



Cooperative Extension Service
Institute of Food and Agricultural Sciences

Plant Protection Pointers: Recognizing Equivalent and Related Generic Fungicide Products¹

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The development of agrichemical pesticides is a laborious and expensive proposition. From the onset of the registration process, the developer of a new fungicide (as with any pesticide) has a proprietary 17-year period that is protected from competition by other manufacturers by patent. During this period, the fungicide developer must recoup millions of dollars expended in product development and registration activities through marketing profits. It is during the patent period that a proliferation of different trade name products emerges from the same active ingredient. These products are directed toward specific agricultural commodity groups like ornamental plant producers or vegetable growers. These distinctively named but chemically identical products often differ in per unit price. Price differences reflect (in part) different costs for the registration process for products destined for use on food/feed crops versus ornamental/turfgrass uses. Some price differentials can be attributed to the fact that some commodity groups can sustain higher input costs compared to other producers in view of the ultimate crop value.

When the patent period ends for a given active ingredient, still more confusion enters the market place. Products with the same active ingredient are produced and sold by different manufacturers, normally at different price structures and often with dissimilar label text. It becomes doubly important for ornamental plant and turfgrass growers to become aware of equivalency among fungicide products because these commodity groups often face the

highest price structure per fungicide unit purchased. Plant producers today must recognize those fungicide trade names that are equivalent products or are closely related chemistry. Both these points are often sadly absent or well hidden on label text drafted by pesticide manufacturers. Recognizing equivalency or relatedness among fungicides offers the following advantages to the ornamental plant producer:

- 1) maximizes legality in product use among plant hosts, in sites (i.e. field, greenhouse or interiorscape) and in mode of application (e.g. drench, spray, chemigation).
- 2) allows appropriate alternation or tank-mix use among protectant and systemic materials.
- 3) prevents unnecessary risk of phytotoxicity when unknowingly alternating or tank mixing among identical products.
- 4) avoids the development of tolerance to fungicides that can develop when either identical systemic products are alternated, or distinct systemic products that share a similar mode of action on the pathogen, are used in series.
- 5) difference in cost per unit.

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Equivalent Fungicides

In today's market, many systemic and protectant fungicides exist under diverse trade names. These may be sold by different manufacturers with different formulations, percentages of active ingredients and label text. Remember that in purchasing a fungicide, the label is the law! For example, although Manzate 200 and Dithane M45 are both mancozeb fungicides (similar in percent active and formulation), Manzate 200 is not labeled for ornamental crops while Dithane is labeled. The following table lists equivalent active ingredients among trade name products. Read the label for legal crop usage, percent active ingredient, formulation, site clearances and application methods as defined by Federal law.

Although many of these fungicide products contain identical amounts of an active ingredient (see Table 1), they will differ as to legal usage sites (e.g. field, greenhouse or interiorscape) and crop clearances (e.g. specific plants versus categorical use on a commodity such as ornamentals). Do not assume equal legality of use between products from the same company or for those from different manufacturers. Rohm & Haas manufactures both Dithane T/O and Fore but only Dithane T/O (NOT Fore) is legal for use in the greenhouse. Similarly, the mancozebs are produced by DuPont, Elf Atochem, Rohm & Haas and W.A. Cleary but only the Rohm & Haas Dithane products have categorical use on ornamentals in the field and greenhouse.

Table 1. TRADE NAME FUNGICIDE EQUIVALENTS IN TODAY'S MARKETPLACE

COMMON CHEMICAL NAME	MANUFACTURER	FUNGICIDE TRADE NAME(S)	PERCENT ACTIVE INGREDIENT	FORMULATION ¹	COMMODITY LABELLING
captan	Micro Flo Co.	Captan 4L	37.4	F	Fruits & Ornamentals
		Captan	50	WP	
		Captan	80	WP	Fruits & Ornamentals
	Zeneca Inc.	Captan	50	WP	Agronomic, Fruit & Vegetables
		Captan	50	WP	Ornamental & Turfgrass
		Captan	80	WP	Agronomic, Fruit, Turfgrass & Vegetables
chloroneb	Kincard Enterprises, Inc.	Chloroneb	65	W	Agronomic & Vegetables
		Terraneb	65	SP	Ornamental & Turfgrass
		Terraneb	65	SP	Turfgrass
	PBI/Gordon Corp.	Terremac	65	SP	Turfgrass
chlorothalonil	Ciba Plant Protection	Ridomil Bravo 81W	72 (plus 9% metalaxyl)	WP	Vegetables

