

TABLE 3-57. DISEASE CONTROL FOR TOMATO

Commodity	Disease	Material	Rate of Material to Use		Minimum Days		Method, Schedule, and Remarks
			Formulation	Active Ingredient	Harv.	Reentry	
Damping-off (<i>Pythium</i>), Root and fruit rots (<i>Phytophthora</i>)		fosetyl-AI (Allete) 80 WDG	2.5 to 5 lb/acre	2 to 4 lb/acre	14		Start sprays at 2- to 4-leaf stage or at transplanting on a 7- to 14-day schedule. Do not use in Granville or Johnston counties. Not for <i>Phytophthora</i> fruit rot.
		mefenoxam (Ridomil Gold GR) (Ridomil Gold) 4 SL (Ultra Flourish) 2 EC	20 lb/trt acre 1 to 2 pt/trt acre 1 to 2 qt/trt acre	0.5 lb/trt acre 0.5 to 1 lb/trt acre 0.5 to 1 lb/trt acre	7 28 28	2	Apply uniformly to soil at time of planting. Incorporate mechanically if rainfall is not expected before seeds germinate. A second application may be made up to 4 weeks before harvest. Do not exceed 3 pt of Ridomil Gold EC or 40 lb of Ridomil Gold GR per acre.
		Early blight	boscalid (Endura) 70%	2.5 to 3.5 oz/acre	1.75 to 2.45 oz/acre	0	0.5
		fluoxastrobin (Evlio) 460 SC	3.8 to 7.7 fl oz/acre	0.12 to 0.18 lb/acre	3	0.5	Begin applications when conditions favor disease development, on 7- to 10-day intervals. Do not apply more than once before alternating with fungicides that have a different mode of action. Do not apply more than 22.8 fl oz per acre per season.
Early blight, Late blight, Septoria leaf spot		azoxystrobin (Aristar) 0.8 F (Quadris)	1.6 to 2 oz/acre 8.2 fl oz/acre	0.08 to 0.10 lb/acre 0.1 lb/acre	1	4 hr	Begin applications when conditions favor disease development. Do not apply more than once before alternating with fungicides that have a different mode of action.
		fenamidone (Reason) 500 SC	5.5 to 8.2 fl oz/acre	0.178 to 0.267 fl oz/acre	14	4 hr	Begin applications when conditions favor disease development, on 5- to 10-day intervals. Do not apply more than once before alternating with fungicides that have a different mode of action. Do not apply more than 24.6 fl oz per acre per season.
		mandipropamid + difenoconazole (Revus Top)	5.5 to 7 oz/acre		1	0.5	Begin applications when conditions favor disease development, on 7- to 10-day intervals. Do not apply more than twice before alternating with fungicides that have a different mode of action. Do not apply more than 28 fl oz per acre per season.
		pyraclostrobin (Cabrio) 20% EG	8 to 12 oz/acre Late blight: 8 to 16 oz/acre	1.6 to 3.2 oz/acre	0	4 hr	
		zinc dimethylthiocarbamate (Ziram) 76 DF	3 to 4 lb/acre	2.3 to 3 lb/acre	7	2	DO NOT use on cherry tomatoes. Begin applications at first sign of infection and continue at 7- to 14-day intervals. DO NOT apply more than 24 lb per acre per season. Ziram can be mixed with copper to enhance bacterial disease control.
