Compatibility *from page 26*

There are soluble fungicides as well. When applying soluble chemicals including fungicides, keep in mind **Rule Number 3. Only one soluble chemical can be tank mixed with any number of insolubles. If two soluble chemicals are tank mixed with or without insolubles, the rate of each soluble should be cut in half to avoid phytotoxicity.** Although they are not numerous, the superintendent is familiar with and has had experience in applying the soluble fungicides such as PMAS, Caddy, Cadminate and Actidione. The latter two are soluble in the spray tank. Coincidentally, three large manufacturers have mixtures of solubles with insolubles presently being marketed.

There is no question that the soluble fungicides have the clout necessary to stop an advanced fungus infection. One can only hypothesize why this is so, and the question resolves itself with the explanation of the difference between fungicidal and fungistatic activity. Fungicides kill whereas fungistats inhibit. But this explanation is too simple. When a spore germinates and sends out a tiny, tender shoot, it is easily killed. Since this is only visible microscopically, the net result determined by sight is that the chemical has prevented spore germination-fungistatic effect. If the spore germinates and the shoot gets a foothold within the grass blade, it takes a more powerful chemical to kill it — fungicidal effect. Some insoluble fungicides possess this advanced stage killing ability to varying degrees; but all of the solubles are immediately fungicidal.

The author has maintained for several years that the ideal tank mix of fungicides is a three-way combination of soluble contact/insoluble contact/insoluble systemic mixture; and, for years has even recommended mixing two soluble contacts, each at half rate to get a broader spectrum than the single soluble at full rate.

Applying rules 2 and 3 in an attempt to get a broader spectrum of control, all of the insolubles can be tank mixed. They can also be tank mixed with one of the solubles or one of the soluble-insoluble combinations. If the solubles and soluble-insoluble combinations are tank mixed, the dosage should be cut in proportion to the number of chemicals added. Because of the soluble portion of the group of soluble-insolubles, they should be treated as if they were solubles. It should be emphasized again that the dosages of two solubles should be cut in half if tank mixed. If three solubles are tank mixed, the dosages should be cut to one-

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third of the recommended rate of each soluble component.

A prime example is the successful combination of MCPP, 2,4-D and dicamba. The recommended rate of MCPP is between 1 and 1½ pounds per acre and the rate of 2,4-D is 1 pound per acre and the rate of dicamba is ¼ - ⅓ pound per acre. However, a successful combination of the three is in the neighborhood of ½ pound MCPP, plus ¼ pound 2,4-D, plus ⅛ pound dicamba. These come premixed in approximately that ratio under the trade names of Trimec and Trex-San.

There are some MCPP/2,4-D combinations in which the rate of MCPP is 1 pound and the rate of 2,4-D is ½ pound. Another example of the synergistic effect of two postemergent chemicals is the combination of DSMA and 2,4-D. In Texas, where 2,4-D is not prevalently used because of its injury to cotton, DSMA anhydrous is recommended for the control of dallisgrass at the rate of 7-10 pounds per acre on bermudagrass. In nearby Louisiana, equally good control has been achieved by the use of 4-5 pounds DSMA plus ½ pound of 2,4-D. This practice has been going on for more than 10 years and, coincidentally, it conforms with rule number 2, which dictates that if two solubles are used together it is a wise practice to cut the dosage of each in half.

Every pesticide applicator knows that fertilizers are usually combinations of insoluble components, and because of the soluble fractions the fertilizers must be watered in to prevent burning. It is not an uncommon practices to add soluble fertilizers to the spray tank in small quantities to attain an immediate greening effect on specific occasions. A more common practice is to add chelated iron for the same reason. But there have been instances of burning because an applicator had a heavy hand in applying these products.

The phenomenon known as salt index comes into play in determining how much of the soluble fertilizer components can be added to the spray tank without incurring phytotoxicity.

Rule Number 4 states that soluble fertilizers and trace elements can be added individually or mixed, provided that the amount will not exceed one ounce solid per gallon tank spray mix. The author has used two ounces per gallon, and has not experienced any burning at the higher rate, but prefers the lower rate. The components that fall into this category are solubles such as urea, ammonium nitrate, ammonium sulfate, muriate of potash, ammonium phosphate, ferrous sulfate, chelated iron, epsom salts, etc.