¹Formulation abbreviations are : A.S. = Aqueous suspensions, DF = Dry Flowable, DG = Dispersible granule, EC = Emulsifiable concentrate, F = Flowable, G = Granule, IP = Ignitable powder, SP = Soluble powder, WDG = Wettable dispersible granule, WDP = Wettable dispersible powder, WP = Wettable powder, WSP = Wettable soluble pouch.

COMMON CHEMICAL NAME	MANUFACTURER	FUNGICIDE TRADE NAME(S)	PERCENT ACTIVE INGREDIENT	FORMULATION ¹	COMMODITY LABELLING
chlorothalonil (cont'd)	Dowelanco	Broadway	41.5 (plus 2.5% fenarimol)	F	Conifers, Ornamentals & Turfgrass
	ISK Biosciences Corp.	Bravo 720	54	F	Agronomic, Conifers, Fruit & Vegetables
		Bravo	75	WP	Conifers & Vegetables
		Bravo Ultrex	82.5	WDG	Agronomic, Conifers, Fruit & Vegetables
		Bravo	90	DF	Agronomic, Conifers, Fruit & Vegetables
		Daconil 2787	40.4	F	Conifers, Ornamentals & Turfgrass
		Daconil Ultrex	82.5	WDG	Conifers, Ornamentals & Turfgrass
		Daconil 2787	90	WDG	Conifers, Ornamentals & Turfgrass
	Lesco, Inc	Manicure Flowable	40.4	F	Ornamentals & Turfgrass
		Manicure	90	DG	Ornamentals & Turfgrass
		Two Some	40 (plus 2.4% fenarimol)	DG	Conifers, Ornamentals & Turfgrass

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chlorothalonil (cont'd)	Platte Chemical Co.	Clean Crop Evade	40.4	F	Agronomic, Fruit, Ornamentals, Turfgrass & Vegetables
		Clean Crop Bravo	90	DG	Agronomic, Conifers, Fruit & Vegetables
	Regal Chemical Co.	Consyst	50 (plus 16.66% thiophanate methyl)	WP	Ornamentals & Turfgrass
	Rigo Co.	Exotherm Termil	20	IP	Ornamentals & Tomatoes
	Setre/Helena Chemical Co.	Agronil 500	40.4	F	Agronomic, Conifers, Fruit & Vegetables
	Sostram Corp.	Echo 500	40.4	F	Ornamentals & Turfgrass
		Echo 720	54	F	Agronomic, Conifers, Fruit & Vegetables
		Echo	90	DF	Agronomic, Conifers, Fruit, Ornamentals & Vegetables
	Terra International	Terranil 6L	40.4	F	Agronomic, Conifers, Fruit & Vegetables
		Terranil	90	DF	Agronomic, Conifers, Fruit & Vegetables

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chlorothalonil (cont'd)		Thalonil	90	DF	Conifers, Ornamentals & Turfgrass
		Thalonil 4L	40.4	F	Conifers, Ornamentals & Turfgrass
copper oxychloride	Micro Flo Co.	Microspense COC 50	91.4	WP	Agronomic, Fruit, Ornamentals & Vegetables
	Platte Chemical Co.	C-O-C-S	74.8 (plus 14.2% copper sulfate)	WDG	Agronomic, Fruit, Ornamentals & Vegetables
copper sulfate basic	Boliden Intertrade Inc.	Tennessee Brand Tri-Basic Copper Sulfate	98%	WP	Agronomic, Fruit, Ornamentals & Vegetables
	CP - Chemicals (Agtrol)	CP - Basic Copper TS-50-WP	50	WP	Agronomic, Fruit, Ornamentals & Vegetables
		CP - Basic Copper TS-53-WP	53	WP	Agronomic, Fruit, Ornamentals & Vegetables
	Cuproquim Corp.	Basic Copper 53	53	WP	Agronomic, Friut & Vegetables
	Griffen Corp.	Basicop	53	WP	Agronomic, Friut & Vegetables