		chlorothalonil (Bravo Weather Stik) 6 F (Bravo Ultrex) 82.5 WDG (Echo 720) 54% (Equus 720) 54%	1.375 to 2.75 pt/acre 1.3 to 2.6 lb/acre 1.375 to 3 pt/acre 1.35 to 2.88 pt/acre	1 to 2.1 lb/acre 1.1 to 2.2 lb/acre 0.75 to 1.6 lb/acre 0.75 to 1.6 lb/acre	0	0.5 0.5 0.5	Apply in sufficient water to obtain adequate coverage. Apply every 5 to 7 days. Use higher rates following fruit set. Only chlorothalonil has <i>Rhizoctonia</i> fruit rot on label.
	mancozeb (Dithane DF, Manzate) 75 W, 80 W 4	1.5 to 3 lb/acre	1.1 to 2.4 lb/acre	5	1		
	mancozeb + zoximide (Gavel) 75 DF	1.5 to 2 lb/acre	1.13 to 1.5 lb/acre	3	2	See Gavel label for use restrictions and use of surfactant to improve performance.	
	maneb (Manex) 4 F	1.2 to 2.4 qt/acre	1.2 to 2.4 lb/acre	5	1		
	mefenoxam+chlorothalonil (Ridomil Gold Bravo)	2.5 to 3 lb/acre	1.5 to 2.2 lb/acre	14	2	Do not make more than 3 applications of Ridomil Gold/Bravo or Ridomil Gold MZ per crop. Tank mix Bravo MZ58 with 0.45 lb mancozeb 80W.	
	mefenoxam + mancozeb (Ridomil Gold MZ)	2.5 lb/acre	1.7 lb/acre	5	2	Do not make more than 3 applications of Ridomil Gold/Bravo or Ridomil Gold MZ per crop. Tank mix Bravo MZ58 with 0.45 lb mancozeb 80W.	
Early blight, Late blight, Gray leaf spot, Septoria leaf spot, Botrytis gray mold, Bacterial speck, Bacterial spot, Bacterial canker 6	famoxadone + cymoxanil (Tanos)	6 to 8 oz/acre	3 to 4 oz/acre	3	4 hr	Begin applications when conditions favor disease development or when disease is present in area. Must be tank mixed with a protectant fungicide (chlorothalonil or mancozeb) appropriate for targeted disease(s). DO NOT apply more than 72 oz per acre per season. Tanos does not list <i>Botrytis</i> gray mold or bacterial canker on label.	
	mancozeb or chlorothalonil + copper hydroxide (Kocide) 101 or DF or 505	See above rates 2 to 4 lb/acre 2.7 to 5.3 pt/acre		5 0 0 0	1 0.5 1 1	Apply specified dosage in adequate water to ensure thorough coverage of foliage and fruit, but do not exceed 175 gal per acre. Initiate applications within 3 days of transplanting or at first sign of disease and repeat every 5 to 10 days. Use shorter intervals in mountains and longer intervals in the piedmont and coastal areas.	
	or chlorothalonil + fixed copper	See above rates (according to manufacturer's label)		— —	1 —	Spray weekly. Chlorothalonil may be combined in the spray tank with EPA-registered pesticide products that claim copper as the active ingredient and are labeled for bacterial diseases of tomatoes. Do not use with Copper-Count N in concentrated spray suspensions.	

