

Pest Management

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Management of Diseases in the Field

Tobacco diseases cause significant losses in yield and quality each year in Kentucky, resulting in lost revenue to growers. The extent of losses varies from year to year and farm to farm, depending upon the weather and diseases present. Tobacco is threatened by disease from seeding until harvest (and even during the curing process). The most common diseases encountered in field production of burley and dark tobacco are black shank, blue mold, target spot, frog-eye, brown spot, soreshin, Fusarium wilt, black root rot, angular leaf spot (wildfire), virus diseases (virus complex, tobacco mosaic, alfalfa mosaic, ringspot, tomato spotted wilt), and bacterial stalk rot (hollow stalk). Diseases such as brown spot and black root rot are found infrequently in burley tobacco but are more common to dark tobacco, while blue mold appears more often on burley. Resistance to black root rot in many burley varieties has reduced the importance of this disease in recent years; however, dark varieties generally lack resistance to black root rot. As with transplant diseases, discussed earlier in this Guide, the key to success in controlling diseases during field production is prevention. In almost every case, it is far easier to prevent disease than to stop it after an epidemic has gained momentum. And even if an outbreak of disease is brought under control through some type of rescue treatment (of which few are available for tobacco), yield losses can occur and quality of the crop can be affected. The latter is especially important for dark tobacco due to the low tolerance of manufacturers for leaf spots and other disease-related damage.

Implementing a preventive disease management program means that control measures have to be carried out or in place before disease appears, and this requires planning ahead. Field selection, picking varieties, and choice of fungicides that will be used are decisions that should be made well in advance of seeding transplants to ensure availability of land, seed, and chemicals. Choosing the practices to be implemented requires knowledge of field history (previous crops, prevalent diseases, field characteristics) and an awareness of the diseases that affect tobacco. The following are recommended practices and tips for managing tobacco diseases in the field.

General Considerations

Take full advantage of resources to monitor and manage disease.

During the growing season, check crops regularly for signs and symptoms of diseases. Where preventive programs aren't in place, best control of diseases will be achieved if action is taken early in an outbreak. Consult your county Extension agent if you are unsure of what is affecting your crop, which can help get a correct diagnosis through the UK Plant Disease Diagnosis laboratories located in Lexington or Princeton. Tobacco-related publications from the UK Cooperative Extension service are available at your local county Extension office. You can access information online that can help with identification of disease problems. The KY Tobacco Disease Information Page (<http://www.uky.edu/Ag/kpn/kyblue/kyblue.htm>) features up-to-date

information on tobacco diseases and recommended controls, as well as advisories on current disease problems (such as blue mold).

Avoid areas with histories of severe disease problems. One of the best ways to keep a particular disease from affecting a crop is to not plant in areas where problems have occurred in the past. This can be an effective way to manage black shank, Fusarium wilt, and black root rot. Locating fields away from areas with large, unmanaged populations of weeds can help minimize problems with a number of insect-transmitted plant viruses, such as alfalfa mosaic and tomato spotted wilt. Planting tobacco early will ensure that tobacco is older and less susceptible when aphid populations begin to grow; however, early plantings may suffer from black root rot. On the other hand, planting later to avoid early activity by thrips may reduce losses to tomato spotted wilt.

Exclude plant pathogens from the field. Keep plant pathogens out of “clean” fields by sanitizing equipment (especially shared equipment or if you farm in several different areas) and shoes, and by keeping (as much as possible) animals from wandering into production areas. This can be effective in the management of black shank and Fusarium wilt. Don't discard stalks from fields with black shank and other diseases in clean fields or near sources of water to avoid introduction. Use locally-produced transplants or those grown north of Kentucky to avoid problems with blue mold. Plants produced in the Deep South may become exposed to blue mold at their source, and their importation into Kentucky could start an outbreak early in the season. Go to the field with healthy transplants; don't set plants with severe Pythium root rot or other diseases. Diseased plants tend to take longer to establish and are more likely to be affected by black shank and soreshin. Do not set plants that have blue mold – destroy them immediately. Such plants will die, or if they survive they will not thrive and can serve as a source of spores for an outbreak in surrounding fields. Avoid tobacco use during setting to prevent the transmission of tobacco mosaic virus.

