

**GROWING RICE UNDER CONTROLLED CONDITIONS**  
**McCouch Research Program**  
**Cornell University, Ithaca, NY**

Revised 4/29/2010

By Sandra Harrington

\*\*\*\*\*

**TABLE OF CONTENTS**

1. Lighting	pg1-2
2. Humidity	pg2
3. Temperature	pg2
4. Watering	pg3
5. Potting Soil & Fertilization	pg3-5
6. Pest Management & Sanitation	pg5-7
a. General	
b. Rice Panicle Mite	

\*\*\*\*\*

**LIGHTING**

General Information

Rice is usually grown with a 12 hr day and high intensity lighting (500-1000 micro mol PAR m<sup>-2</sup> s<sup>-1</sup>). In some growth chambers, we rice can grow with as little as 300-400 PAR, but that is just to sustain minimum growth for DNA extraction. Generally greater than 500 PAR is recommend to get robust plants. Rice leaves photosynthetically saturate around 1000 PAR, but that is not necessary to get good growth. For reference, full noon summer sunlight is around 1800-2000 PAR depending on haziness. Excess light, however, usually comes with high temperatures in the field, and this leads to photo-respiration during the heat of the day. Some physiological considerations may require the higher light intensities, but for most purposes, 500-1000 PAR is recommended.

\*PAR is a unit of bulb measurment. The number after PAR is divided by 8 to get the maximum diameter of the bulb in inches. (<http://www.ledcome.com/faq.htm>)

Keep in mind that most rice varieties will flower sooner if given short day treatments (10-11 hours of daylight and 13-14 hrs night).

## McCouch Greenhouse Lighting Conditions

400 & 600 watt sodium lamps are used for supplemental light. On sunny days to dissipate the heat the lamps can be turned off manually.

As of April 2010, lighting conditions are set at:

9am EST LIGHTS ON/SHADE CURTAIN OPENS	11 hr light
8pm EST LIGHTS OFF/SHADE CURTAIN CLOSES	13 hr dark

\*\*\*\*\*

## **HUMIDITY**

### McCouch Greenhouse Humidity Conditions

A **Micro Cool** humidity system is currently used in one greenhouse to keep the relative humidity at 55%.

No humidity control is used in one greenhouse.

\*\*\*\*\*

## **TEMPERATURE**

### General Information

Day temperatures of 28-32 C are standard, with night temperatures about 3 degrees lower. Temperature may be critical to optimize growth for specific cultivars or wild species, and this needs to be determined for each variety or species, depending on its zone of adaptation.

### McCouch Greenhouse temperature Conditions

Day temperature setting:	29.4C
Night temperature setting:	26.7C

\*\*\*\*\*

## WATERING

### McCouch Greenhouse watering practices

Soil should be wetted completely through the pot/tray before planting seed. When seeds are first planted, sprinkle the soil surface with gently with “light rain” as needed until germination. Keep the soil surface moist at all times, but do not add large amounts of water to young plants.

After germination, soil should be kept well watered at all times. This can be done by **underwatering** (see below) or by adding water to the soil surface 1-3 times per day.

Underwatering is NOT recommended for young seedlings *if they are grown in small cells*. These should be hand-watered these until plants are about 3 weeks old (when they have 3-4 leaves).

If seedlings are growing in 3” pots or larger, underwatering is appropriate after germination takes place.

#### **Notes about underwatering:**

Underwatering does not mean withholding water supply from the plant! Underwatering requires setting pots in tanks/trays containing about 3-4" of room temperature water that can be "wicked" up to maintain soil moisture without constant addition of water from above. Use only water at room temperature when adding to the tanks. Do not add very cold water at any time as the roots are sensitive to water temp. Sturdy plastic trays capable of holding 4-8 pots each are generally used in growth chambers, whereas tanks covering an entire bench area are used in greenhouses. Note that the soil must be saturated before planting or the water may not wick up appropriately and dry spots may occur in the middle of pots.

\*\*\*\*\*

## SOIL & FERTILIZATION

\*Most components of soil are ordered from Griffin Greenhouse Supply (315) 255-1450.

### General Information

This procedure is not too labor or time intensive and allows production of thousands of healthy plants for genetic and phenotypic evaluation. It is, however, subject to some cyclic variation in physiological condition due to the timing of fertilizer application.

Plants are underwatered (see definition above) at all times (see exception above for germinating seeds and young seedling in small cells).

### Standard Cornell Guterman Greenhouse Procedure used for Rice

#### **SOIL**

##### Rice Cornell Mix

1 1/2 bales (=5.7cu ft) peat

2 bags (=12 cu ft) medium to course vermiculite

5lbs lime

1 lb 3oz Peter's Unimix Plus III

\*Most components of soil are ordered from Griffin Greenhouse Supply (315) 255-1450.