TABLE
Common
TOMATO
(continuu
TABLE
K.L. IV
Key to
++++ E
Practic
Use of
Crop re
Fertility
Use of
Destro:
Rogue
Promo
Use of
Use of
Do not
Use of
Biologi
Applic
Fumigi

TABLE 3-57. DISEASE CONTROL FOR TOMATO

Commodity	Disease	Material	Rate of Material to Use		Minimum Days		Method, Schedule, and Remarks
			Formulation	Active Ingredient	Harv.	Reentry	
TOMATO, field (continued)	Late blight	mancozeb + copper hydroxide (ManKocide) 61 DF	2.5 to 5 lb/acre	1.5 to 3 lb/acre	5	1	Apply at 7- to 10-day intervals. Do not mix with other fungicide products.
		mancozeb (Dithane DF, Manzate) 75 W, 80 W + fixed copper ⁶	1.5 to 3 lb/acre	1.1 to 2.4 lb/acre	5	1	Apply in 100 to 150 gal water per acre. Begin when seedlings emerge. Repeat every 5 to 10 days.
		cyazofamid (Ranman) 400 SC	2.1 to 2.75 fl oz/acre	0.05 to 0.0710 lb/acre	0	0.5	Alternate sprays with a fungicide with a different mode of action, DO NOT apply more than 6 sprays of Ranman 400 SC per crop. Must be tank mixed with an organosilicate surfactant.
		cymoxanil (Curzate 60 DF)	3.2 to 5 oz/acre	1.9 to 3.0 oz	3	0.5	For Curzol or Previcur, use only in combination with a labeled rate of a protectant fungicide.
		dimethomorph (Acrobat) 50 WP (Forum) 4.18 F	6.4 oz/acre 6 oz/acre	3.2 oz/acre 2.5 oz/acre	4	0.5	Must be applied as a tank mix with another fungicide with a different mode of action. Follow label restrictions carefully.
		fluopicolide (Presidio) 4F	3 to 4 fl oz/acre	0.09 to 0.125 lb/acre	2	0.5	Use only in combination with a labeled rate of another fungicide product with a different mode of action.
		fluoxastrobin (Evlto) 480 SC	5.7 fl oz/acre	0.18 lb/acre	3	0.5	Begin applications when conditions favor disease development, on 7-day intervals. Do not apply more than once before alternating with fungicides that have a different mode of action. Do not apply more than 22.8 fl oz per acre per season.
	propamocarb (Previcur Flex) 6.0	0.7 to 1.5 pt/acre	0.5 to 1.0 pt/acre	5	0.5	For Curzol or Previcur, use only in combination with a labeled rate of a protectant fungicide.	
Southern blight	fluoxastrobin (Evlto) 480 SC	3.8 to 7.7 fl oz/acre	0.12 to 0.18 lb/acre	3	0.5	Begin applications when conditions favor disease development, on 7- to 10-day intervals. Do not apply more than once before alternating with fungicides that have a different mode of action. Do not apply more than 22.8 fl oz per acre per season.	

TABLE 3-58. RELATIVE EFFECTIVENESS OF ALTERNATIVE MANAGEMENT PRACTICES FOR FOLIAR DISEASE CONTROL ON TOMATO

K.L. IVORS and F.J. LOUWS, Extension Plant Pathology, NC State University; and D. INGRAM, Extension Plant Pathology, MS State University

Key to efficacy ratings based on observations and reports

++++ Excellent; +++ Good; ++ Fair; + Poor; - Not effective; ? Not known; -- Not applicable

Practice	RELATIVE CONTROL RATING								
	Bacterial canker	Bacterial speck	Bacterial spot	Botrytis	Buckeye rot	Early blight	Late blight	Septoria	
Use of resistant cultivars	-	++	++	-	-	+++	-	-	
Crop rotation (3-4 years)	++	+	+	-	++	++	-	++	
Fertility	-	-	-	+++	-	++	-	-	
Use of cover crops	-	-	-	-	++	+	-	-	
Destroy crop residue	-	-	-	-	-	+	-	-	
Rogue plants	+	-	-	-	-	-	-	-	
Promote air movement	++	++	++	+++	+	+	++	++	
Use of disease free seed / treatment	++++	++++	++++	-	-	-	-	-	
Use of plastic mulches	-	-	-	-	+++	-	-	-	
Do not handle plants when wet	++++	+++	+++	-	-	+	+	+	
Use of drip irrigation	+++	+++	+++	++	+	++	++	++	
Biological control	+	+	++	+	-	+	+	-	
Application of fungicides	++	+	+	+++	+++	++++	++++	++++	
Fumigation	-	-	-	-	+++	-	-	-	