Rotate to non-related crops. Rotate away from tobacco every 2-3 years to a crop that is not related to tobacco for 1-2 years. This will prevent the buildup of soilborne pathogens such as *Phytophthora nicotianae* (black shank), *Fusarium*, *Rhizoctonia* (soreshin and target spot), and *Thielaviopsis* (black root rot).

Plant disease-resistant varieties. Select varieties with resistance to the diseases that you anticipate to be a problem. Using resistant varieties is one of the least expensive management practices—the cost is built into the price of the seed. Burley varieties are available with good resistance to diseases such as black shank, blue mold, Fusarium wilt, virus complex, tobacco mosaic, and black root rot (Table 1). Most burley varieties are resistant to wildfire, while only two varieties of dark tobacco, TN D950 and DF 911, have good resistance to this disease. Resistance to black root rot and black shank is not as well-developed in many varieties of dark tobacco, however (Table 2). Look at the entire resistance “package” when choosing a variety, as levels of resis-

Table 1. Relative levels of resistance to disease in burley varieties.

Variety	Black Shank ^a		Black Root Rot ^b	Virus Complex ^c	TMV	Fusarium Wilt
	Race 0	Race 1				
KY 14 × L8 LC	10	0	M	S	R	6
KY 907 LC	2	2	H	R	R	1
KT 200 LC	6	6	H	R	R	0
KT 204 LC	7	7	H	R	R	1
NC BH 129	1	1	H	S	R	1
NC 3d	2	2	H	R	R	1
NC 4	2	2	H	R	R	6
NC 5d	10	4	H	R	R	0
NC 6d	10	3	H	R	R	0
NC 7	10	3	H	R	R	5
NC 2000e	0	0	L	S	R	1
NC 2002e	0	0	L	S	R	0
TN 86 LC	4	4	H	R	S	0
TN 90 LC	4	4	H	R	R	0
TN 97 LC	4	4	H	R	R	0
Hybrid 403 LC	0	0	M	S	R	6
Hybrid 501 LC	5	5	H	S	R	4
N-126	0	0	M	S	R	3
N-777 LC	2	2	M	S	S	0
N-7371 LC	3*	3*	-	-	-	-
NBH 98	2	2	M	S	R	3
HB 04P LC	0	0	H	S	R	0
R 610 LC	4	4	M	S	-	3
R 630 LC	3	3	M	R	R	4
R7-11	0	0	M	S	R	6
R7-12 LC	0	0	H	S	R	4

^a Black shank and Fusarium wilt resistance scored on a 0-10 scale where 0=no resistance and 10=high resistance.

^b L=low resistance, M=medium resistance, H=high resistance.

^c S=susceptible to virus complex or TMV, R=high level of resistance.

^d Variety with resistance to root-knot nematode.

^e Variety with resistance to blue mold.

* Rating based upon a limited number of trials.

- No data available.

tance to individual diseases can vary and may not be appropriate for some fields. For example, NC 2002 has good resistance to blue mold, but no resistance to black shank and would be a poor choice to plant in areas where black shank has been a problem. Varieties such as TN 86 and TN 90 have moderate resistance to black shank and none to Fusarium wilt.

Resistance is second only to rotation in effectiveness for managing black shank. In general, select varieties based upon the level of resistance to Race 1 of the black shank pathogen, since most fields in Kentucky have mixed populations of Race 0 and Race 1 of *Phytophthora nicotianae*. Where the Race 0 only is active, select a variety like KY 14 × L8 or NC 7, which have near-immunity ('Ph' gene) resistance to black shank. Use resistance as part of an overall management program that includes crop rotation and/or mefenoxam (Ridomil Gold or Ultra Flourish).