Exceptions to the rule governing compatibility of solubles is as follows: Heavy cations such as mercury and cadmium fungicides and Paraquat and Diquat are incompatible with heavy anionic herbicides such as DSMA, MSMA, 2,4-D, MCPP, MCPA, and DICAMBA. Precipitation will take place in the spray tank. These combinations are not likely to be used because selective weed control does not involve non-selective weed killers such as Paraquat or Diquat, and the applicator is not likely to use a soluble fungicide such as cadmium or mercury.

There are quick methods to check compatibility. When solubles are mixed with water in the proportion to be used in the spray tank, the solution should remain clear for the number of hours anticipated for spraying.

Emulsifiable concentrates should disperse throughout the water in a stable emulsion without incurring an oily layer separation on standing. The emulsifiable concentrates should be added last, after all solubles and wettables have been added. (However, I strongly urge not to tank mix emulsifiable concentrates).

If three solubles are tank mixed, the dosage should be cut to one-third of the recommended rate of each soluble component.

Thirdly, when wettable powders are components of a tank mix, after standing awhile, the mixture should be sieved through at least a 100 mesh screen. If residue appears on the screen, agglomeration or precipitation has taken place, signaling incompatibility.

These tests can be run in a convenient quart glass jar. The sieve screen should be wet with water with some surfactant added before sieving.

Soluble iron or magnesium salts might remain clear in the glass jar for about an hour and will then begin to hydrolyze in hard water or in water that has a pH of 7 or above. They will decompose to oxide precipitates that are of no value. Whenever possible, use chelated forms of iron and magnesium which will not hydrolyze. They are more expensive, but one can use far less and be able to count on their effectiveness.

Coincidentally, herbicides also fall into two classes— solubles and insolubles. The soluble herbicides are postemergent in nature whereas the insolubles are preemergent in activity. The insoluble preemergents are safe to apply because by their very nature they slowly release the active toxicant by hydrolysis in the soil (although certain preemergents exhibit some phytotoxicity on certain species and cultivars; however, these cautions are covered on the labels).

The rate of release of active toxicants is sufficient to kill the germinating weed seedling and, strangely enough, insufficient as a rule to kill the mature weed plant. The rate of release will determine the length of residual activity of the product. Each individual preemergent has its own time release schedule. The residuals range anywhere from 45 to 90 days, with an average of about 60 days.

It should be noted that one important factor which will materially alter the residual is oil structure. Adsorption of the hydrolytic toxicant by soil particles dictates different rates for different soils. Label directions must be carefully followed. But

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Compatibility *from page 32*

the parent pre-emergent compound is an insoluble, thus nonburning.

Pre-emergents should be applied before the weed seed germinating season begins, which is usually in March, April or May depending upon that portion of the country. Preemergent chemicals can be tank mixed and sprayed as a wettable powder or can be applied with a granular carrier as a spreader.

It is obvious that wettable pre-emergent powders will not present a phytotoxic problem at the time of application. However, some preemergents will release the toxicant rapidly and pose a phytotoxicity to certain types of grasses such as bentgrass. Some applicators will split the rate of application of a preemergent wettable powder in half when treating bentgrass greens and put on two applications a month apart.

> The tank mixing of two or three soluble postemergent herbicides is becoming more and more prevalent.

The problem of phytotoxicity is an important factor when dealing with soluble postemergent herbicides. As a general rule, the phytotoxicity index (safety factor) is narrow for all postemergent chemicals. Yet they are used rather extensively and effectively, provided the rates of application are followed closely. The tank mixing of two or three soluble postemergent herbicides is becoming more and more prevalent. This practice is useful because the applicator has found a synergistic effect with combination; but, in doing so he must again apply rule number 2 which states that whenever solubles are added to the spray tank the dosage rate should be cut proportionately, depending upon the number of solubles.

Surfactants or wetting agents should be treated as solubles. Wetting agents are usually added to the spray tank in order to reduce the surface tension of water so that the spray comes out as finer droplets and wets the blades of the weeds or grasses giving a more uniform coverage. This also reduces the safety factor of soluble herbicides and promotes phytotoxicity. If a wetting agent is used, apply Rule No. 3. Cut the rate of the soluble herbicide. When used with insoluble fungicides, it is not necessary to reduce the rate.