TABLE 3-59. RELATIVE EFFECTIVENESS OF VARIOUS CHEMICALS FOR TOMATO FOLIAR DISEASE CONTROL

K. IVORS and F. J. LOUWS, Plant Pathology Extension

Pesticide	Fungicide Group ¹	Preharvest Interval (Days)	Relative Control Rating (— = ineffective; +++++ = very effective; ? = activity unknown)									
			Bacterial Canker	Bacterial Speck	Bacterial Spot	Botrytis Graymold	Buckeye Rot	Crystallaria Leaf Spot	Early Blight	Late Blight	Powdery Mildew	Septoria Leaf Spot
Strobilurins :												
azoxystrobin (Amistar, Quadris)	11	1	—	—	—	—	?	?	++++	+++	++++	+++
femoxadone/cymoxanil (Tanos)	11 + 27	3	—	—	—	—	+	—	+++	+++	?	+++
fluoxastrobin (Evidis)	11	3	—	—	—	—	—	—	+++	—	++++	+++
pyraclostrobin (Cabrio)	11	0	—	—	—	—	?	?	++++	+++	++++	+++
bacteriophage (AgriPhage)	NA	0	—	+	+	—	—	—	—	—	—	—
acibenzolar-S-methyl (Actigard)	21	14	?	+++	+++	—	—	—	—	—	—	—
boscalid (Endura)	7	0	—	—	—	+++	—	?	++++	—	?	?
chlorothalonil (Bravo, Equus, Echo)	M	0	—	—	—	++	+	—	++	++++	+	++++
cyazofamid (Ranman)	21	0	—	—	—	—	—	—	++	+++	—	—
cymoxanil (Curzate)	27	3	—	—	—	—	+?	—	—	++++	—	?
(Tanos, see femoxadone/cymoxanil above)	11 + 27	3	—	—	—	—	+	—	+++	++++	?	+++
dimethomorph (Acrobat, Forum)	15	4	—	—	—	—	+++	—	—	+++	—	—
fenamidone (Reason)	11	14	—	—	—	—	++	—	+++	+++	?	+
fixed copper	M	0	+++	+++	+++	—	+	—	++	+++	+	+++
fluopicolide (Prasidio)	43	2	—	—	—	—	+	—	—	++++	—	—
mancozeb (Dithene M-45, DF, Manzate 200, Penncozeb, Manex II)	M	5	—	—	—	—	+	—	++++	+++	—	+++
mancozeb + fixed copper (ManKocide)	M + M	5	+++	+++	+++	—	+	—	+++	+++	+	+++
mancozeb + zoxamide (Gavel)	M + 22	3	—	—	—	—	+	—	+++	++	—	++
mandipropamid + difenoconazole (Revus Top)	40 + 3	1	—	—	—	—	+	—	+++	++++	—	?
maneb (Manex, Maneb)	M	5	—	—	—	—	+	—	++++	+++	—	+++
mefenoxam + chlorothalonil (Ridomil Gold Bravo, Flouronil)	4 + M	14	—	—	—	+	++++	—	+	++++	—	++
mefenoxam + copper (Ridomil Gold/Copper)	4 + M	14	++	++	++	—	++++	—	++	++++	+	++
mefenoxam + mancozeb (Ridomil Gold MZ)	4 + M	5	—	—	—	—	++++	—	+++	++++	—	++
myclobutanil (Nova)	3	1	—	—	—	—	—	++++	—	—	++++	—
propamocarb (Previcur Flex)	28	5	—	—	—	—	+	—	—	+++	—	—
pyrimethanil (Scala)	9	1	—	—	—	++	—	—	++	—	?	?
streptomycin (Agri-Mycin, Streptrol)	25	0	+++	+++	+++	—	—	—	—	—	—	—
sulfur	M	0	—	—	—	—	—	—	—	—	+++	—
zinc dimethylthiocarbamate (Ziram)	M	7	—	—	—	—	—	—	++	?	?	++

¹ Key to Fungicide Groups: 1: methyl benzimidazole carbamates; 2: dicarboxamides; 3: demethylation inhibitors; 4: phenylamides; 7: carboxamides; 9: anilino-pyrimidines; 11: quinone outside inhibitors; 12: phenylpyroles; 15: cinnamic acids; 21: quinone inside inhibitors; 22: benzamides; 25: glucopyranosyl antibiotic; 27: cyanoacetamide-oximes; 28: carbamates; 33: phosphonates; 40: carboxylic acid amines; 43: acylpicolides; M: multi-site activity; NA: not applicable

² Contact control only; not systemic.

³ Biological control product consisting of a virus that attacks pathogenic bacteria.

⁴ Fixed coppers include: Bascop, Champ, Champion, Citcop, Copper-Count-N, Kocide, Nu-Cop, Super Cu, Tenn-Cop, Top Cop with Sulfur, and Tri-basic copper sulfate.

⁵ Streptomycin may only be used on transplants; not registered for field use.

⁶ Sulfur may be phytotoxic; follow label carefully.

⁷ Curative activity; not systemic.

⁸ Curative activity; systemic.

⁹ Systemic activated resistance.

