

## 2016 Fungicide Spray Guide for Tomato in North Carolina

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**Foliar Diseases.** There are several diseases that attack tomato leaves and fruit in North Carolina. Some diseases are caused by fungi, such as early blight (*Alternaria lineariae* = *A. tomatophila*), late blight (*Phytophthora infestans*) and Septoria leaf spot (*Septoria lycopersici*) (**Fig. 1**), while other diseases are caused by bacteria, such as bacterial spot (*Xanthomonas perforans*) and bacterial speck (*Pseudomonas syringae*). The population structure of bacteria attacking field-grown tomatoes has shifted since the early 2000s, and bacterial spot is now considered the most predominant foliar pathogen throughout North Carolina, as well as the Southeastern U.S.



**Fig 1.** Tomato diseases (from left to right): Botrytis gray mold on tomato fruit, late blight on tomato leaf and fruit, early blight on tomato leaf, bacterial leaf spot on tomato leaf.

**Effective Chemicals.** There is no SINGLE product that is effective against all important foliar diseases. For example, mancozeb gives good control of early blight, but chlorothalonil gives only fair control; however, chlorothalonil, mandipropamid (one of the active ingredients in Revus Top), and fluopicolide (Presidio) are presently the best products for managing late blight. In addition, copper-based products are effective against bacterial canker, but some strains of the speck and spot bacteria are resistant to copper; the use of Actigard has been shown to be effective in reducing all 3 bacterial diseases. Therefore, it is necessary to use a combination of products in a spray program to optimize disease management. It is important to consider that products have different pre-harvest intervals (PHI). A product with a PHI greater than 2 days such as mancozeb (PHI = 5 days) cannot be used when growers harvest 2 or more times per week. It also is important to incorporate fungicide resistance management into a spray program. For example, resistance to the QoI fungicides (most strobilurins- i.e. Cabrio or Quadris) in the early blight fungus has been detected in North Carolina since the 2007 growing season because it had been used almost exclusively for early blight control.

**Volume-based Spray Schedule.** The following suggested weekly spray schedule (Table 1) accounts for the above considerations and label restrictions of different products and is based on years of field research in NC. Labeled rates of products are usually listed on a **per acre basis**, but for staked tomatoes, these should be applied on a **per volume basis**. The reason for spraying on a per volume basis is that early in the season when plants are small, less volume (and thus, less product) is needed to obtain full coverage, than later in the season when plants are larger and more spray volume is needed to obtain full coverage. First, determine the maximum spray volume per acre for your sprayer for fully-grown plants. Then, mix the acre rate for a given product in the maximum spray volume that it takes to cover an acre. For example, mancozeb products are labeled at 3 lbs per acre. If the maximum spray volume is 100 gallons per acre for your sprayer when plants are fully grown, then mix the mancozeb product at the rate of 3 lbs per 100 gallons of spray. At the start of the season, it may take only 30 gallons per acre to obtain full coverage, so the amount of the mancozeb product would be 1.0 lb for 30 gallons. The volume of spray per acre is then increased as plants grow and spray nozzles are added until the maximum 100-gallon volume per acre is reached at full plant growth.

**The purpose of this schedule is to provide a general spray program, which can be altered depending on disease pressure and weather conditions.**

**Table 1.** Suggested weekly spray schedule and products<sup>Y</sup> for foliar disease control on tomato in NC

|   |  |   |  |
|---|--|---|--|
| <b>Before harvest:</b><br>(target diseases are: <b>early blight</b> , <b>bacterial spot</b> , <b>both</b> )               | Week 1                                   | - | <b>mancozeb + copper + Actigard</b>                              |
|   | Week 2                                   | - | <b>mancozeb + copper</b>   |
|   | Week 3                                   | - | <b>mancozeb + strobilurin + Actigard</b>                         |
|   | Week 4                                   | - | <b>mancozeb + copper</b>   |
|   | Week 5                                   | - | <b>Endura LOW rate + Actigard</b>                                |
|   | Week 6                                   | - | <b>mancozeb + copper</b>   |
|   | **Week 7                                 | - | <b>mancozeb + strobilurin + Actigard</b>                         |
|   | **Week 8                                 | - | <b>mancozeb + copper</b>   |
| <b>During harvest:</b><br>(target diseases are: <b>early blight</b> , <b>late blight</b> , or <b>both</b> ; or gray mold) | Week 9                                   | - | <b>Endura LOW rate OR HIGH rate<sup>Z</sup> + chlorothalonil</b> |
|   | Week 10                                  | - | <b>Revus Top OR Presidio OR Ranman</b>                           |
|   | Week 11                                  | - | <b>strobilurin + chlorothalonil</b>                              |
|   | Week 12                                  | - | <b>Revus Top OR Presidio OR Ranman</b>                           |
|   | Week 13                                  | - | <b>Endura LOW rate OR HIGH rate<sup>Z</sup> + chlorothalonil</b> |
|   | Week 14                                  | - | <b>Revus Top OR Presidio OR Ranman</b>                           |
|   | Week 15                                  | - | <b>strobilurin + chlorothalonil</b>                              |
|   | Finish season with <b>chlorothalonil</b> |   |  |