Select and prepare sites properly. Do not set plants into saturated soils. Choose a site that is well drained to avoid soil saturation and problems with black shank. Install ditches or drain tiles if needed to promote good soil drainage. Select sites that are not excessively shaded and have good air movement to suppress diseases like target spot and blue mold. Do not plant tobacco adjacent to areas where vegetables are produced, as many vegetable crops (especially tomatoes and peppers) can

Table 2. Relative levels of resistance^a to disease in dark tobacco varieties.

Variety	Black Shank		Black Root Rot	Wildfire	TMV	Fusarium Wilt
	Race 0	Race 1				
NL Madole	S	S	S	S	S	S
TR Madole	S	S	S	S	S	S
Little Crittenden	S	S	S	S	S	S
DF 911	S	S	H	H	H	S
KY 160	S	S	S	S	H	S
KY 171	S	S	H	S	H	M
VA 309	LM	LM	M	-	S	-
VA 359	L	L	L	-	S	-
TN D950	M	M	H	H	H	S
KT D4LC	M	M	S	S	S	-
KT D6LC	M	M	H	H	H	-

^a S=completely susceptible, L=low resistance, M=medium resistance, H=high resistance

- No data available.

harbor viruses that can be moved onto tobacco by insect vectors. By the same token, don't plant tomatoes or peppers in tobacco fields.

Plow cover crops early to make sure that plant matter decomposes thoroughly before setting time. Soreshin and black root rot can be problems in fields with high levels of partially decomposed organic matter. Heavily manured fields may also have higher severity of black root rot. Turn tobacco roots and stubble under soon after harvest to promote decomposition and a more rapid decline of soilborne pathogens.

Manage soil fertility and pH. Keep pH within recommended ranges during the growing season. Allow pH to drop somewhat during rotational periods to promote rapid decline of *Phytophthora* (black shank) populations in soil. Do not over-fertilize, as this favors development of blue mold and black root rot; however, low nitrogen levels can contribute to severe outbreaks of target spot.

Harvest in a timely manner and manage barns correctly. Over-mature tobacco is more prone to leaf spotting diseases such as brown spot. Manage humidity levels in barns to avoid house-burn and barn rots.

Use fungicides correctly. Timely and accurate application of fungicides is essential for best performance. The following are some general guidelines for successful use of fungicides to manage diseases of tobacco.

- Apply fungicides preventively or at the latest when first symptoms of disease appear. Most products labeled for tobacco are protectants and must be in place before the arrival of the pathogen to suppress infection. Applications made after a disease has become established will take longer to bring the epidemic under control, or may not be successful. This is especially true for blue mold. Begin fungicide applications for blue mold control when the disease is forecasted to threaten your area or has been found nearby. Contact your county Extension agent for disease advisories, or visit the KY Tobacco Disease Information Page (<http://www.uky.edu/Ag/kpn/kyblue/kyblue.htm>). Maintain recommended application intervals while disease threatens or the weather favors disease. Applying fungicides with a specific mode

of action, such as Quadris, when high levels of disease are present can lead to the development of resistance in certain plant pathogens.

- Use an application volume that gives the best coverage of plants. This amount will change as the crop grows, but in general use 20 gallons per acre early (when plants are small) and increase to as much as 100 gallons per acre for applications made at topping or afterward. Spray pressure should be between 40 and 100 psi, and use hollow-cone nozzles for best effect. As the crop grows, configure your sprayer, if possible, with one nozzle centered over the row and multiple nozzles on drop extensions to allow for good coverage in the lower canopy.
- Calibrate your sprayer for accurate delivery. This will ensure the crop receives neither too little fungicide (poor disease control) nor too much (extra cost and potential injury). Clean nozzles regularly, and change them as they become worn. This is an extra expense that will pay for itself in the long run.