Finally, there are two classes of chemicals which are infrequently used by applicators and by their very nature cannot be tank mixed. They are nematicides, such as Dasanit and Nemagon, and general weed and grass killers such as Phytar, Paraquat and Roundup.

When the applicator embarks on a new formula it would be wise for him to practice on small areas, preferably his nursery.

Also, according to the federal Environmental Protection Agency, if a chemical applicator willfully uses more than the recommended amount on the label and destroys turf, he is technically criminally libel.

But we are addressing ourselves to applicators who are faced with multiple diseases and multiple weeds. In this situation, one single product is inadequate, and it becomes costly and somewhat ridiculous to spray each individual product separately. But never apply more than the amount recommended on the label, and following the rules outlined in this paper, it is necessary to split dosages of solubles.

Solubility and Formulation

	EC, S, SP Solubles		WP, F Insolubles		Soluble-Insoluble Combinations
FUNGICIDES					
PMAS			Tersan 75	Fore	Calo-Clor
Caddy			Tersan LSR	Maneb	Kromad
Cadminate			Tersan SP	Zineb	Actidione RZ
Actidione TGF			Spotrete	Captan	Actidione Thiram
			Bromosan	Daconil 2787	Thimer
			Spectro	Dyrene	Cadtrete
			3336	Fungo	
			1991	RP26019	
INSECTICIDES					
Dursban	Malathion		Diazinon		
Diazinon	Proxol		Dursban		
Chlordane	Dylox		Sevin		
Sevin			Malathion		
HERBICIDES					
2,4-D	DSMA		Dacthal		
2,4,5-T	MSMA		Tupersan		
MCPP	AMA		Balan		
dicamba	Betasan-EC				
FERTILIZERS					
urea			ureaform		
ammonium nitrate			IBDU		
ammonium phosphate					
ammonium sulfate					
potassium nitrate					
muriate of potash					

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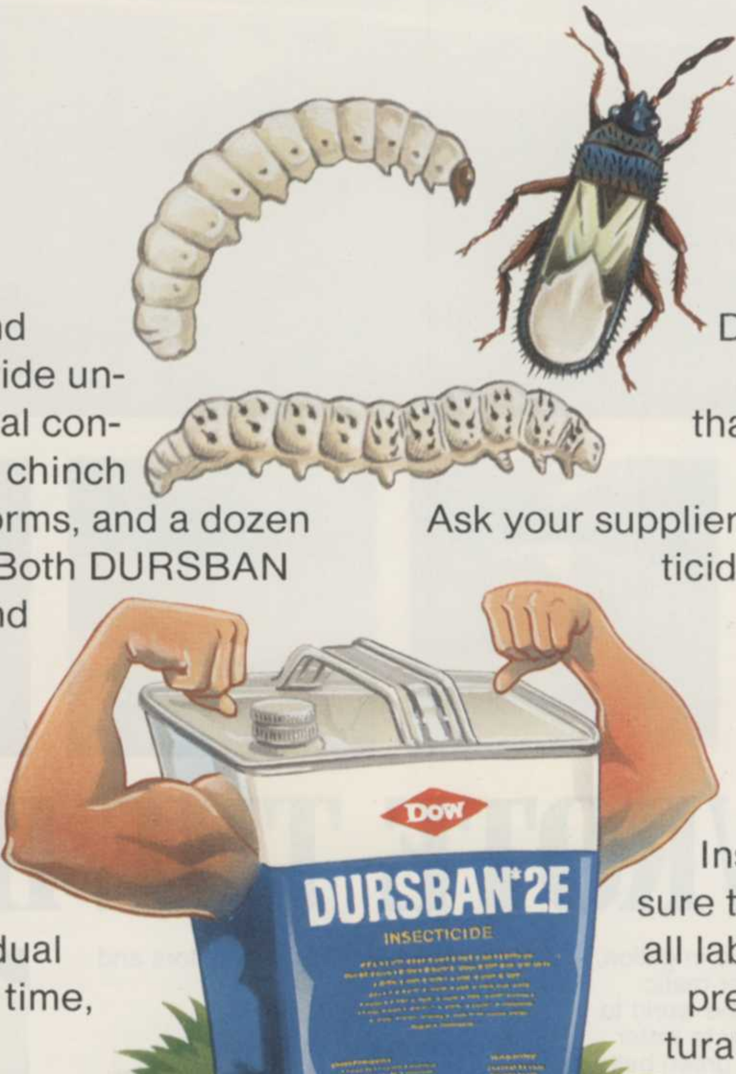

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TIMING, RATE ARE CRITICAL FOR PREEMERGENCE HERBICIDES

by Robert C. Shearman, Ph.D.

