

2011

Satellite Farms Broccoli
Production Manual



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Organic Field School at Gardens of Eagan

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- **Broccoli Varieties**

- Gypsy (58D)
 - Seed source : Johnny's, Snow Seed (usually the best price), Harris
 - This has been our go-to variety ever since we started summer production
 - Tends to be 2 weeks earlier than Imperial at the start of the season
 - Beautiful, delicious, easily cleaned heads especially in Fall
 - Does produce some side-shoots after crown harvest
 - Has less uniformity in the summer especially in very hot, dry weather.
- Imperial (70D)
 - Seed source: Snow Seed
 - We've trialed this for the past 3 years and this year it will be our only variety planted for summer harvest (Mid July thru August)
 - Superior uniformity and heat resistance
 - First planting is at least 2 weeks behind Gypsy but as the season progresses this delay decreases
 - More difficult to clean due to size and toughness of stalks and stems.

- **Greenhouse Transplant Production**

- Schedule
 - Generally seed to transplant is 35-40 days
 - I error on having younger plants especially in spring in case the fields aren't ready. Also if planted in plug trays nutrient levels can decrease by the time the transplants are ready causing the plants to show signs of stress (purpling) and lose momentum.
 - Imperial is a little slower so I seed it a few days earlier.
 - We seed every week for 8 weeks in the greenhouse
- Seeding and Potting up
 - First 3 Plantings
 - 300 seeds per 1020 open flat
 - Germinate in chamber 48 hours at 75-80°
 - Ready to pot up in 2 weeks
 - Pot up to 1020 open flat 72 plants per flat (6 x 12). It is essential to plant these in a straight grid as they are cut prior to field transplanting.
 - Plantings 4-8
 - We direct seed these plants into an 1020 open flat using a vacuum seeder (Hand seeding would work as well as 72 plug trays)
 - We have a dibble board that indents the soil slightly and seeds drop into these indents. Then seeds are covered with thin layer of soil
 - Again the seeds need to be in a precise grid patten which facilitates cutting flats prior to field transplant (open flats only)
 - Flats germinate directly in the greenhouse usually in 3 days. Do not let the flats dry out during germination.
- Fertility
 - If seeded into 72 plug trays extra nutrients are required. Generally fertilizing begins when plants are hardened off outdoors.
 - We've used fish emulsion in the past injected into greenhouse hose
 - This year we are supplementing with Vermont Compost Plus. This will be sprinkled on the flats and watered in.
 - If open flats are used more nutrients are available to each plant and extra nutrients may not be required. However heavy watering in hot sunny weather leaches nutrients out.
 - If plants begin to turn purple the plants are stressed and need more nutrients. It is best, obviously, to fertilize before plants exhibit stress.

- Preparing for Field Transplant
 - Harden off transplants by exposing to outside elements for 1 week before transplanting. Avoid excessive wind especially on first exposure.
 - If using plug trays skip the cutting steps.
 - 2-3 days in advance of transplanting open flats should be cut.
 - Cut width-wise so plants pull out in six packs during transplanting. This is why the plants need to be in a precise grid pattern to facilitate this cutting process. Cutting length-wise is not necessary as plants pull apart easily from the six packs.
 - Cutting damages roots and should be done in advance to reduce transplant shock.
 - Water all flats thoroughly immediately before transplanting to the field.

- **Seedbed Transplant Production**

- Planting #9-#15 are done in the seedbed because the number of plants increases dramatically, soil temperature increases (enabling germination outdoors), and greenhouse space is unavailable.
- Stale Bed Preparation (New method for 2011)
 - Entire seedbed field is worked ASAP in the spring.
 - 2 weeks prior to 1st planting work field again then cover 1st bed with reemay to encourage weed seed germination
 - 1 week prior to 1st planting remove reemay when weeds are in thread stage to half inch in height kill them by shallow basket weeder, flame weeder, or by hand. Then recover with reemay and cover 2nd bed.
 - Do not work soil deep as this will bring up more weed seeds.
 - I generally avoid using a rototiller as this can lead to crusted soil and difficult germination
 - Continue adding a bed each week
- On the day of seeding
 - Remove reemay
 - Kill young weeds as in prior week (shallow basket weeder)
 - Fertilize bed with fine grade Sustane. Use basket weeder 140 on low creeper gear.
 - Use Jang seeder or other direct seeder with appropriate roller/plate size.
 - Plant 3x's as many seeds as you want transplants.
 - Rows are 6 inches apart
 - Cover with Reemay to keep out flea beetles until plants are 4-6 inches tall
- Irrigation
 - The critical stage for moisture is during germination. Don't allow soil to become dry.
 - The Reemay helps retain moisture along with keeping out pests.
 - This year we will try using Mini-wobblers attached to our water tank and pump to evenly water seedbeds as needed.

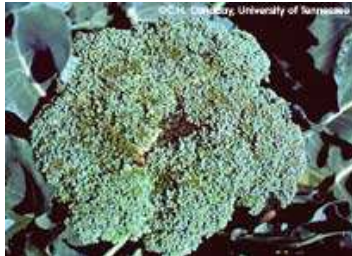
Transplanting Broccoli to the field

- Transplants from the Greenhouse
 - Water transplants thoroughly
 - Spacing 15" between plants. 36" between rows
 - Plants should be watered during or soon after transplanting. Avoid using heavy overhead irrigation for 1 week after planting.

