



DONALD DANFORTH
PLANT SCIENCE CENTER

*Integrated Plant Growth Facility
Donald Danforth Plant Science Center, St. Louis, MO*

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MAIZE PROTOCOL

SEED GERMINATION

1. Place a deep 1801 insert (3X6 3.5" square pots) into a flat without holes. If fewer than 18 plants are needed, break off extra pots. If more than 36 plants (2 flats) are needed, use a deep 50 star plug tray placed into a tray without holes.
2. Fill the pots to the top with MetroMix360/Turface 3:1 blend. Do not compact soil, and brush off excess so that soil is level with top of pots.
3. Moisten soil so that it is wet all the way to the bottom.
4. Place two seeds in each 3.5" pot, or 1/plug. Sow seed 1.5 cm. deep with the embryo pointed downwards and cover with soil.
5. Cover flats with a tall, clear dome to increase germination rate.
6. Flats can go into a designated corn house until they are ready to be transplanted.
7. Using flats without holes and a dome, seeds should not need water again until after germination is complete.
8. After plants have germinated, thin plants to one per pot.
9. Seedlings will be watered as needed after emergence. (Plug trays get bottom watered.)

TRANSPLANTING

1. Maize seedlings are transplanted two weeks after planting (V3 or V4). Fill a 2.5 gallon pot approximately $\frac{1}{2}$ to $\frac{3}{4}$ full with Pro-Mix BRK 7-35% soil. Tap the pot lightly to settle the soil – do not compact.
2. Sprinkle $\frac{3}{4}$ teaspoon tomato maker around the center of the pot where the seedling root ball will go. Take seedling out of container and put into pot. Set the seedling so that the first leaf collar is positioned 4-5 cm below the top rim of the pot. The stem below the first leaf collar will be completely buried after the soil settles.
3. Add soil until it is almost to the rim. Lightly rock pot to settle soil – do not compact.
4. Add $\frac{2}{3}$ tsp. of Tomato Maker and $\frac{1}{2}$ tsp. of chelated iron on the soil surface and lightly incorporate them into the soil.
5. Place plants into the designated greenhouse space, preferably on a raised table.
6. Water in the pots with 15-5-15 fertilizer water until soil in the top half of the pot is saturated. The soil should settle to be about 4-5 cm below the rim to allow space for water.
 - a. Do not saturate the entire pot – this can cause the soil to dry too slowly and cause health issues for the young plants.



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GREENHOUSE CARE

Environmental Conditions

1. Day length: 14 – 16 hours
2. Temperature: 28°C day, 22°C night
3. Humidity: minimum 40% RH
4. Light: Supplemental lights turn on when the sunlight is below 600 W/m² between 6am and 8pm (14 hours) from mid-September through mid-May and between 6am and 10am mid-May through mid-September. Lights are maintained at 5 – 6 feet above the top of the plants in equipped greenhouses.
5. Shading: The shade curtain automatically closes to 50% when the sunlight level is over 800 W/m² and it pulls to 100% when the sunlight is over 1000 W/m².

Watering

1. Until the plants reach the rapid growth stage (approximately V8), they are watered only when the pots are very light in weight. This provides the conditions necessary for good root establishment. Plants should stay on raised tables until they are well rooted and can be lifted by the stalk. (approximately V8) This takes about 2-3 weeks depending on the season.
2. The pots are then moved to tables on the floor to prevent tassels from getting too close to the lights. Now in the rapid growth stage, plants are watered generously as the reproductive stage approaches. Plants are lifted by the stalk to determine water loss by feeling the weight, and watered when slightly below container capacity.
3. After pollination, water use decreases, but pots are still kept very moist for the first two weeks.
4. The pots are allowed to get increasingly dry during the 3 – 4 weeks post-pollination, until watering is stopped at day 28.

Fertilizer

1. Maize plants are fertilized at every watering during the week since they dry down at different rates, using Jack's 15-5-15 Ca-Mg diluted to 150 ppm nitrogen. Plants are fertilized throughout their life cycle. Clear RO water is used on the weekends.
2. Some varieties may need a second or third application of Sprint if iron deficiency symptoms are present.
3. Some corn plants may develop rippled or "torn" edges and un-pigmented patches on the leaves due to an environmentally induced calcium deficiency. In severe cases the leaves wrap tightly around each other and eventually rot. Plants can also be stunted. Careful avoidance of overwatering of young plants will help. This is



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more commonly found from late fall to early spring in certain varieties (such as tip whorl rot in young B104 and “buggy-whipping” of older B73.) Supplemental Ca may be added if symptoms of deficiency persist.