Premergence herbicides play an important role in turfgrass maintenance programs. Timing of application is critical in their effectiveness. They must be applied prior to weed germination or emergence. An application two weeks prior to anticipated emergence of the target weed is generally suggested. This allows sufficient time for the preemergence herbicide to form a chemical barrier at or near the soil surface. Susceptible weeds germinate, absorb the herbicide, and are killed.

Preemergence herbicides are commonly used to control weedy, annual grasses like crabgrass, goosegrass, and foxtail. Some are also effective in controlling annual, broadleaf weeds such as prostrate or spotted spurge. Effectiveness and longevity of control depends upon the (a) preemergence herbicide, (b) application rate and timing, (c) weed species, (d) environmental conditions, (e) soil type and reaction, (f) cultural practices and (g) microorganism activity. Before selecting a preemergence herbicide turfgrass managers should check with local researchers and specialists for the chemicals that perform well in their area, and for the appropriate rates and timing of application.

Preemergence herbicide application rate and timing are critical aspects for effective weed control. A threshold level of herbicide activity must be maintained past the period of germination for the target weed to obtain satisfactory results. Figure 1 illustrates this point. Herbicide I maintains a soil concentration above the threshold level past the period of weed germination. Herbicide I would give effective weed control, while, Herbicide II fails to maintain a satisfactory concentration throughout the germination period. Herbicide II would require more than one application to give effective control of the target weed. When weed pressure is heavy or the germination period is extended weed control is more difficult. A heavy initial application rate or more than one herbicide application may be necessary under these conditions. If herbicides are applied too early, the chemical barrier may break down and allow weed infestation to occur. In turn, if the herbicide is applied too late germination will have already occurred and ineffective weed control will result.

Preemergence herbicides offer definite advantages to turfgrass managers. They are beneficial in maintaining the integrity, quality, and function of

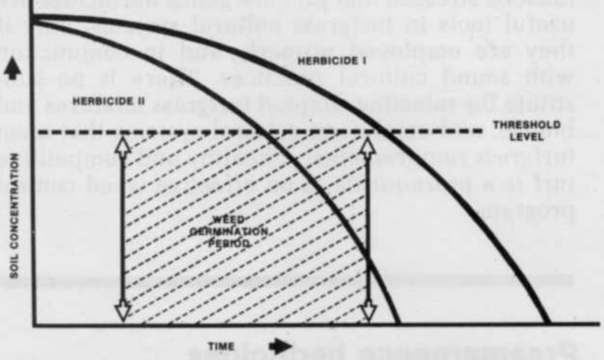

Figure 1. The preemergence herbicide must remain at sufficient concentration in the soil throughout the germination period of the target weed.

the turf; while they give effective and relatively safe selective control of emerging weeds. Preemergence herbicides, like other pesticides, have limitations and should be used appropriately. They cannot substitute for ineffective cultural systems, and must be incorporated with sound mowing, fertilizing and watering practices. Along with the advantages of using preemergence herbicides there are some potential disadvantages that should be considered. Some are rather obvious in nature. For instance, applications at the recommended rates for crabgrass and annual bluegrass will reduce germination of overseeded, cool-season turfgrass species. Reduced rates of siduron (Tupersan) is an exception, since it is recommended for seedbed application of certain turfgrass species and cultivars.

Other detrimental effects of preemergence herbicide applications appear to be more subtle in nature than the influence on seedling emergence. Almost every preemergence herbicide has been reported to influence some aspect of turfgrass growth, development, and performance. Successive annual applications or repeated applications within a year are particularly suspect. Decreased root and rhizome production, reduced sod strength and transplant rooting, reduced low temperature tolerance, increased high temperature and drought stress, and increased incidence of disease on susceptible turfgrass species and cultivars have been reported for the various preemergence herbicides commonly used in turf. However, these reports are contradictory and confusing since a particular herbicide may cause injury in one case and not another.