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copper sulfate basic (cont'd)	Micro Flo Co.	Basic Copper 53	98	WP	Agronomic, Fruit & Vegetables
		Cuproxat	27.1	F	Agronomic, Fruit, Ornamentals & Vegetables
	Old Bridge Chemical	Basic Copper Sulfate	99	WP	Fruit & Vegetables
	Pesticide Service Consultants	BSC-Copper Fungicide	39	F	Fruit & Vegetables
		Basic Copper "53"	53	WP	Agronomic, Fruit & Vegetable
cupric hydroxide	Agtrol Chemical Products	Champ	23	F	Agronomic, Fruit, Ornamentals & Vegetables
		Champion	77	WP	Agronomic, Fruit, Ornamentals & Vegetables
	Ciba Plant Protection	Ridomil Copper	60 (plus 10% metalaxyl)	WP	Vegetables
	Griffin Corp.	Kocide LF	23	F	Agronomic, Fruit, Ornamentals & Vegetables
		Kocide 606	37.5	F	Agronomic, Fruit, Ornamentals & Vegetables
		Kocide DF	61.4	DF	Agronomic, Fruit, Ornamentals, Turfgrass & Vegetables

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cupric hydroxide (cont'd)	Micro Flo Co.	Kocide 404S	26 (plus 15% sulfur)	F	Agronomic, Fruit & Vegetables
		Kocide 101	77	WP	Agronomic, Fruit, Ornamentals, Turfgrass & Vegetables
		Blue Shield	77	WP	Agronomic, Fruit, Ornamentals & Vegetables
		Blue Shield	77	DF	Agronomic, Fruit, Ornamentals & Vegetables
	Cuproquim Corp.	Hydrox	77	WP	Agronomic, Fruit, Ornamentals & Vegetables
etridiazole (ethazol)	Scotts-Sierra Crop Protective Co.	Truban	5	G	Ornamentals
		Truban	25	EC	Ornamentals
		Truban	30	WP	Ornamentals
		Koban	1.3	G	Ornamentals
		Koban	30	WP	Turfgrass
		Banrot	15 (plus 25% thiophanate methyl)	WP	Ornamentals

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etridiazole (ethazol) (cont'd)		Banrot 8G	3 (plus 5% thiophanate methyl)	G	Ornamentals
	Uniroyal Chem. Co. Inc.	Terrazole	35	WP	Ornamentals & Turfgrass
		Terraclor Super X	5.8 (plus 23.2% PCNB)	EC	Cotton
		Terraclor Super X	2.5 (plus 10% PCNB)	EC	Cotton
fenarimol	Dow Elanco	Rubigan A.S.	11.6	AS	Turfgrass
		Rubigan EC	12	EC	Ornamentals
	SePRO	Rubigan EC	12	EC	Fruit
fenbuconazole	Rohm & Haas	Enable 2F	23.5	F	Fruit (Pecan)
		Indar	75	WSP	Fruit
fosetyl aluminum	Lesco Inc.	Prodigy	80	DG	Ornamentals & Turfgrass (not production)

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fosetyl aluminum (cont'd)	Rhone-Poulenc	Aliette	80	WDG	Fruit & Vegetables
		Aliette	80	WDG	Ornamentals & Turfgrass
iprodione	Rhone-Poulenc	Chipco	23.3	F	Turfgrass
		Chipco 26019	50	WP	Ornamentals & Turfgrass
		Rovral 4 FLO	41.6	F	Agronomic, Fruit & Vegetables
		Rovral	50	WP	Agronomic, Fruit & Vegetables
		Rovral-R	4.6	F	Agronomic (Rice)
mancozeb	Ciba Plant Protection	Pace	70 (plus 7.0% metalaxyl)	WSP	Turfgrass
		Ridomil MZ58	48 (plus 10% metalaxyl)	WP	Agronomic, Fruit & Vegetable
	E.I. DuPont de Nemours and Co.	Manzate 200	75	DF	Agronomic, Fruit, Sod Farms & Vegetables
	Elf Atochem N.A. Inc.	Penncozeb	75	DF	Agronomic, Fruit & Vegetables
		Penncozeb	80	WP	Agronomic, Fruit & Vegetables