Chemicals for Disease Management

Blue mold, target spot, and frogeye. More fungicide products will be available for use on tobacco in 2007 than ever before. Quadris received a full (Section 3) label in 2006 for control of these diseases. Our results indicate that Quadris provides consistent and effective control of blue mold, target spot, and frogeye, and will help reduce losses of yield and quality associated with these diseases.

Quadris is the only labeled option for management of frogeye and target spot, two diseases that have become more of a problem over the past few years. Research over the past two years has shown that where target spot has been historically severe, 1-2 applications of Quadris made at 8-12 fl oz/A, beginning when plants are between 24-36 inches tall, will provide significant control of target spot. Early applications prevent buildup of the target spot pathogen, suppressing disease later in the season; however, a mid-to late-season application may be required to protect tobacco between topping and harvest. Where disease severity is low, a single application made early (before the canopy closes between rows) can be as effective against target spot as three applications made at 2-3 week intervals. Greater levels of disease will require at least two applications of Quadris to get good control of disease and improved yield. Growers with recurring losses to target spot should consider applying Quadris to their crops.

Keep in mind that Quadris is a protectant fungicide, and has limited systemic activity. Good coverage is critical to getting good disease control with Quadris. Quadris can be applied up to the day of harvest, making this material a good option for post-topping control of leaf spotting diseases.

Other options for blue mold include Acrobat 50W or Forum, Dithane DF, Aliette WDG, and Actigard. Forum is a liquid formulation of dimethomorph, the same active ingredient found in Acrobat 50WP, introduced by BASF in 2006. The liquid formulation should be easier to measure and mix than Acrobat 50WP. According to the Acrobat and Forum labels, these products must be tank-mixed with another blue mold fungicide for management of resistance. Actigard remains one of our best options for blue mold control. This is a systemic product that functions by inducing plant defenses and is thus not a true fungicide. Coverage is not as critical with Actigard as with other fungicides, so this product may be applied with standard "over-the-top" type equipment and will still give good control of blue mold. Activation of host defenses takes several days for full protection, so Actigard should be applied 3-5 days

before tobacco is exposed to the blue mold pathogen. If infection threatens before the 3-5 day activation period, Actigard can be tank-mixed with another fungicide to protect plants during this critical time. A second application made 10 days after the first has been shown to provide good protection against blue mold up to topping time. Do not apply Actigard to burley tobacco until plants are greater than 18 inches tall (12 inches for dark tobacco) to avoid serious injury. Use another fungicide if blue mold threatens tobacco less than the recommended height to protect until Actigard can be applied.

Bayer CropScience received a label in 2006 for Aliette WDG on tobacco for control of blue mold only. For field use, apply 2.5-4 lb/A of Aliette in a minimum of 20 gal/A of water on newly transplanted tobacco. Increase the spray volume by 20 gal/A for each week of growth until 100 gal/A is reached. The first application of Aliette should be made immediately after transplanting and subsequent sprays can be made on a 7-to-10-day schedule. Aliette should not be tank-mixed with copper compounds, surfactants or foliar fertilizers, and the pH of the spray solution should not be less than 6.0. Our experience with Aliette in Kentucky is limited at this time. We will test Aliette in field trials across Kentucky during the 2007 season so that better guidance on the efficacy of this fungicide can be provided to our growers in the future.

We saw evidence in 2006 that soil applications of Ridomil Gold did reduce severity of blue mold in some fields, but in general this fungicide should not be relied upon to manage blue mold. Resistance to mefenoxam (Ridomil Gold and Ultra Flourish) is widespread in populations of the blue mold pathogen, making Ridomil a risky choice.