¹⁰ Do not use on cherry tomatoes.

^R Resistance to this pesticide has been detected in the pathogen population. In the case of mefenoxam, Phytophthora (late blight) resistant strains predominate.

TABLE 3-60. COMMERCIAL TOMATO VARIETIES, THEIR RESISTANCE TO SPECIFIC DISEASES, AND RECOMMENDED LOCATION FOR CULTIVATION.

K.L. Ivors, Extension Plant Pathology, NC State University

Powdery Mildew	Septoria Leaf Spot	Tomato variety	type	Alternaria stem canker	Bacterial speck	Gray leaf spot	Fusarium wilt race 1	Fusarium wilt race 2	Fusarium wilt race 3	Root knot nematodes	Tobacco Mosaic Virus	Tomato Spotted Wilt Virus	Verticillium wilt race 1	Recommended location
		Amelia	round	X		X	X	X	X	X		X	X	AGL
++++	+++	Bella Rose	round	X		X	X	X				X	X	AG
?	++	BHN 444	round				X	X				X	X	AGN
++++	++	Biltmore	round	X		X	X	X					X	N
		Carolina Gold	round	X		X	X	X					X	AGNS
		Crista	round	X		X	X	X	X	X		X	X	AGMI
++++	++++	Florida 47	round	X		X	X	X					X	AGL
		Florida 91	round	X		X	X	X					X	GLM
-	-	Floralina	round	X		X	X	X	X				X	ANS
-	-	Mountain Crest	round	X		X	X	X					X	AGL
		Mountain Glory	round	X		X	X	X		?		X	X	N
?	?	Mountain Fresh Plus	round	X		X	X	X		X			X	ANS
+	++++	Mountain Spring	round	X		X	X	X					X	AGL
-	-	Phoenix	round	X		X	X	X					X	N
-	?	Quincy	round				X	X				X	X	AGM
		Red defender	round	X		X	X	X				X	X	N
?	+++	Scarlet red	round	X		X	X	X					X	N
-	-	Solar set (FALL ONLY)	round	X			X	X					X	LMS
?	+	Sun Chaser	round			X	X	X					X	L
+	+++	Sun Leaper	round			X	X	X					X	AGL
-	-	Sunbeam	round	X		X	X	X					X	NS
		Sunrise	round	X		X	X	X					X	M
-	+++	Talladega	round						X			X		AGS
		Cherry Grande	cherry	X		X	X	X					X	AGL
+	+++	Marcelino	cherry											N
-	++	Mountain Belle	cherry			X	X						X	AGNS
-	+	Sun Gold	cherry											AMN
-	?	Brixmore	grape							X	X		X	N
-	+++	Elfin	grape											GNS
		Jolly Elf	grape					X						AGMI
-	++	Mini Charm	grape				X	X			X		X	M
		Navidad	grape					X						AGMI
+	++	Rosa	grape											AN
-	++	Santa Claus	grape											AGNS
++++	-	Saint Nick	grape											AGMI
-	-	Smarty	grape											ANS
		Snappy	grape											AN
?	?	BHN 410	roma		X		X	X					X	AGNS
-	-	Mariana	roma	X	X	X	X	X		X			X	N
+++	-	Picus	roma	X		X	X					X	X	N
?	++	Plum Crimson	roma	X		X	X	X	X				X	AGN
		Plum Dandy	roma	X		X	X						X	N
		Spectrum	roma											GNS
		Sunoma	roma	X	X	X	X	X		X	X		X	N

An 'X' indicates the variety is considered 'resistant' to that particular disease.

Causal agents of each disease listed above:

Alternaria stem canker = *Alternaria alternata* f.sp. *lycopersici*

Bacterial speck = *Pseudomonas syringae* pv. *tomato*

Gray leaf spot = *Stemphyllium solani*

Fusarium wilt = *Fusarium oxysporum* f.sp. *lycopersici*

Root knot nematodes = *Meloidogyne incognita*, *M. javanica*, *M. hapla*

Verticillium wilt = *Verticillium dahliae* race 1 (no known commercial resistance to race 2)

*Recommended states:

Alabama (A) Georgia (G) Louisiana (L) Mississippi (M) North Carolina (N) South Carolina (S)

SPRAY SCHEDULE FOR FOLIAR DISEASE CONTROL IN FRESH-MARKET TOMATO PRODUCTION

K. IVORS and F. J. LOUWS, Plant Pathology Extension

The following schedule is based on research conducted at the Mountain Horticulture Research Station, Fletcher, N.C. Products and schedules may be different for other regions of North Carolina depending upon the disease involved and the amount of disease pressure.