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mancozeb (cont'd)	Lesco, Inc.	Mancozeb DG	75	DG	Ornamentals & Turfgrass
		Flowable Mancozeb	37	F	Ornamentals & Turfgrass
	PBI/Gordon Corp.	Formec	80	WP	Ornamentals & Turfgrass
	Platte Chemical Co.	Clean Crop Mancozeb	80	WP	Agronomic, Fruit, Turfgrass & Vegetables
		Clean Crop Mancozeb 4L	37	F	Agronomic, Fruit, Turfgrass & Vegetables
	Rohm & Hass Co.	Dithane F-45	37	F	Agronomic, Fruit & Vegetables
		Dithane WF	37	F	Ornamentals & Turfgrass
		Dithane DF	75	DF	Agronomic, Fruit & Vegetables
		Dithane T/O	75	DF	Ornamentals & Turfgrass
		Ditthane M - 45	80	WP	Agronomic, Fruit & Vegetables
		Fore	80	WP	Ornamentals & Turfgrass
	Scotts-Sierra Crop Protection Co.	Duosan	60 (plus 15% thiophanate methyl)	WP	Ornamentals & Turfgrass

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mancozeb (cont'd)		Duosan WSB	63 (plus 15% thiophanate methyl)	WSP	Ornamentals & Turfgrass
		Zyban	60 (plus 15% thiophanate methyl)	WP	Ornamentals
	W. A. Clearly Chemical Corp.	Protect T/O	80	WP	Ornamentals & Turfgrass
maneb	Elf Atochem A. N. Inc.	Maneb	75	DF	Fruit, Ornamentals, Turfgrass & Vegetables
		Maneb	80	WP	Fruit, Ornamentals, Turfgrass & Vegetables
	Griffin Corp.	Manex	37	F	Fruit, Ornamentals, Turfgrass & Vegetables
metalaxyl	Ciba Plant Protection	Apron	25	WP	Agronomic, Turfgrass & Vegetable seed treatment
		Apron	50	WP	Agronomic, Turfgrass & Vegetable seed treatment
		Ridomil 2E	25.1	EC	Agronomic, Fruit & Vegetables
		Ridomil 5G	5.0	G	Agronomic, Fruit & Vegetables

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metalaxyl (cont'd)		Ridomil Bravo 81W	9.0 (plus 72% chlorothalonil)	WP	Vegetables
		Ridomil MZ58	10.0 (plus 48% mancozeb)	WP	Agronomic, Fruit & Vegetables
		Ridomil PC 11G	1.0 plus 10% PCNB)	G	Agronomic
		Ridomil Copper 70W	10 (plus 60% cupric hydroxide)	WP	Fruits & Vegetables
		Ridomil PC Liquid	25.1	EC	Agronomic (cotton)
		Ridomil 50W	50	W	Agronomic, Fruit & Vegetables
		Ridomil MZ72	8 (plus 64% mancozeb)	W	Agronomic, Fruit & Vegetables
		Subdue 2E	25.1	EC	Non-bearing Fruit & Nuts, Conifers, Ornamentals & Turfgrass
		Subdue 2G	2.0	G	Non-bearing Fruit & Nuts, Conifers, Ornamentals & Turfgrass
		Subdue + WSP	25.0	WSP	Turfgrass
		Subdue II	25.0	WSP	Conifers, Non-bearing Fruit & Nuts, Ornamentals & Vegetable transplants
		Pace	7.0 (plus 70% mancozeb)	WSP	Turfgrass

