IR-4 NATIONAL PESTICIDE CLEARANCE
EFFICACY AND PERFORMANCE PROTOCOL

PR. NO.: P12077
DATE: 4/20

1. PROJECT TITLE:

Copper Hydroxide: Efficacy and Crop Safety of Copper Hydroxide for the Control of Bacterial Diseases (*Pseudomonas cichorii*) of Greenhouse Basil Transplants (greenhouse herb transplants for retail sale)

2. JUSTIFICATION AND OBJECTIVES:

IR-4 received a request for the use of copper hydroxide on greenhouse basil transplants for control of bacterial diseases (bacterial leaf spot (*Pseudomonas cichorii*)). The purpose of this research is to collect efficacy and crop safety data to support registration of copper hydroxide on greenhouse basil transplants for the control of bacterial diseases.

3. IR-4 RESEARCH COORDINATOR:

Kathryn Homa, IR-4 Project Headquarters, 500 College Road East, Suite 201 W, Princeton, NJ 08540, (732) 932-9575 X4604, FAX# (609) 514-2612, E-mail: homa@njaes.rutgers.edu

Signature of IR-4 Research Coordinator indicating protocol has been finalized. 4/21/20 Date

4. TEST SYSTEM/CROP:

Greenhouse Basil Transplants- Use a locally grown commercial variety **that is susceptible** to bacterial diseases (bacterial leaf spot (*Pseudomonas cichorii*)) and report: variety/source, lot number, etc. Greenhouse trials will be conducted at the appropriate sites to determine the efficacy and crop safety on greenhouse basil transplants. Trials should be located in geographical locations that represent important commercial greenhouse basil transplant production areas.

5. TEST/CONTROL SUBSTANCE:

Evaluate the test materials listed below. **The products tested should be fresh product.** Do not use other test products that have been stored for more than two years or that have been stored under conditions inconsistent with the product label. If needed, the IR-4 Research Coordinator will arrange for fresh test substances to be delivered. Upon receipt, document the lot/batch number. Store the test substance in a secure, clean, dry area at temperature ranges noted in the product label.

Product % AI and formulation	Active Ingredient(s)	EPA Reg. Number	CAS Number
Previsto Fungicide-Bactericide (copper hydroxide)	0.30 lbs metallic copper/gallon	10163-330	20427-59-2
Badge SC (copper hydroxide + copper oxychloride)	Metallic Copper (Cu) Equivalent is 20% by weight or 2.27 Pounds Metallic Copper per gallon	80289-3-10163	Copper Oxychloride: 1332-40-7 Copper hydroxide: 20427-59-2
Serenade ASO (Registered Standard)	Contains a minimum of 1×10^9 cfu/g of QST 713 strain of *Bacillus subtilis*	264-1152	---

6. TEST SYSTEM DESIGN and STATISTICAL METHOD:

Each test site should conduct **four replicates of each treatment** listed in Section 9. Arrange plots in a randomized complete block design or other appropriate statistical design. The individual plots should be large enough to permit accurate application of the test substance in a manner that represents the major application technique that will be used commercially. Conduct appropriate statistical analysis to determine if significant differences exist between treatments.

7. TEST SITE PREPARATION:

Prepare a test site following good local agricultural practices for the production of greenhouse basil transplants including fertilization, irrigation, if necessary and available, and other practices that ensure good crop production. The test site should have a known pesticide and crop treatment history of a minimum of 1 year.

8. TEST SUBSTANCE APPLICATION:

Use application equipment that will provide uniform application of the test substance and simulates the intended commercial application technique as specified below. To ensure accurate delivery, calibrate test application equipment just prior to application of the test substance.

9. APPLICATION TREATMENTS AND TIMING: BASIL TRANSPLANTS

Trt#	Treatment	Target Rate of active ingredient	Target Rate of formulated product*	Application Type	Spray Volume Range**
01	Untreated	Not Applicable	Not Applicable	Not Applicable	Not Applicable
02	Previsto	0.225 lb ai/acre	2,839 mL/acre	Foliar Spray	20-60 GPA
03	Badge SC **(Labelled Field Rate)**	0.426 lb ai/acre	710 mL/acre	Foliar Spray	20-60 GPA
04	Badge SC **(Low Rate Comparison to Previsto)**	0.225 lb ai/acre	375 mL/acre	Foliar Spray	20-60 GPA
05	Serenade ASO **(Registered Standard)**	----	4 qt product/A	Foliar Spray	20-60 GPA

*The nominal formulation concentration of the test substance will be used in calculating application rates.
**GPA=gallons per acre

Researchers can rely on natural inoculum or inoculate by misting a water suspension containing 10^4 bacterial cells per ml of *Pseudomonas cichorii* on healthy basil plants and maintaining in a dew chamber for 24 hours at 26°C and then moving to a greenhouse to initiate the disease. The disease should not be initiated until 2-3 days after the first application is made.