Pest Management

1. The greenhouse staff routinely scouts for pests. For general infestations, an entire greenhouse is usually sprayed weekly. Small outbreaks of pests may be spot treated with pesticides as needed.
2. The most common pest is the two-spotted spider mite. Miticides are used for control. Oils and soaps can cause phytotoxicity to maize and are not used.
3. Black grain aphids may appear in scattered infestations and are easily controlled with an insecticide.
4. Western flower thrips often cause minor damage on young leaves, but rarely on older foliage. Susceptible corn varieties can be treated with predatory mites or an insecticide.

Disease Management

1. Sporadic infections by the fungus *Ustilago maydis* (common corn smut) may infect the ears, causing the kernels to develop into gray galls. As the gall develops, it swells and eventually bursts emitting masses of black spores. Early detection and removal of galls before they sporulate is the key to preventing further outbreaks. Signs with Danforth procedures for smut control are posted on the inside of corn greenhouse doors. While the greenhouse staff can monitor plants for developing galls, it is the responsibility of the researcher to check all ears under bags for galls beginning 7 days post pollination, and at least twice weekly after that.

POLLINATION - Pollinations are the responsibility of the researcher. Greenhouse staff can do pollinations on a contractual basis.

1. Cover emerging ears with a shoot bag before the silks are exposed. Snug the bag down tightly to prevent it from blowing off during pesticide sprays.
2. When the tassel begins to shed pollen, bag it with a 401, 402, or 404 bag. Fold the bag in half lengthwise, and place it over the tassel. With the stem pressed into the crease of the bag, pull both the bottom corners together, and fold them together back towards the stem into a triangle. Staple the folds closed tightly against the stem to prevent pollen from falling out.
3. If the timing is right, the ear will be ready to pollinate the next day with fresh pollen. Ideally, silks have emerged for 2 -3 days, but will still be receptive as long as they are less than 10 inches long. If silks have not emerged, but are developed in the husk, cut the top of the ear off about one inch past the tip of the cob and replace the shoot bag. Clean



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the scissors with the Physan spray solution provided in the greenhouse between every cut. The next day a “brush” of silks should be ready for pollination.

4. The day after bagging the tassel, fresh pollen will develop. Pollen grains are viable for 3-4 hours and are usually shed in the late morning, depending on temperature and humidity. Therefore pollinations are best made around noon. Viable pollen is white to pale yellow and has a shiny appearance. Carefully bend the tassel sideways and tap the bag to knock the pollen off the anthers. Some corn varieties (such as B73) have stiff stems that easily break when bent, so the entire plant may need to be tilted to collect pollen. Open the bag to remove the tassel.
5. Pour the pollen on the silks and immediately replace the shoot bag. If repeated pollinations are desired over the next 1-2 days, re-bag the tassel. At the time of the final pollination, use the tassel bag to cover the ear. Record the cross on the bag with a black Sharpie (doesn't fade), wrap the bottom sides of the bag together around the main stem of the plant, and staple. This ensures the bag cannot fall off as the ear grows or from pesticide sprays. It is not necessary or desirable to tear off the leaf adjacent to the pollinated ear as is frequently done in the field.

HARVEST

1. Beginning one week post-pollination, ears should be inspected for the presence of smut galls. Feel the ear for any swellings inside the husk that are significantly larger than a developing kernel. If found, please contact the greenhouse staff for removal.
2. Two weeks after pollination, bags should be removed from around the ears to allow for better mold and pest control. Continue to inspect for smut galls. The bag can be folded flat and either snugly slipped between the leaf sheath and the stalk, or wrapped around the stalk above the ear and stapled to itself.
3. In greenhouses with recent smut infections, peel back the husks at three weeks post-pollination. Otherwise, wait until four weeks.
4. At four weeks post-pollination, irrigation is discontinued, but the ears are not yet fully mature. Over the next 7-12 days, the seeds will continue to receive nutrition. Full maturation is evidenced when the milk line disappears and a black layer at the seed base forms.