Mancozeb, copper, chlorothalonil, cyazofamid, and strobilurin are common names for products sold under various trade names. Actigard and Endura are trade names of products manufactured by Syngenta and BASF Corporation, respectively. Refer to labels and Table 3-58 for rates to use in volume-based spraying.

TABLE 3-61. SUGGESTED WEEKLY SPRAY SCHEDULE FOR FOLIAR DISEASE CONTROL IN FRESH-MARKET TOMATO PRODUCTION

Week	Chemical	Number of Applications of Chemical Per Season
BEFORE HARVEST		
1	mancozeb* + copper + Actigard*	mancozeb, 1; Actigard, 1
2	mancozeb* + copper	mancozeb, 2
3	strobilurin* + Actigard	strobilurin, 1; Actigard, 2
4	mancozeb* + copper	mancozeb, 3
5	mancozeb* + copper + Actigard	mancozeb, 4; Actigard, 3
6	strobilurin*	strobilurin, 2
7	mancozeb* + copper + Actigard	mancozeb, 5; Actigard, 4
8	mancozeb* + copper + Endura**	mancozeb, 6; Endura, 1
DURING HARVEST		
9	cyazofamid*** or Revus Top****+ strobilurin*	cyazofamid, 1; strobilurin, 3
10	chlorothalonil + Endura**	chlorothalonil, 1; Endura, 2
11	chlorothalonil	chlorothalonil, 2
12	cyazofamid*** or Revus Top****+ strobilurin*	cyazofamid, 2; strobilurin, 4
13	chlorothalonil	chlorothalonil, 3
14	cyazofamid*** or Revus Top****+ strobilurin*	cyazofamid, 3; strobilurin, 5
15	chlorothalonil	chlorothalonil, 4

*Total number of applications per season is restricted by label.

** Endura applications are only necessary if conditions are conducive for gray mold (wet and cool shortly before and during harvest).

*** Tank mix cyazofamid with an organosilicone surfactant, following the manufacturer's label recommendations.

**** Revus Top must be tank mix applied with another product with a different mode of action, such as a strobilurin as suggested in this table.

RATES FOR FOLIAR DISEASE CONTROL IN FRESH-MARKET TOMATOES AT FULL PLANT GROWTH

K. IVORS and F. J. LOUWS, Plant Pathology Extension

TABLE 3-62. RATES FOR FOLIAR DISEASE CONTROL IN FRESH-MARKET TOMATOES AT FULL PLANT GROWTH

Product	Amount per 100 gal ¹
acibenzolar S-methyl (Actigard 50WG)	0.5 to 0.75 oz
<i>Bacillus subtilis</i> biocontrol bacterium (Serenade Max)	1 to 3 lb
boscalid (Endura)	9.0 oz
chlorothalonil (Bravo Ultrex, Equus DF) (Bravo Weather Slik)	2.6 lb 2.75 pt
Fixed copper (Cuprofix Ultra 40 Disperse) (Kocide 3000)	1.25 to 3 lb 0.75 to 2 lb
mancozeb (Dithene DF, Penncozeb 75DF, Manzate 75DF/80WO, Manzate Pro-stick)	3 lb 1.5 to 3 lb
strobilurin (Amistar) (Cabrio EG) (Quadris 2.08F) (Tanos)	1.6 to 2 oz 8 to 12 oz 5 to 6.2 fl oz 6 to 8 oz

¹ Assumes a maximum of 100 gal spray per acre at full plant growth.

For updates or an electronic version of this spray guide, click on Tomato Spray Guide for 2009 at <http://www.ces.ncsu.edu/fletcher/programs/planpath>.