'Off-shore' cuttings are from selected and maintained stock plants. The same selection process can be done at one's own growing facility.

## JUVENILE CUTTINGS

Cuttings taken from the juvenile parts of many plants can better produce roots compared to older parts. Shoots at the tops of the plant are physiologically older (*more mature*) than the shoots at the bottom of the plant (*more juvenile*). The top shoots have the characteristics of the more mature parts of the plant from which they originate. **Juvenile cuttings require lower plant rooting hormone rates compared to the 'older' cuttings.**

To maintain juvenility, annual and perennial cuttings should be taken from young stock plants. These stock plants, often a half year old, are used to produce the next generation stock plants from current cuttings. For woody plants 'hedging' can be done.

## THE 'BEST' TIME TO TAKE CUTTINGS

Some plants, especially those which go dormant, have different rooting ability at different times of the year. Timing of a few weeks in taking of cuttings may have success or failure. After maturing to a certain age, often years, cuttings taken from certain plants may not be able to produce roots.

## TYPICAL TIMING TO TAKE CUTTINGS

- **Herbaceous cuttings from greenhouse crops, annual and tropical plants: anytime.**
- **Deciduous and evergreen plant cuttings: early summer through early fall.**
- **Dormant hardwood cuttings: fall or winter.**



## PREPARATION AND CARE OF CUTTINGS

**Before taking cuttings**, stock plants must be provided with good light and fertilization. This will boost stored carbohydrates used to feed the newly formed roots.

- **Herbaceous** plant cuttings should be treated and stuck soon after being taken. To prevent heat damage, in hot climates cuttings are put in coolers soon after being cut. Perennial and annual cutting suppliers may have offshore stock plant nurseries. When shipped, cuttings from these nurseries are kept chilled during transit using special cartons that protect the cuttings from temperature variation. The cuttings are packed in plastic bags to assure continued hydration. Shipping time is kept short, assuring prompt arrival at the rooting facility. Certain plants do not ship well; to assure propagation success, those stock plants should be grown near the rooting facility.
- Winter **woody cuttings** taken in the fall can be treated with rooting hormones, kept in plastic, stored in cold storage, then planted-out in the spring.
- Growers usually take plant shoot cuttings from plant growth of the current growing season. Generally, thin cuttings will root more easily than thick cuttings. No one cutting type is useful to propagate all plants.

## TYPES OF CUTTINGS

### STEM CUTTINGS

'Stem cuttings' are the out-growing stems, mature sprouts or tip cuttings. Growers may take many types of stem cuttings.

- **SOFTWOOD & HERBACEOUS CUTTINGS:** these are the fast growing soft tips of stems, usually taken in the spring. Herbaceous cuttings, sometimes called 'tip cuttings' or 'shoot cuttings', are taken from the young soft tips of stems.

Softwood and Herbaceous cuttings have many variations. Cuttings taken from annuals, herbaceous perennials, tropical plants and house plants are easier to propagate from cuttings than more hardened cuttings.

**When using 'herbaceous' cuttings for foliar applied Rooting Solutions, other types of 'herbaceous' cuttings can be used:**

- *tender annual cuttings*
  - *tender perennial cuttings*
  - *hardy perennial cuttings*
  - *tender woody cuttings*
- **HARDWOOD CUTTINGS:** these are taken from the fully mature stems of deciduous shrubs and trees. Stock plants for these cuttings require careful selection and preparation before growers take the cuttings. Pruning of the stock plants allow them to produce new growth early in the growing season. The new growth can produce roots. Growers take these cuttings at the end of the growing season or during the dormant season.
  - **GREENWOOD CUTTINGS:** these are the soft tips or stems after the spring growth has slowed. The stem is harder and woodier than the soft wood cutting.
  - **SEMI-RIPE CUTTINGS:** these are taken during the late summer after the annual growth has slowed. The stem is harder than softwood or green wood cuttings.
  - **HARDWOOD CUTTINGS:** these are taken from dormant fully mature stems, usually from the current year's growth.

### **SCION CUTTINGS**

'Scion cuttings' are dormant 'ligneous' woody twigs.

### **EYE CUTTINGS**

'Eye cuttings' are pieces of foliated or defoliated stalks with one or more eyes.

### **ROOT CUTTINGS**

'Root cuttings' are parts of the root, usually annual. Growers take these from certain plants which have the capacity to regenerate stems from root parts.

### **LEAF CUTTINGS**

'Leaf cuttings' are parts of the leaf. New roots develop at the base or veins of the cutting. Dry powder rooting hormones are usually used to treat these cuttings.

# Handling Un-rooted Cuttings

- After taking cuttings, stick as soon as possible.
- USE PLANT ROOTING HORMONES.
- Do inspection.
- Reduce wilting during rooting.
- Maintain the appropriate environmental controls.
- Practice good sanitation.