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myclobutanil	Rohm & Hass	Nova	40	W	Fruit
		Rally	40	W	Fruit
n-alkyl ammonium chloride	Maril Products, Inc.	Physan 20	20	L	Ornamentals & Surfaces
	Voluntary Purchasing Groups, Inc.	Consan	20	L	Ornamentals & Surfaces
	Whitmire Research Laboratories, Inc.	PT2000 Green-Shield Algicide	20	L	Surfaces
Pentachloro-nitrobenzene (PCNB)	Amvac Chemical Corp.	PCNB	10	G	Agronomic, Ornamentals, Turfgrass & Vegetables
		PCNB 2F	21.6	F	Ornamentals & Turfgrass
		PCNB 2-E	24	EC	Agronomic, Ornamentals, Turfgrass & Vegetables
		PCNB	75	W	Ornamentals & Turfgrass
		PCNB	75	WP	Agronomic & Vegetables

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Pentachloro-nitrobenzene (PCNB) (cont'd)	Ciba Plant Protection	Ridomil PC 11G	10 (plus 1% metalaxyl)	G	Agronomic
	Lesco Inc.	PCNB	10	G	Ornamentals & Turfgrass
		Revere	75	DG	Ornamentals & Turfgrass
	Platte Chemical Co.	Clean Crop PCNB	10	G	Agronomic, Ornamentals, Turfgrass & Vegetables
	Scott - Sierra Crop Protection Co.	Penstar	10	G	Turfgrass
		Penstar	75	WP	Turfgrass
	Uniroyal Chem. Co. Inc.	Turfcide	10	G	Ornamentals & Turfgrass
		Terraclor	10	G	Agronomic & Vegetables
		Terraclor 2LB. E	23.8	EC	Agronomic & Vegetables
		Terraclor 400	40	F	Ornamentals & Turfgrass
		Turfcide 400	40	F	Turfgrass
		Terraclor F	40	F	Agronomic & Vegetables

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Pentachloro-nitrobenzene (PCNB) (cont'd)		Terraclor	75	WP	Ornamentals & Turfgrass
		Terraclor	75	WP	Agronomic & Vegetables
		Terraclor Super X	23.2 (plus 5.8% ethazol)	EC	Cotton
		Terraclor Super X	10 (plus 2.5% ethazol)	G	Cotton
	United Horticultural Supply	Turfgo Engage	10	G	Ornamentals & Turfgrass
		Turfgo Engage	75	W	Ornamentals & Turfgrass
	W. A. Clearys Chemical Corp.	PCNB	10	G	Ornamentals & Turfgrass
		PCNB	75	WP	Ornamentals & Turfgrass
potassium salts of fatty acids	Mycogen	DeMoss	40	L	Lawns and surfaces
	Ringer	Safer Moss & Algae Killer	2	L	Greenhouses and surfaces
		Safer Lawn Moss Killer	40	L	Lawns and surfaces

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potassium salts of fatty acids (cont'd)		Safer Moss & Algae Killer	40	L	Lawns, surfaces & trees
propiconazole	Ciba Plant Protection	Alamo	14.3	EC	Oak Wilt & Dutch Elm diseases
		Banner	14.3	EC	Non-bearing Fruit & Nuts, Ornamentals & Turfgrass
		Banner GL	41.8	EC	Non-bearing Fruit & Nuts, Ornamentals & Turfgrass
		Orbit	41.8	EC	Fruits & Nuts
		Tilt	41.8	EC	Agronomic & Turfgrass grown for seed, Vegetables
sulfur	Elf Atochem N.A. Inc.	Microthiol Special	80	WP	Agronomic, Fruit, Ornamentals & Vegetables
	Platte Chemical Co.	Clean Crop Sulfur Flowable	52	F	Agronomic, Fruit & Vegetables
		Clean Crop Thiolux	80	DF	Fruit, Ornamentals & Vegetables
		Clean Crop Wettable Sulfur	92	W	Fruit & Vegetables
		Dusting Sulfur	98	D	Agronomic, Fruit, Ornamentals & Vegetables