Turfgrass injury resulting from preemergence herbicides can usually be related to factors such as: (a) the species or cultivar treated, (b) herbicide used, (c) herbicide concentration or application rate, (d) soil type (e) cultural practices, and (f) amount of thatch present. These factors should be

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given careful thought and equal consideration to the efficacy of the product, when reviewing a preemergence herbicide for use in a maintenance program.

The turfgrass manager should select the materials that appear safest and most effective based on research in his area, and apply these materials according to label recommendations. It must be stressed that preemergence herbicides are useful tools in turfgrass cultural systems, only if they are employed properly and in conjunction with sound cultural practices. There is no substitute for selecting adapted turfgrass mixtures and blends, and employing cultural systems that meet turfgrass requirements. A healthy and competitive turf is a prerequisite to an effective weed control program.

Preemergence herbicides and their effect on thatch

Dr. Al Turgeon in the Department of Horticulture at the University of Illinois has reported extensively on the development of thatch due to preemergent herbicides and also the effect of thatch on the control of annual weedy grasses with preemergent herbicides. While some preemergent herbicides do induce thatch, it is more because of their effect as a pesticide on the earthworm and soil microbial balance.

Thatch results, according to Dr. Turgeon, because of an imbalance between opposing processes of accumulation and decomposition of organic material. He suggests that where any chemical that induces thatch is used, a cultural program should be adjusted to compensate for the loss of earthworms and other organisms that are important in decomposing the thatch and generally improving soil physical conditions.

This may involve periodic verticle mowing, aeration, topdressing, or other practices to overcome the adverse effects of the chemicals on the turfgrass ecosystem.

In an experiment to determine the effect of thatch on preemergence herbicide activity in Kentucky bluegrass, Dr. Turgeon found that, while preemergence control was excellent on thatchy plots, there was some amount of turfgrass injury that was not as severe as on thatch-free plots. This may be due to at least two factors: Herbicides are more mobile in thatch than in soil, thus, as more herbicide enters the rootzone, more injury results; and since there were no observations of differences in mobility between benefin and DCPA, the selectivity of preemergence herbicides may be due to biochemical as well as mobility differences. The following chart indicates a comparison of crabgrass control on thatchy and thatch-free Kentucky bluegrass. Herbicides were applied April 24, 1976 and April 21, 1977.

Injury ratings were an average of observations made July 21, 1976 and July 18, 1977. They are based on a scale of one to nine, with one indicating no injury and nine indicating necrosis of turf.

The percentage of crabgrass cover is an average of visual observations made August 13, 1976 and September 8, 1977. The sites were overseeded with crabgrass each year.

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Effect of Thatch on Preemergence Herbicide Control

			Injury to Turf		Percent Crabgrass Cover	
Treatment	Form	Kg/ha[1]	Thatch-free	2-3cm Thatch	Thatch-free	2-3cm Thatch
benefin	2.5G	2.2	1.0	3.0	5.3	1.1
		3.4	1.0	3.6	5.7	0.7
		4.5	1.0	4.6	2.0	0.1
bensulide	4E	11.2	1.0	1.1	4.7	0.1
		22.4	1.0	1.6	10.3	0.1
	3.6G	11.2	1.0	1.6	1.6	0.1
		22.4	1.3	2.1	0.3	0.4
	12.5G	11.2	1.0	1.0	2.0	0.6
		22.4	1.0	1.6	3.0	0.1
DCPA	75WP	11.8	1.0	1.0	2.6	1.1
		23.5	1.0	1.3	2.6	1.3
	5G	11.8	1.0	1.1	3.7	1.3
		23.5	1.0	1.1	3.0	1.1
oxadiazon	2G	2.2	1.0	4.6	9.0	2.3
		3.4	1.0	5.6	2.8	0.0
		4.5	2.0	6.3	4.3	0.0
prosulfalin	50WP	2.2	2.0	2.1	6.0	0.2
		3.4	3.0	6.5	5.0	0.8
untreated			1.0	1.0	29.0	11.5
LSD 0.05[2]			0.3	0.9	8.0	2.7

1. Kg/ha multiplied times 1.12 equals lb./A.
2. Level of Significant Difference, i.e. under Injury to Turf, Thatch-free, observation figures must differ by 0.3 to be significant, by 8.0 under Percent Crabgrass Cover, Thatch-free.