## HANDLING OFF-SHORE UN-ROOTED CUTTINGS

After receiving cuttings from off-shore sources, open all boxes immediately. Inspect the un-rooted cuttings for damage, dehydration, heat or freeze damage, breakage or rot. Report any missing items or damaged cuttings to the vendor. Do not allow the boxes to remain in sunny or hot places, or below freezing temperatures. Growers should stick the un-rooted cuttings into pre-moistened, well drained, soil-less media with 5.5- 6.5 *pH*. If it not possible to stick the un-rooted cuttings immediately they can be held for several days in a cooler between 35-45°F. The cuttings will deteriorate rapidly at warm temperatures.

## WOUNDING

- Hardwood cuttings may root better if a 1/2 to 3/4 inch long notch, “wound,” is made at the basal end before applying the plant rooting hormone.
- Tropical and other herbaceous cuttings are not 'wounded'.

## MEDIA

Stick cuttings as soon as possible after either taking cuttings or receiving off-shore cuttings. Use pre-moistened, well drained, soil-less media with 5.5- 6.5 *pH*. ‘Airy’ media allows oxygen to stimulate root growth. *See page 45 for notes.*

## STICKING DEPTH

Stick the cuttings just deep enough that the medium anchors them. Thin cutting may be stuck 1/4-1/2 inch deep.

## TRAY SIZE AND DIRECT STICKING

Tray sizes range from 36 to 128 cell. Larger cells are used for cuttings scheduled to remain in the starting tray longer. Un-rooted cuttings can also direct stick in the finishing container or sometimes beds.

# Rooting Solutions, Rooting Powders and Methods

Hortus IBA Water Soluble Salts & Rhizopon AA rooting hormones are applied to cuttings *from 'easy-to-root' to 'difficult-to-root'*. Treated cuttings quickly form new uniform roots, strong root mass and homogenous propagation crops.

**For detailed information see the following pages:**

**Products** 2-3, 13-16

**Methods** 17-28

**Rates** 29-38 (For Rhizopon AA Water Soluble Tablets see chart pg.15)

<b>SOLUTION METHODS &amp; CUTTING TYPES</b>	<b>Hortus IBA Water Soluble Salts (ppm IBA)</b>
<b>TOTAL IMMERSE &amp; SPRAY DRIP DOWN METHODS</b> Annual, perennials, chrysanthemum Herbaceous and hard to root perennial plant cuttings Woody ornamental cuttings	<b>Trial rates</b> 80-250 250-1500 300-1500
<b>BASAL QUICK DIP METHOD</b> Annuals, soft perennial, tender cuttings from ornamental plants, tropical house plants Herbaceous, perennials, pot rose cuttings Difficult to root herbaceous, perennials, tropical house plants Softwood cuttings Hardwood cuttings Difficult to root hardwood cuttings ( <i>See note page 32</i> )	<b>Trial rates</b> 80-200 150-1500 500-1500 500-1500 500-2000 2000-10,000
<b>BASAL LONG SOAK METHOD</b> Hard to root annuals and perennials Herbaceous cuttings Woody ornamental cuttings, grape, roses	<b>Trial rates</b> 25-100 50-200 50-400
<b>DRY DIP METHOD &amp; CUTTING TYPES</b>	<b>Rhizopon AA #1, #2, #3</b>
<b>In the Growing Season</b> Leafy cuttings: annuals Leafy cuttings: perennials Leafy cuttings: woody ornamental and forestry <b>All Year</b> Tropical plants Annuals Perennials Woody ornamental and forestry plants, hard to root cuttings <b>Winter dormant cuttings</b>	<b>Trial rates</b> #1 or #2 #1, #2, or #3 #2 or #3 #1 or #2 #1 or #2 #1, #2, or #3 #2 or #3 #2 or #3



## Control of the Growing Area

Raising selected stock plants under controlled conditions is important. When growers give their stock plants proper care, the plants will produce the best cuttings. 'Just taking' cuttings from random 'field plants' leads to marginal results. The same way, control of the propagation house is equally important to the propagation of new plants.

**Always perform your own trials for your own plants, in your own facility, before doing large scale production.**



Inspection of cuttings

### INSPECTION

Growers must inspect their crops regularly to observe both intended and undesired results. Records should be kept that include information of the methods, materials, and plants used, and the quality of stock plants and cuttings.

### ROOTED CUTTING CARE

Early stage treatment of the cutting crop is essential to produce high quality finished plants. Do not allow the rooted cuttings to become over-rooted, dried-out, crowded or under-fertilized. These situations may reduce plant growth.

### PROVIDING THE BEST POSSIBLE CONDITIONS FOR ROOTING

Cuttings given less than optimal rooting conditions will waste energy. The result will be inferior root systems. To produce its own store of carbohydrates a plant needs the raw materials of light, water, carbon dioxide and oxygen.

### LIGHT

Growers should regulate the propagation house so that the cuttings are not under direct sunlight. The effect of direct sunlight and the resultant heat will cause stress to the cuttings. Light is necessary for photosynthesis. Un-rooted cuttings are not able to engage in much photosynthesis; a small amount of light, 100-125  $\mu\text{m}$  PAR light, during the rooting process is sufficient. It is important at this stage is to provide a long period of light. A

photo-period of 16-18 hours is adequate. Artificial lights are useful to extend natural daylight hours. Natural lighting or artificial lights may cause a rise in ambient temperature. Growers must control the growing area to avoid high temperatures from light sources.