<sup>Y</sup> Refer to product labels and Table 2 for rates to use in volume-based spraying.<sup>Z</sup> Low rate of **Endura** controls early blight; high rate controls early blight & Botrytis gray mold and only is necessary during cool, wet conditions around harvest.**\*\*For late plantings only: If late blight is in the area, consider chlorothalonil for late blight control beginning Week 7 or 8.****Note: Strobilurin** products must be **rotated as per label restrictions**, and to **limit development of fungicide resistance** in the early blight pathogen.**Actigard** applications should be limited to reduce the risk of **phytotoxicity** and **plant stunting**.Field trials also have found that **Regalia** or **Serenade Max** have some efficacy against bacterial spot.**Table 2.** Amount of product/100 gal, assuming a maximum of 100 gal/acre at full plant growth.

| Common name                       | FRAC  | PHI (days)               | Product name               | Amount/100 gal      | Max. Amt/ac/season        |
|-----------------------------------|-------|--------------------------|----------------------------|---------------------|---------------------------|
| chlorothalonil                    | M     | 0                        | Bravo Ultrex, Equus DF     | 1.3 to 2.6 lb       | 18.3 lb                   |
|                                   | M     |                          | Bravo Weather Stik         | 1.375 to 2.75 pints | 20 pints                  |
|                                   | M+33  |                          | Catamaran                  | 4.5 to 7.0 pints    | 50 pints                  |
| fixed copper                      | M     | varies<br>check<br>label | Kocide 3000                | 0.75 to 1.75 lb     | varies;<br>check<br>label |
|                                   |       |                          | Cuprofix Ultra 40 Disperss | 0.75 to 3.0 lb      |                           |
|                                   |       |                          | MasterCop                  | 0.5 to 3.0 pints    |                           |
| mancozeb                          | M     | 5                        | Manzate Pro-stick          | 0.75 to 3.0 lb      | 22.4 lb                   |
|                                   |       |                          | Penncozeb 75 DF            | 0.75 to 3.0 lb      | 22.4 lb                   |
|                                   |       |                          | Dithane F45                | 1.2 to 2.4 qt       | 16.8 qt                   |
| difenoconazole +<br>cyprodinil    | 3+9   | 0                        | Inspire Super (GM)         | 16.0 to 20.0 fl oz  | 47 fl oz                  |
| mefanoxam (S)+<br>chlorothalonil  | 4 + M | 5                        | Ridomil Gold Bravo         | 2.5 pints           | 12.5 pints                |
| boscalid                          | 7     | 0                        | Endura                     | LOW 3.5 to 5.0 oz   | 25.0 oz                   |
| boscalid                          | 7     | 0                        | Endura                     | HIGH 9.0 to 12.0 oz | 25.0 oz                   |
| penthiopyrad                      | 7     | 0                        | Fontelis                   | 16.0 to 24.0 fl oz  | 72.0 fl oz                |
| strobilurin                       | 11    | 0                        | Cabrio EG                  | 8.0 to 16.0 oz      | 96.0 oz                   |
|                                   | 11    | 0                        | Quadris 2.08F              | 5.0 to 6.2 fl oz    | 37.0 fl oz                |
|                                   | 11+7  | 7                        | Priaxor (GM)               | 4.0 to 8.0 fl oz    | 24.0 fl oz                |
| famoxadone +<br>cymoxanil         | 11+27 | 3                        | Tanos                      | 6.0 to 8.0 fl oz    | 72.0 oz                   |
| acibenzolar S-methyl              | 21    | 14                       | Actigard 50WG              | 0.33 to 0.75 oz     | 6.0 oz                    |
| cyazofamid                        | 21    | 0                        | Ranman                     | 2.1 to 2.75 fl oz   | 16.5 fl oz                |
| propamocarb (S)                   | 28    | 5                        | Previcur Flex              | 0.7 to 1.5 pints    | 7.5 pints                 |
| mandipropamid +<br>difenoconazole | 40+3  | 1                        | Revus Top                  | 5.5 to 7.0 fl oz    | 28.0 fl oz                |
| fluopicolide(S)                   | 43    | 2                        | Presidio                   | 3.0 to 4.0 fl oz    | 12.0 fl oz                |
| <i>Bacillus subtilis</i>          | 44    | 0                        | Serenade Max               | 1.0 to 3.0 lb       | NA                        |
| ametoctradin +<br>dimethomorph    | 45+40 | 4                        | Zampro                     | 14 fl oz            | 42 fl oz                  |
| <i>Reynoutria sachalinensis</i>   | P5    | 0                        | Regalia                    | 0.5 to 4.0 quarts   | NA                        |

**(S) THIS PRODUCT HAS SYSTEMIC ACTIVITY; IT SHOULD BE USED FOR CURATIVE CONTROL OF LATE BLIGHT.**

(GM) This product also controls gray mold.

For an electronic version of this spray guide, visit <http://www.ces.ncsu.edu/fletcher/programs/plantpath/>**Note:** Recommendations for the use of agricultural chemicals are included here as a convenience to the reader. The use of brand names and mention or listing of commercial products does not imply endorsement by North Carolina State University nor discrimination against similar products or services not mentioned.

Individuals who use agricultural chemicals are responsible for ensuring that the intended use complies with current regulations and conforms to the product label.

Examine a current product label before applying any chemical. For assistance, contact your county North Carolina Cooperative Extension Service agent.