

## 2009 Foliar Fungicide Spray Guide for Tomatoes in NC

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**Tomato foliar diseases.** There are several diseases that attack tomato leaves and fruit during tomato production in North Carolina. Some diseases are caused by bacteria, such as bacterial canker (*Clavibacter michiganensis* subsp. *michiganensis*), bacterial spot (*Xanthomonas perforans*), and bacterial speck (*Pseudomonas syringae* pv. *tomato*). Other important foliar diseases are caused by fungi, such as early blight (*Alternaria solani*), late blight (*Phytophthora infestans*), and Septoria leaf spot (*Septoria lycopersici*) (Fig. 1).



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

**Effective chemicals.** There is no SINGLE product that is effective against all important foliar tomato diseases. For example, mancozeb gives good control but chlorothalonil gives only fair control of early blight; 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 have become resistant to copper. However, the use of Actigard has been shown to be effective in reducing all three bacterial diseases. And the product boscalid (Endura) has excellent activity against Botrytis gray mold and early blight. Therefore, it is necessary to use a combination of different products in a spray program to optimize management of the different tomato diseases that occur. One important consideration is that different products have different preharvest intervals (PHI). A product with a PHI greater than 1 day such as mancozeb (PHI = 5 days) cannot be used when harvests are done 2 or more times per week. Another important consideration is fungicide resistance management. For example, early blight is developing insensitivity (resistance) to the strobilurins, i.e. Cabrio, Quadris or Tanos, when these products are used too frequently. Early blight resistance to the QoI fungicides (most strobilurins) was detected in western North Carolina in the 2007 and 2008 growing seasons.

**Volume-based spray schedule.** The following suggested weekly spray schedule (Table 1) takes into account the above considerations and label restrictions of different products and is based on many 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. To determine your mixing rate, 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 (Dithane, Manzate, Penncozeb, etc.) are labeled at 3 lbs per acre. If the maximum spray volume is 100 gallons per acre for your sprayer when plants are full 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 25 to 30 gallons per acre to obtain full coverage. 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>x</sup> for foliar tomato disease control in NC.

Before harvest	Week 1	- mancozeb (1) <sup>y</sup> + copper + Actigard (1) <sup>y</sup>
	Week 2	- mancozeb (2) + copper
	Week 3	- mancozeb (3) + strobilurin (1) <sup>y</sup> + Actigard (2)
	Week 4	- mancozeb (4) + copper
	Week 5	- mancozeb (5) + Actigard (3)
	Week 6	- mancozeb (6) + copper
	Week 7	- mancozeb (7) + strobilurin (2) + Actigard (4)
	Week 8	- mancozeb (8) + copper + Endura (1) <sup>y</sup>
During harvest	Week 9	- chlorothalonil (1)
	Week 10	- Revus Top (1) <sup>y</sup> <b>OR</b> Presidio (1) <sup>y</sup>
	Week 11	- chlorothalonil (2) + strobilurin (3)
	Week 12	- Revus Top (2) <b>OR</b> Presidio (2)
	Week 13	- chlorothalonil (3)
	Week 14	- Revus Top (3) <b>OR</b> Presidio (3)
	Week 15	- chlorothalonil (4) + strobilurin (4)
Finish season with chlorothalonil		

<sup>x</sup> Mancozeb, copper, chlorothalonil, and strobilurin are common names for products sold under various trade names (see Table 2). Actigard, Endura, Revus Top, and Presidio are trade names of products from Syngenta, BASF, Syngenta, and Valent respectively. Refer to labels, Table 2 below and the discussion in the text for rates to use in volume-based spraying.

<sup>y</sup> Total number of applications per season is restricted by the label.

Growers have the option of incorporating Serenade Max into their spray program for bacterial disease control. Field trials have found this AgraQuest product to have some efficacy against bacterial spot.

**Table 2.** Amount of product / 100 gallons, assuming a max. of 100 gallons / acre at full plant growth.

Common name	Product name	Amount/100 gal
Acibenzolar S-methyl (PHI=14)	Actigard 50WG	0.33 to 0.75 oz
Bacillus subtilis (PHI=0)	Serenade Max	1.0 to 3.0 lb
Boscalid (PHI=0)	Endura	9.0 oz
Chlorothalonil (PHI=1)	Bravo Ultrex, Equus DF Bravo Weather Stik	2.6 lb 2.75 pt
Fixed copper (PHI=0)	Kocide 3000 Cuprofix Ultra 40 Disperss	0.75 to 1.75 lb 1.25 to 3.0 lb
Fluopicolide (PHI=2)	Presidio	3.0 to 4.0 fl oz with 20-50 GPA
Mancozeb (PHI=5)	Manzate 75DF/80WP, Manzate Pro-stick Dithane DF, Penncozeb 75DF	1.5 to 3.0 lb
Mandipropamid + Difenconazole (PHI=1)	Revus Top	5.5 to 7.0 oz
Strobilurin	Amistar (PHI=1) Cabrio EG (PHI=0) Quadris 2.08F (PHI=1) Tanos (PHI=3) Evito (PHI=3)	1.6 to 2.0 oz 8.0 to 12.0 oz 5.0 to 6.2 fl oz 6.0 to 8.0 oz 3.8 to 5.7 fl oz

For an update or electronic version of this spray guide, click on "Tomato Spray Guide for 2009" at:

<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.