### **WATER CONTENT OF THE MEDIA**

A plant must have a good root system in order for it to absorb water. Water is crucial while the cuttings begin to form roots. If the substrate that is too dry, the plant will have cell death. Dead cells increase the risk of rot. A very dry substrate encourages callus formation. Although many believe that callus is beneficial for root formation, this is not true. The callus hinders and slows root formation. Growers measure how much moisture in the soil with a tensiometer. For best rooting, the meter should display a reading between moist and wet. Another way is to weigh the trays regularly. By trial, the growers determine if the trays have the proper weight for the “the proper moisture level,” then provide water based on these observations.

### **CARBON DIOXIDE (CO<sup>2</sup>) IN AIR & OXYGEN IN MEDIA**



Environmentally controlled chrysanthemum propagation house in Holland

Photosynthesis is important for cuttings. Photosynthesis requires sufficient **carbon dioxide** (CO<sup>2</sup>), light, and water. An advantage of an increased level of CO<sup>2</sup> in the air is that it reduces the transpiration, loss of water, through the plant. Cuttings in an environment with sufficient light and an increased CO<sup>2</sup> level (800-1000 ppm) will form roots better. CO<sup>2</sup> can be controlled using special generators. **Oxygen** is necessary for cell division and crucial for root formation. Growers

must stick the cuttings into a substrate that has a structure which is sufficiently open to allow air, containing oxygen, to reach the developing roots. Dense media inhibits oxygen stimulation.

## **AIR CIRCULATION & TEMPERATURE CONTROL**

Good air circulation is necessary when rooting un-rooted cuttings. Shade to approximately 50% light conditions, or as required, to reduce temperature during high heat periods.

## **TEMPERATURE**

### **Soil Temperature**

Soil temperature has a direct influence on the speed of rooting. A soil temperature ranging between 68-77°F is ideal during the initial rooting stage. After this initial stage, growers can allow the temperature to drop a few degrees.

### **Air Temperature**

To prevent excess transpiration, controlling the temperature is important. To reduce aerial growth, air temperature should be a bit lower than soil temperature. The cuttings should be encouraged to use their energy mainly for developing roots. Above ground growth will come later.

### **Light and Temperature Relationship**

During the winter, when there is a low level of natural light, with no artificial lights, use a lower temperature. For example, cuttings will die if kept at temperatures near 74°F, short day and low light levels. Rooting activity in the soil will outpace its ability to do photosynthesis induced by the light.

## **FERTILIZATION**

Follow fertilizer label instructions. Growers should fertilize un-rooted cuttings during propagation. Apply a complete N-P-K fertilizer. For many plants, use a fertilizer containing 300 ppm of nitrogen approximately two to three times a week. Start on the third day after sticking or when the callus is starting to form. Quality can suffer if the roots become rootbound. Fertilize the cuttings when planting. Apply liquid fertilizer solutions at a rate of 300 to 400 ppm immediately after planting.

## **INSECT AND DISEASE CONTROL**

Good cultural practices and clean, well-ventilated growing space are your best defense against disease. Botrytis, the chief fungal threat, thrives in a moist, stagnant environment. Good air circulation and adequate light will reduce its harmful effects. *Apply appropriate fungicides, insecticides, and other control products following label instructions.*

# Humidity



Un-rooted cuttings must receive the highest amount of humidity. Temperature influences the ambient humidity. When the first roots appear, the humidity can be lowered; the rooted cuttings can adapt to the surroundings better.

## MISTING GUIDELINES

Apply mist immediately and frequently to maintain turgidity and minimize wilting while roots develop. Extended days of high humidity may cause some plant cuttings to form aerial roots.

Typical mist cycle for fast to root annual and perennial cuttings	
<b>1-3 DAYS AFTER STICKING</b>	<ul style="list-style-type: none"> <li>• Mist during daylight hours in all stages and the night for the first 3-4 days helps keep the cuttings turgid for optimum rooting.</li> <li>• Mist 10 seconds every 5-10 minutes.</li> </ul>
<b>4-7 DAYS AFTER STICKING</b>	<ul style="list-style-type: none"> <li>• Callus is being formed.</li> <li>• Mist 10 seconds every 20 minutes.</li> </ul>
<b>8-15 DAYS AFTER STICKING</b>	<ul style="list-style-type: none"> <li>• Roots are being formed.</li> <li>• Mist 10 seconds every 30 minutes.</li> <li>• Depending upon the plant variety, under ideal conditions, mist can be off 10 days after sticking.</li> </ul>
<b>AFTER 14 DAYS</b>	<ul style="list-style-type: none"> <li>• Fast to root cuttings can be ready to plant.</li> </ul>



*The Dutch growing system in this photo has controlled humidity by covering the propagation trays with either transparent or translucent plastic. Edges of the trays are sealed so that no air current at the sides affect the cuttings. No misting system is used.*