#### **FERTILIZER**

Two types of fertilizer stock solutions are made and diluted 1:100 just before use.

##### Solution A

Peters Water Soluble Fertilizer N.P.K-15-5-15      10lbs/5gallons water

##### Solution B

Peters Water Soluble Fertilizer N.P.K-15-5-15      10lbs/5gallons water  
& Sprint 330      2lbs/5gallons

\*Peters Water-Soluble Fertilizer is ordered from Scotts

\*Sprint 330 (Iron. Fe) 10% -10% Chelated Iron is ordered from Becker Underwood, Inc.

#### **FERTILIZER APPLICATION**

Apply 1:100 dilutions of Solution A 2-3 times/ week and Solution B once/week. Adjust according to growth of the plant material.

Fertilizer solution is always applied onto *soil surface*.

**NOTE about fertilizer application regime:**

Until you get to know your plants and what they specifically need in terms of fertilizer, you could try the following regime:

Fertilize with 1:100 dilution of Solution B (with iron) at 3-5 days after germination and again with Solution B one week later.

From 2 weeks of age until booting (flowering), alternate with 1:100 dilution of Solution A and B every 7-10 days. Once plants have flowered, stop using Solution B. Apply only Solution A (1:100 dilution) every 2 weeks (10-14 days) until harvest.

\*\*\*\*\*

**PEST MANAGEMENT & SANITATION**

General Practices

Growth rooms are cleaned and disinfected with a product similar to Phisan 20 or Greenshield before plants are germinated. Follow all label instructions, as these products are pesticides. It is important to maintain a clean growth environment during the experiment by cleaning floors, benches and drains on a regular basis.

Plants need to be spaced properly for good air movement between plants and to make sure pests don't have hiding places.

Hypoaspis mites are applied at or shortly after planting. These mites keep Fungus Gnats, Shore Fly and Thrips levels under control.

Plants should be scouted weekly to guard against insect or pathogen infestations.

Know what pesticides are compatible with your plants, bio controls and pests before growing begins.

## Rice Panicle Mite (RPM) Control Practices

Rice Panicle Mite (**RPM**) remains on the United States' "NO TOLERANCE" list.

### To rid our facility of the RPM, the following practices were followed:

1. All material removed from an RPM-infested greenhouse treated with one of the following methods:
  - a. Autoclaving materials (plant material, soil, pots)
  - b. Placing materials in plastic containers/bags that were disinfected (sprayed) with 70% ethanol before removal from the greenhouse and then placed directly into a -20C freezer for 72 hours. (seeds)
  - c. Placing materials directly into liquid nitrogen and then into a -20C freezer (leaf tissue)
  - d. Wiping material with 70% alcohol (small instruments like crossing scissors)
2. After material and supplies were removed as described in (1), the entire greenhouse was sprayed with Greenshield foam. The greenhouse was then locked and left to sit empty at an elevated temperature for 30 days.
3. Hooded Tyvek suits, booties and gloves were worn whenever the infested greenhouse(s) was entered. The suits/booties/gloves were discarded and autoclaved upon exiting. No other greenhouses were entered after entering the infested greenhouse.

### To keep facilities free of RPM, these practices are followed:

1. All seeds imported are cold-treated upon arrival for 72 hours at -20C.
2. All seeds produced in McCouch facilities are harvested into paper envelopes and dried at 35C in a blower located in the greenhouse to approximately 12-13% water content. This usually takes about 2 days. The seeds are then immediately placed in a -20C freezer for 72 hours. (This *does* include naked (F1) seeds.) The dates of cold treatment are stamped on each envelope. The seeds are allowed to come to room temperature to "dry". (Do not store immediately in a closed container or

mold may occur.) Seeds are then stored at room temperature if for short-term use. If the seeds are to be kept long-term, they are placed in a 4C storage facility in brown paper envelopes.

3. All seeds that are to be planted are treated with 20% Clorox for 15 minutes (with gentle shaking) then rinsed with water for 15 minutes before the planting. If naked (F1) seeds are to be planted, a Clorox treatment of 10% for 10 minutes with a 10 minute water rinse is used.
4. Entry to the facilities by people other than those directly involved in the project and the greenhouse crew is prohibited. Entering the greenhouse after visiting other facilities is highly discouraged to avoid pest introduction due to contact with an alternate host.
5. Entry into more than one rice-growing greenhouse in one day is discouraged to prevent the spread of disease between greenhouses. If this is absolutely necessary, a clean lab coat should be worn in each greenhouse.
6. No plants are moved between facilities, and plants are never removed from a greenhouse and then brought back in. Once removed, the plants must be kept in a growth chamber or destroyed.
7. A rotating selection of miticides is routinely applied in the greenhouses to stave off infestation and to prevent build up of resistance to any single miticide.