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sulfur (cont'd)	Stoller Chemical Co.	That Flowable	52	F	Agronomic, Fruit & Vegetables
		Top Cop with Sulfur	50 (plus 8.4% copper sulfate)	WP	Agronomic, Fruit & Vegetables
	Wilbur-Ellis	Sulfur	80	DF	Fruit, Ornamentals & Vegetables
thiophanate methyl	Elf Atochem N.A. Inc.	Topsin M4.5	46.2	F	Agronomic, Fruit & Vegetables
		Topsin M70	70	WP	Agronomic, Fruit & Vegetables
		Topsin M85	85	WDG	Agronomic, Fruit & Vegetables
	Regal Chemical Co.	ConSyst	16.66 (plus 50% chlorothalonil)	WP	Ornamentals & Turfgrass
		SysTec 1998	46.2	F	Ornamentals & Turfgrass
	Scotts-Sierra Crop Protection Co.	Banrot 8G	5 (plus 3% ethazole)	G	Ornamentals
		Banrot 40	25 (plus 15% ethazol)	WP	Ornamentals
		Domain FL	46.2	F	Ornamentals

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thiophanate methyl (cont'd)		Duosan	15 (plus 60% mancozeb)	WP	Ornamentals & Turfgrass
		Duosan WSB	15 (plus 63% mancozeb)	WSP	Ornamentals & Turfgrass
		Fungo FLO	46.2	F	Ornamentals & Turfgrass
		Fungo 50	50	WP	Ornamentals & Turfgrass
		Fungo 85DF	85	DF	Ornamentals & Turfgrass
		Zyban	15 (plus 60% mancozeb)	WP	Ornamentals
	W. A. Cleary Chemical Corp.	3336-F	46.2	F	Ornamentals & Turfgrass
		3336	50	WP, WSP	Ornamentals & Turfgrass
thiram	W. A. Cleary Chemical Corp.	Spotrete	42	F	Turfgrass
		Spotrete	75	WDG	Turfgrass
triadimefon	Lesco Inc.	Granular Turf Fungicide	1.0	G	Turfgrass

¹Formulation abbreviations are : A.S. = Aqueous suspensions, DF = Dry Flowable, DG = Dispersible granule, EC = Emulsifiable concentrate, F = Flowable, G = Granule, IP = Ignitable powder, SP = Soluble powder, WDG = Wetttable dispersible granule, WDP = Wetttable dispersible powder, WP = Wetttable powder, WSP = Wetttable soluble pouch

COMMON CHEMICAL NAME	MANUFACTURER	FUNGICIDE TRADE NAME(S)	PERCENT ACTIVE INGREDIENT	FORMULATION ¹	COMMODITY LABELLING
triadimefon (cont'd)	Miles Inc.	Bayleton	25	WP	Ornamentals & Turfgrass (non-nursery use)
		Bayleton	50	DF	Agronomic, Conifers, Fruit & Vegetables
	United Horticultural Supply	Accost 1G	1.0	G	Turfgrass
	Olympic Horticultural Products, Inc.	Strike	25	WDG	Ornamentals (Nursery & greenhouse use only)
triflumizole	Uniroyal Chem. Co., Inc.	Procure WS	50	WP	Fruit
		Terraguard	50	W	Ornamentals
triforine	Ciba Plant Protection	Funginex	18.2	EC	Fruit & Vegetables
	Solaris Group	Funginex	6.5	EC	Ornamentals
	Valent U.S.A. Corp.	Triforine	18.2	EC	Ornamentals
vinclozolin	BASF Corp.	Curalan	41.3	F	Ornamentals & Turfgrass

¹Formulation abbreviations are : A.S. = Aqueous suspensions, DF = Dry Flowable, DG = Dispersible granule, EC = Emulsifiable concentrate, F = Flowable, G = Granule, IP = Ignitable powder, SP = Soluble powder, WDG = Wetttable dispersible granule, WDP = Wetttable dispersible powder, WP = Wetttable powder, WSP = Wetttable soluble pouch

