

## **Resistance Risk of Fungicides for Vegetable Crops**

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Managing fungicide resistance is an important component of an effective fungicide program. This is because most fungicides currently available and those being developed are considered to have medium to high risk for resistance to develop. Additionally these fungicides tend to be more effective than contact fungicides which have low resistance risk. Their greater efficacy is partly due to their mobility providing ability to move to the lower surface of leaves where many pathogens develop best. Ability to move into leaf tissue also means these fungicides have good rainfastness. Other reasons that it is important to be thinking about managing resistance when developing fungicide programs include: 1) goal of resistance management is to delay resistance development rather than manage resistant pathogen strains after detection, 2) many of the most important pathogens have medium to high potential to develop resistance, 3) developing new fungicides is a slow, expensive process thus it cannot be expected that there will be replacements for those lost to resistance, and 4) more effective control often can be obtained when using a diversity of fungicides not just because of resistance management. Use directions for many fungicides include requirements that compel resistance management, most commonly limits to the number of consecutive applications. Some fungicides have limits to total number of applications relative to total number. Some must be used with another (typically low resistance risk) fungicide.

Fungicides in table on next page are registered for use on vegetables in the USA. Footnote w indicates products not registered for use in New York.

<b>Fungicide <sup>z</sup></b>	<b>Active ingredient</b>	<b>FRAC code <sup>y</sup></b>	<b>Resistance risk <sup>y</sup></b>
Bravo and OLP <sup>x</sup>	chlorothalonil	M5	L
Champ and OLP	copper hydroxide, etc.	M1	L
Elixir	mancozeb + chlorothalonil	M3 + M5	L
Manzate and OLP	mancozeb	M3	L
Polyram	metiram	M3	L
Microthiol Disperss + OLP	sulfur	M2	L
biopesticides	<i>numerous, see separate list</i>	NC	L
Actigard	acibenzolar-S-methyl	P 1	L
Aproach	picoxystrobin	11	H
Aprovia Top <sup>w</sup>	solatenol + difenconazole	7 + 3	M-H + M
Ariston	chlorothalonil + cymoxanil	M5 + 27	L + L-M
Cabrio, Headline and OLP	pyraclostrobin	11	H
Cannonball	fludioxonil	12	L-M
Curzate	cymoxanil	27	L-M
Emesto Silver	penflufen + prothioconazole	7 + 3	M-H + M
Endura	boscalid	7	M-H
Evito	fluoxastrobin	11	H
Flint, Gem	trifloxystrobin	11	H
Folicur, Tebuzol <sup>w</sup>	tebuconazole	3	M
Fontelis <sup>w</sup>	penthiopyrad	7	M-H
Forum	dimethomorph	40	M
Gavel	zoxamide + mancozeb	22 + M3	L-M + L
Inspire Super	difenconazole + cyprodinil	3 + 9	M + M
Luna Experience <sup>w</sup>	fluopyram + tebuconazole	7 + 3	M-H + M
Luna Tranquility <sup>w</sup>	fluopyram + pyrimethanil	7 + 9	M-H + H
Merivon	fluxapyroxad + pyraclostrobin	7 + 11	M-H + H
Moncut	flutolanil	7	M-H
Omega	fluazinam	29	L
Presidio	fluopicolide	43	NK
Previcur Flex	propomocarb HCL	28	L-M
Priaxor <sup>w</sup>	fluxapyroxad + pyraclostrobin	7 + 11	M-H + H
Pristine	pyraclostrobin + boscalid	11 + 7	H + M-H
Procure	triflumizole	3	M
Proline <sup>w</sup>	prothioconazole	3	M
ProPhyt and OLP	phosphorous acid and salts	33	L
Prosaro	prothioconazole + tebuconazole	3 + 3	M
Quadris and OLP	azoxystrobin	11	H
Quadris Opti	azoxystrobin + chlorothalonil	11 + M5	H + L
Quadris Top	azoxystrobin + difenconazole	11 + 3	H + M
Quash	metconazole	3	M
Quilt	azoxystrobin + propiconazole	11 + 3	H + M
Quintec	quinoxifen	13	H
Rally	myclobutanil	3	M
Ranman	cyazofamid	21	M-H

Reason	fenamidone	11	H
Revus	mandipropamid	40	M
Revus Top	mandipropamid + difenconazole	40 + 3	M + M
Ridomil Gold and OLP	mefenoxam	4	H
Ridomil Gold Copper	mefenoxam + copper	4 + M1	H + L
Ridomil Gold MZ	mefenoxam + mancozeb	4 + M3	H + L
Ridomil Gold Bravo	mefenoxam + chlorothalonil	4 + M5	H + L
Rovral	iprodione	2	M-H
Scala	pyrimethanil	9	M
Stratego	trifloxystrobin + propiconazole	11 + 3	H + M
Switch	cyprodinil + fludioxonil	9 + 12	M + L-M
Tanos	famoxadone + cymoxanil	11 + 27	H + M
Tilt	propiconazole	3	M
Topsin M	thiophanate-methyl	1	H
Torino	cyflufenamid	U6	M
Uniform	mefenoxam + azoxystrobin	4 + 11	H
Vanguard	cyprodinil	9	M
Vivando	metrafenone	U8	M
Zampro	ametoctradin + dimethomorph	45 + 40	M-H + M
Zing!	zoxamide + chlorothalonil	22 + M1	L-M + L

<sup>z</sup> First seven listed are contact fungicides with multi-site mode of action recommended used in tank mixtures with other fungicides that have greater resistance risk.

<sup>y</sup> From FRAC Code List (<http://www.frac.info/>). NC = not classified. NK = not known.

<sup>x</sup> OLP = other labeled products

<sup>w</sup> Product not registered for use in New York. For current status of these fungicides see <http://pims.psur.cornell.edu/ProductName.php>

*Updated November 2015*