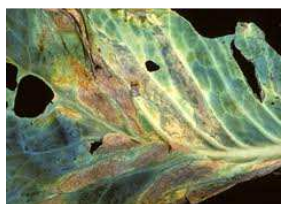
- Transplants from Seedbed
 - Bare Root transplants are pulled the same day as they are planted.
 - If there exists an extended time between pulling plants and transplanting, plants can be placed in cooler.
 - Ideally transplanting is done after 2pm especially if temperatures exceed 80 degrees.
 - Ideally the roots remain wet but this can cause a muddy mess while transplanting.
 - Our mechanical tranplanter provides water directly to the roots during planting.
 - Do Not Use overhead irrigation until after shock period
 - Spacing 15" between plants and 36" between rows.
 - Bare Root shock period
 - Immediately after planting, transplants appear wilted and lay flat on the ground. Do not be alarmed.
 - As the roots develop the plants regain turgidity and will be fully upright 2-4 days after transplanting.
 - Do not use overhead irrigation for 1 week after transplanting as this can mat them down during shock time.

- **After Planting Care**

- Keep weeds under control by cultivating or hand weeding when needed
- Sidedress plants one time using Sustane no earlier than 2 week and no later than 5 weeks after transplanting
- Irrigate when needed especially during hot weather and before the plants begin heading.
- Disease
 - Bacterial Soft Rot – Caused by warm wet conditions with no drying for prolonged periods.
 - This can also occur in the fall and can be identified by its rotten odor.
 - Do Not harvest



- Black Rot – caused by bacteria
 - Very destructive and contagious
 - Avoid fields with black rot. Wash equipment and clothes to avoid spreading to other fields.
 - Don't plant brassica in field for at least 2 years.



- Downy Mildew
 - Brown discolored beads on head
 - Especially prevalent in late fall plantings
 - Do Not Harvest.

- **Pests**

- Cabbage Worms and Cabbage Loopers

- These generally eat the leaves and rarely do enough damage to kill the plant
- However tolerance for worms in wholesale broccoli production is virtually zero.
- When white or yellow butterflies are present inspect for worms and determine if spray is necessary
- We control worms and loopers mainly with Dipel. Entrust also works but is more expensive and should be used if multiple pests are present.



- Flea Beetles

- These do the most damage when the plants are young. Cover seedbed with floating row cover.
- Plants in the field can be sprayed with Dipel, Pyganic, or Entrust to reduce pressure. If the plants are exceedingly stressed it may cause the plant to bolt rendering the head unharvestable.



- Root Maggots

- We had our first encounter with root maggots in 2010
- Decimated our first two plantings but only the first two plantings.
- Maggots eat the root hairs effectively cutting off water. The plants wilt and die.
- We have no control for this and are hoping 2010 was just a particularly bad year for pests due to strong southerly winds early in the season.



- **Forecasting, Harvest and Packing**
 - Forecasting depends greatly on the weather and time of year
 - Forecasting June-August
 - To avoid losing broccoli but maximizing each plant's potential we harvest 3x's per week during the summer months.
 - Generally if the head is quarter-sized it is about 10 days to harvest.
 - Baseball sized is 4 days out
 - Softball sized will be picked the next time through (2 day usually)
 - Forecasting Sept-October
 - Daylight and temperatures are rapidly decreasing which makes forecasting different than in the summer months and temperature fluctuations affect growth rates substantially.
 - Baseball sized is now 10 days out
 - Softball is a week from harvest
 - We adjust our harvest to go through only twice per week and toward the end of the season we may only go through once a week.
 - Heads that look ready to pick can stay in the field for a week and not grow much when the temperatures stay below 50degrees.
 - Estimating Harvest
 - Look at weather forecast to help understand how fast heads become mature.
 - Count at least 2 rows per planting and average them.
 - Choose rows that give an accurate sample. (Don't choose two that are next to each other unless there are only two rows in the entire planting)
 - Divide total number of heads by 22 for Gypsy and 18 for Imperial to get the total number of forecasted boxes.
 - Forecast for the next 2 picks and keep those records in order to adjust your forecasts.
 - This is a difficult task and requires a lot of patience, practice and attention.

- Harvest
 - In summer harvest is conducted in the morning before the heat of the day.
 - Fall Harvest can be done anytime as long as the plants are fully thawed.
 - Heads are ready to harvest when they are 5-6 inches in diameter.
 - The head is cut so that the entire length of the head and stalk is 8 inches.
 - All large leaves are removed usually by simply breaking them off by hand (trimming with a knife takes more time and can result in stalk damage. Imperial has tougher leaves and stems and therefore may require some knife trimming)
 - Cleaned heads are placed gently on the conveyor belt or directly into shipping box. Boxes should be weighed at the beginning of the season so harvesters can get used to what an 18-pound box feels and looks like. Boxes should be checked periodically by supervisor throughout the season to ensure quality.
 - If a conveyor belt is used the packer can ensure uniformity and quality.
- Quality
 - Quality must be maintained especially if harvester is packing his/her own box.
 - Heads should be nicely domed with tight beads. If beads are loose and starting to open the head is passed and should not be picked. This can happen very quickly in the summer.
 - Heads showing signs of disease or rot should not be picked as they deteriorate quickly after harvest.
- Packing
 - The first layer of broccoli is packed with the stalks toward the center of each box. Fit the rest of the 18lbs as best you can ensuring no broccoli will be damaged when the box is closed.
 - Broccoli must be packed with care to ensure no damage is caused by packer.
 - 18lbs are in one box. (Generally 22 heads of Gypsy and 18 heads of Imperial make one full box.
 - Store filled boxes in shaded area and transport to packing area as soon as possible
 - In packing area open each full broccoli box and put two ice scoops or one shovel worth of ice in each box.
 - Stack boxes on pallet
 - Label each box with Broccoli, 18 #, and Lot number.
 - Place pallet of broccoli in the cooler and write down harvested boxes on Harvest Record Sheet.