Black shank. For suppression of black shank, use products containing mefenoxam (Ridomil Gold or Ultra Flourish) in conjunction with resistant varieties and crop rotation. Where black shank has been severe, consider making a pre-plant application at 1-1.5 pt/A of Ridomil Gold or 1-1.5 qt of Ultra Flourish per acre prior to transplanting. Use a volume of water or fertilizer sufficient for good soil coverage and incorporate into the top 2-4 inches of soil by disking or irrigation. Under light-to-moderate disease pressure, apply mefenoxam within 1-2 weeks of transplanting. To extend period of protection, make supplemental applications at first cultivation and layby. Do not exceed the equivalent of 1.5 lb a.i./A of mefenoxam (3 pt of Ridomil Gold or 3 qt of Ultra Flourish). Good soil moisture is needed for best performance of mefenoxam products against black shank.

Brown spot and ragged leaf spot. We have no fungicides for the moment to manage brown spot and ragged leaf spot. A fungicide program that contains Dithane DF and Quadris may provide some suppression of these diseases.

Bacterial diseases. Agricultural streptomycin (Agri-Mycin 17, Firewall) can be used to manage angular leaf spot and wild-fire. Begin applications when symptoms appear and continue while weather conditions favor disease development (warm and rainy weather). Hollow stalk, another bacterial disease, cannot be managed with chemicals. Instead, make sure that crops are not over-fertilized. Minimize mechanical and chemical wounding during topping and sucker control operations, and don't top during rainy or overcast conditions, or if plants are wet.

Virus diseases. Chemical control of virus diseases is not possible. Host resistance can be effective against certain virus diseases of tobacco (see section on resistant varieties). Control of insect vectors gives variable (and unpredictable) levels of control of aphid-transmitted viruses (potyviruses) or TSWV (thrips). Weed control in and around fields can be helpful, as weeds serve as reservoirs of certain diseases; don't plant tobacco near vegetables for the same reason. Tobacco surrounded by, or planted adjacent to corn, soybeans, or other small grains will have less problems with aphid-transmitted diseases, as

the insects "lose" the virus as they feed on small grains before moving onto tobacco.

Fumigants. Several fumigants are registered for use on tobacco for preplant suppression of soilborne pathogens and nematodes in Kentucky, but should be considered a measure of last resort. Nematodes have not been a serious problem in Kentucky, and the use of products such as Telone C-17 or C-35 is not warranted under most circumstances due to high material costs and expensive custom application. Chloropicrin used as a pre-plant soil treatment will reduce populations of *Phytophthora nicotianae*, *Rhizoctonia*, *Fusarium*, *Pythium*, and *Thielaviopsis*, giving fair control of disease. As with soil nematicides, chloropicrin is expensive and must be applied with specialized equipment and will not be an economically viable choice for most producers.

Tables 3 and 4 list labeled chemicals that are available to growers in Kentucky for use in the production of burley and dark tobacco in 2007. As always, read all product labels carefully and follow all directions provided by the manufacturers. Each product has specific use directions that should be followed to minimize the risk of damage to the crop and to maximize the effectiveness of the product. The following summary is provided as a general set of guidelines to aid in product selection but is not intended to replace product labels.

Table 3. Guide to chemicals available for control of tobacco diseases 2006—soil application (field).

Fumigants	Product Rate Per		Target Diseases	Label Notes
	Application ^a	Season		
Chloropicrin	60-100 lb/A (broadcast)	--	black root rot black shank	Inject to 8-in. depth. Apply when soil temperatures are >55°F and moisture levels are adequate. Apply a minimum of 3 weeks before setting transplants.
Chlor-O-Pic	150-500 lb/A (broadcast)	--	damping-off nematodes	
Telone C-17	10.8-17.1 gal/A (broadcast)	--	bacterial wilt black root rot	Inject to 8-in. depth. Apply when soil temperatures are >55°F and moisture levels are adequate. Apply a minimum of 3 weeks before setting transplants.
Telone C-35	13-20.5 gal/A (broadcast)	--	black shank nematodes	