COMMON CHEMICAL NAME	MANUFACTURER	FUNGICIDE TRADE NAME(S)	PERCENT ACTIVE INGREDIENT	FORMULATION ¹	COMMODITY LABELLING
vinclozolin (cont'd)		Curalan DF	50	DF	Ornamentals & Turfgrass
		Ronilan	50	DF	Fruits & Vegetables
	Lesco Inc.	Touche'	41.3	F	Ornamentals & Turfgrass
	Scotts-Sierra Crop Protectoin Co.	Ornalin FL	41.3	F	Ornamentals
		Ornalin	50	WP	Ornamentals
		Vorlan	50	DF	Turfgrasses
		Vorlan FL	41.3	F	Turfgrasses
		Vorlan	50	WP	Turfgrasses
ziram	Elf Atochem N. A. Inc.	Ziram F-4	39.2	F	Fruits & Ornamentals
		Ziram 76	76	WP	Fruits & Ornamentals
	Platte Chemical Co.	Ziram 76	76	WDG	Fruits & Ornamentals
	Micro Flo Co.	Ziram Granuflo	76	F	Non-bearing Fruit & Ornamentals

¹Formulation abbreviations are : A.S. = Aqueous suspensions, DF = Dry Flowable, DG = Dispersible granule, EC = Emulsifiable concentrate, F = Flowable, G = Granule, IP = Ignitable powder, SP = Soluble powder, WDG = Wetttable dispersible granule, WDP = Wetttable dispersible powder, WP = Wetttable powder, WSP = Wetttable soluble pouch

Perhaps more important and difficult than recognizing equivalent products is the need to recognize related systemic fungicides that share a mode of action toward the pathogen. Two major groups of widely used systemic products exist today. The older group is known as the benzimidazole class of fungicides and contains three fungicides in active use: benomyl, thiabendazole and thiophanate methyl. All three represent broadly systemic compounds whose effects on the fungal target are similar. When one or more of these products is abused or used without proper alternation, tolerance to the fungicide can develop in the fungal population. Tolerance to benomyl by a fungal pathogen translates most often into tolerance by the fungus to both thiabendazole and thiophanate methyl as well. **Do not alternate among fungicides within this class.**

The second class of systemic fungicides has received much attention in trade magazines in recent years. Surely everyone has heard or read of the “SIs”, “EBI”, or “DMIs”. The proper name for this class is the DMI (demethylation inhibiting) fungicides that

interfere with the production of ergosterol (cell wall component) in fungi. Inhibition of this biochemical pathway in the fungus curtails both vegetative and reproductive growth in the pathogen. However, as with the benzimidazoles, if the DMIs are abused or over used, tolerance in a fungus can develop and will be tolerance to the entire fungicide class. Additionally, it is important to recognize relatedness in this fungicide class to avoid adverse effects on the host plant through growth regulation. **Remember - do not alternate among the DMI fungicides within this class.**

(Table 2) lists the trade names of fungicides that share a mode of action within a fungicide class. Product labels indicate different chemical ingredients but do not normally allude to relatedness to other fungicide products. Please learn to recognize these active ingredients as related ones. Use them properly with alternation with unrelated systemics or protectants. Development of fungal tolerance will lead to reduced product efficacy, increased product liability for the manufacturer and ultimately the restriction or loss in availability of the product in a given geographical zone.

Table 2. Systemic Fungicides with Related Modes of Action¹.

Fungicide Class	Common Chemical Name	Trade Name
Benzimidazole	benomyl	Benlate, Tersan 1991
	thiabendazole	Mertect 340-F
	thiophanate methyl	Clearys 3336, Domain, Fungo, Topsin, SysTec 1998
		Banrot*, Duosan/Zyban**
Demethylation inhibiting (DMI)	cyproconazole	Sentinel
	difenoconazole	Dividend
	fenarimol	Rubigan, Broadway***, Two Some***
	fenbuconazole	Enable, Indar
	myclobutanil	Eagle, Nova, Rally, Systhane
	propiconazole	Alamo, Banner, Orbit, Tilt
	tebuconazole	Folicur
	triadimefon	Bayleton, Strike, Accost, Lesco Granular
		Turf Fungicide
	triflumizole	Terraguard, Procure
	triforine	Funginex, Triforine

¹All products listed do not share equal labeling on crops, percent active ingredient, formulations, sites of use nor application modes. Read the label.

*Two-component products which include ethazol.

**Two-component products which include mancozeb.

***Two-component products which include chlorothalonil.