Treatments 02, 03, 04, 05: Make 4 foliar applications at intervals of 7 to 10 days.

Begin applications preventatively, when conditions are optimal for the presence of disease. When disease pressure is severe, use the shorter 7 day retreatment interval.

10. EVALUATION OF PEST AND CROP INJURY:

EVALUATIONS OF DISEASES:

Disease incidence and severity of bacterial leaf spot (*Pseudomonas cichorii*) should be **rated weekly** approximately 1-2 days after each application. An initial rating should be done before any applications are made to determine if the disease is present in the plots before the applications begin. Evaluations should be conducted when conditions are most favorable for the diseases.

Incidence and severity: Bacterial leaf spot (*Pseudomonas cichorii*)

Disease Incidence: Evaluate basil transplants in each replicate and calculate the number of infected plants (% infection).

Disease Severity: Evaluate each basil transplant for percent of surface infection (% leaf area infected) using a known scale (e.g. Horsfall-Barratt scale)

Crop Safety Assessments:
Crop health should be evaluated on all plots **1-2 days after each application**. If injury occurs then additional evaluations should be considered. Evaluate the impact on disease development. Assess four randomly selected areas within each treatment.

Foliage injury: 0 = no adverse effect; 3 = moderate damage; 5 = severe damage including defoliation and numerous spotting

Also specify the type of injury (stunting, stand loss, leaf burn, leaf cupping or twisting, chlorosis, etc.) Record if any delay in maturity occurred. Evaluate if the crop is stunted and provide an overall assessment (if the level of phytotoxicity would be acceptable in commercial production).

11. SUPPLEMENTAL CROP TREATMENTS:

The integrity of the study should be protected by managing pests causing significant damage to the test crop. Only EPA-registered maintenance pesticides should be used at labeled rates. Document all supplemental crop treatments.

12. FIELD DOCUMENTATION AND RECORD KEEPING:

All operations, data and observations, appropriate to this study should be recorded directly and promptly. At a minimum, collect and maintain the following raw data:

- Test site information
- Plot maps
- Information regarding calibration, and use of application equipment
- Treatment application data
- Crop maintenance pesticides and cultural practices
- Meteorological/Irrigation records
- Other data requested in this protocol such as pest damage ratings and crop safety/injury ratings.

13. PROTOCOL/MODIFICATIONS:

Consult with the IR-4 Regional/ARS Field Research Coordinator and IR-4 HQ Research Coordinator regarding desired changes in this protocol prior to occurrence.

14. FIELD RESEARCH REPORT:

The Field Research Director should write a one to two page summary report similar to those found in a Plant Disease Management Report. The report and supporting documents should be sent to the Regional/ARS Field Coordinator listed below. It is recommended that the Field Research Director maintain a complete copy of these field documents.

15. FIELD PERSONNEL / ID NO. / REGIONAL/ARS FIELD RESEARCH LOCATION

Field Research Director	Field ID NO.	RFC	Test Crop
Dr Mary K. Hausbeck, Michigan State University, Department of Plant, Soil and Microbial Sciences, Plant Biology Lab, 612 Wilson Road, Room 140, East Lansing, MI 48824. (517) 355-4534; Fax: 517-353-9704; e-mail: hausbec1@msu.edu	P12077.20-MIP10	NCR	Basil Greenhouse Transplants
	P12077.20-MIP11		

RFC = Regional/ARS Field Coordinator

Location:
NCR: Dr Anthony VanWoerkom, IR-4 North Central Research Center, Michigan State Univ., 3815 Technology Blvd., Suite 1031B, Lansing, MI 48910-8396, Phones: 517-336-4611(MSU) or 269-561-5040 x107 (TNRC); Cell: 616-403-4706; FAX# 517-432-2098; e-mail: vanwoer3@msu.edu