Non-fumigants	Product Rate Per		Target Diseases	Label Notes	
	Application ^a	Season			
Ridomil Gold EC	preplant only	2-3 pt	3 pt	black shank	Incorporate after application.
	preplant + layby	2 pt + 1 pt			
	preplant + 1st cultivation + layby	1 pt + 1 pt + 1 pt			
Ridomil Gold SL	preplant only	1-3 pt	3 pt	black shank	Incorporate after application.
	preplant + layby	2 pt + 1 pt			
	preplant + 1st cultivation + layby	1 pt + 1 pt + 1 pt			
Ultra Flourish	preplant only	2-3 qt	3 qt	black shank	Incorporate after application.
	preplant + layby	2 qt + 1 qt			
	preplant + 1st cultivation + layby	1 qt + 1 qt + 1 qt			

^a Rate range of product. In general, use the highest labeled rates when disease pressure is high. Refer to product label for application information, restrictions, and warnings.

Table 4. Guide to chemicals available for control of tobacco diseases in the field, 2006—foliar applications.

Chemical	Product Rate Per		PHib (days)	Target Diseases	Label Notes
	Application ^a	Season			
Agricultural streptomycin Agri-Mycin 17 Firewall	100-200 ppm (4-8 oz/50 gal H ₂ O)	no limit	0	wildfire blue mold	
Acrobat 50WP	2-8 oz	32 oz	0	blue mold	Increase rate and application volume as crop size increases. Acrobat must be tank-mixed with another fungicide.
Actigard 50WG	0.5 oz	1.5 oz (3 apps.)	21	blue mold	Begin applications when plants are >18 inches in height. Actigard must be applied 3-5 days prior to infection to allow for activation of plant defense compounds. Make up to 3 applications on a 10-day schedule. Apply in a minimum of 20 gal/A.
Dithane DF	1.5-2 lb	no limit	30	blue mold damping-off anthracnose	Apply on weekly schedule; discontinue sprays when blue mold threat no longer exists.
Aliette WDG	2.5-4 lb	20 lb	3	blue mold	Make first application immediately after trans planting; continue on a 7-10 day schedule. Use a minimum spray volume of 20 gal/A; increase by 20 gal/A weekly to a maximum of 100 gal/A.
Forum	2-8 fl oz	30 fl oz	0	blue mold	See notes for Acrobat
Quadris 2.08SC	6-12 fl oz	31.2 fl oz	0	target spot frog-eye blue mold	Begin applications at the first sign of disease. Continue sprays on a 7-14 day schedule (use a shorter spray interval when conditions favor disease. Do not make back to back sprays. Alternate with different fungicide labeled for tobacco.
Ridomil Gold EC/SL	½-1 pt	3 pt	n/a	blue mold	Apply to soil at transplanting for blue mold.
Ultra Flourish	½-1 qt	3 qt	n/a	blue mold	Apply to soil at transplanting for blue mold.

^a Rate range of product PER ACRE. In general, use the highest labeled rates when disease pressure is high. Refer to product label for application information, restrictions, and warnings.

^b Pre-harvest interval

^c Actigard can be applied to dark tobacco varieties at the 12-inch stage.

Weed Control

Weeds can impact tobacco production by reducing yield and interfering with crop harvest. Many of the common weed problems in tobacco are summer annuals such as foxtails, pigweeds, lambsquarters, and annual morningglories. In addition, some perennials such as johnsongrass, honeyvine milkweed and yellow nutsedge can be particularly troublesome in some tobacco fields. In locations where troublesome weeds are difficult to control it may become necessary to choose an alternative field site to grow tobacco. Table 5 is a guide to the relative response of selected weeds to various herbicides available for use in tobacco.

Land preparation practices such as moldboard plowing and discing are beneficial for initial weed control by destroying early season weeds that have emerged before transplanting. Field cultivation and hand-hoeing are also traditional methods used for obtaining good weed control post-transplant. In more recent years effective herbicide control options have decreased the need for mechanical control method. A foliar burndown herbicide also allows production of tobacco by conservation tillage methods. Specific herbicide options that are currently recommended for use on tobacco fields are discussed in Table 6.

Table 5. Guide to the relative response of weeds to herbicides.¹

	Crabgrass	Fall Panicum	Foxtails	Johnsongrass (seedling)	Johnsongrass (rhizome)	Shattercane (Wild Cane)	Yellow Nutsedge	Black Nightshade	Cocklebur	Galinsoga, Hairy	Jimsonweed	Lambsquarters	Morningglory	Pigweeds	Common Ragweed	Ragweed, Giant (Horseweed)	Smartweed	Velvetleaf
Command	G	G	G	F	P	F	P	P	F	F	F	G	P	P	G	F	F	G
Devrinol	G	G	G	F	P	P	P	P	N	F	N	F	N	F	F	N	P	P
Prowl	G	G	G	G	P	F	N	N	N	P	N	G	P	G	P	N	F	F
Spartan	F	F	F	P	P	P	G	G	F	F	G	G	G	G	P	P	G	F
Spartan + Command	G	G	G	F	P	F	G	G	F	G	G	G	G	G	G	F	G	G
Poast	G	G	G	G	F	G	N	N	N	N	N	N	N	N	N	N	N	N

G = Good F = Fair P = Poor N = None - No Data Available

¹ This table should be used only as a guide for comparing the relative effectiveness of herbicides to a particular weed. Under extreme environmental conditions, the herbicide may perform better or worse than indicated in the table. If a grower is getting satisfactory results under his conditions, he should not necessarily change products as a result of the information in the table.

Table 6. Herbicides recommended for use in tobacco fields.

Herbicide	Weeds Controlled	Remarks and Limitations
Before Transplanting—Burndown Herbicides for Use in Conservation Tillage		
Gramoxone Inteon 2S 2.4 to 3.75 pt/A (paraquat 0.6 to 0.94 lb ai/A) or Gramoxone MAX 3S 1.6 to 2.5 pt/A (paraquat 0.6 to 0.94 lb ai/A) [24c Registration expires 12/31/2007] + Non-ionic Surfactant 2 pt/100 gal or Crop Oil Concentrate 1 gal/100 gal	Annual grasses and broadleaf type weeds that have emerged or for burndown of cover crops. Apply when weeds and cover crop are actively growing and between 1" to 6" in height. Vegetation 6" or taller may not be effectively controlled.	<i>A copy of the supplemental label should be in the hands of the applicator at time of application.</i> Apply as a broadcast treatment during the early spring but prior to transplanting tobacco. Use the higher rate on dense populations and/or on larger or harder to control weeds. Weeds and grasses emerging after application will not be controlled. A maximum of 2 applications may be made. Gramoxone may be tank-mixed with other registered tobacco herbicides for improved burndown. Do not graze treated areas or feed treated cover crops to livestock.
Before Transplanting—Soil-applied Herbicides		
Devrinol 50DF 2 lb/A or Devrinol 2EC 2 qt/A (napropamide 1 lb ai/A)	Crabgrass, fall panicum, foxtails.	Apply before transplanting and incorporate immediately, preferably in same operation. Follow incorporation directions on label. To avoid injury to crops not specified on the label, do not plant rotational crops until 12 months after the last DEVRINOL application.
Prowl 3.3EC 3 to 3.6 pt/A (pendimethalin 1.25 to 1.5 lb ai/A) or Prowl H₂O 3 pt/A (pendimethalin 1.4 lb ai/A)	Crabgrass, fall panicum, foxtails, lambsquarters, pigweeds.	Apply to prepared soil surface up to 60 days prior to transplanting. Incorporate within 7 days after application within the top 1 to 2 inches of soil. Consult incorporation directions on label. Emerged weeds will not be controlled. Tobacco plants growing under stress conditions (cold/wet or hot/dry weather) may be injured where PROWL is used. Wheat or barley may be planted 120 days after application, unless small grains will be planted in a no-tillage system.
Command 3ME 2 to 2.67 pt/A (clomazone 0.75 to 1 lb ai/A)	Crabgrass, fall panicum, foxtails, jimsonweed, lambsquarters, common ragweed, velvetleaf.	Apply COMMAND 3ME as a soil-applied treatment prior to transplanting or over-the-top of tobacco plants immediately, or up to 7 days after transplanting, but prior to emergence of weeds. Off-site movement of spray drift or vapors of COMMAND can cause foliar whitening or yellowing of nearby sensitive plants. Consult label for spray drift precautions and required setbacks when applied near sensitive crops and other plants. Tobacco plants growing under stressed conditions (cold/wet weather) may show temporary symptoms of whitening or yellowing. COMMAND may be tank mixed with other herbicides registered for use in tobacco to broaden the weed control spectrum or with other tobacco pesticides. Cover crops may be planted anytime, but foliar whitening, yellowing, and/or stand reductions may occur in some areas. Do not graze or harvest for food or feed cover crops planted less than 9 months after treatment. When COMMAND 3ME is applied alone, rotational crops which may be planted include soybeans, peppers, or pumpkins anytime; field corn, popcorn, sorghum, cucurbits, or tomatoes (transplanted) after 9 months; sweet corn, cabbage, or wheat after 12 months; and barley, alfalfa, or forage grasses after 16 months following application. See label for rotation guidelines for other crops and when tank mixed with other herbicides.
Spartan 4F 8 to 12 fl.oz/A (sulfentrazone 0.25 to 0.375 lb ai/A)	Black nightshade, jimsonweed, lambsquarters, morningglories, pigweeds, smartweed, yellow nutsedge.	Use the higher rate of SPARTAN when weed pressure is heavy with morningglory or yellow nutsedge. Apply from 14 days before up to 12 hours prior to transplanting tobacco as a soil surface treatment or preplant incorporated (less than 2 inches deep). Perform all cultural practices for land preparation, fertilizer/fungicide incorporation, etc. prior to application of SPARTAN. If the soil must be worked after application, but prior to transplanting, do not disturb the soil to a depth greater than 2 inches. Temporary stunting or yellowing of tobacco and localized leaf burns may be observed under some conditions with this treatment. Unacceptable crop injury can occur if applied post-transplant. <i>Spartan may be impregnated on dry bulk fertilizers (consult label). Proper mixing and uniform spreading of the impregnated fertilizer mixture on the soil surface is required for good weed control and to avoid crop injury.</i> Rotational crops which may be planted include soybeans or sunflowers anytime; wheat, barley, or rye after 4 months; field corn after 10 months; alfalfa and oats after 12 months; and popcorn, sweet corn, and sorghum (for rates above 8 oz/A) after 18 months. See label for rotation guidelines with other crops.
After Transplanting—Postemergence Herbicides		
Poast 1.5E 1.5 pt/A (sethoxydim 0.28 lb ai/A) + Oil Concentrate 2 pt/A	Crabgrass, fall panicum, foxtails, johnsongrass, shattercane.	<i>A copy of the supplemental label should be in the hands of the applicator at time of application.</i> POAST herbicide provides selective postemergence control of annual and perennial grasses. Apply any time from transplanting up to 7 weeks after transplanting tobacco, but avoid applications within 42 days of harvest. For adequate control ensure good spray coverage using a spray volume from 5 to 20 GPA (gallons per acre). Do not cultivate within 5 days before of 7 days after applying POAST. For rhizome johnsongrass more than one application may be needed. Make the first application of POAST (1.5 pt/A) when johnsongrass plants are 20 to 25 inches; followed by a second application of POAST (1 pt/A) when regrowth is 12 inches. A maximum of 4 pt/A of POAST can be applied per season to tobacco. As a spot treatment, prepare a 1% to 1.5% solution (1.3 oz/gal to 2 oz/gal) of POAST plus a 1% solution of Oil Concentrate (1.3 oz/A) and apply to the grass foliage on a spray-to-wet basis. Do not apply more than 4 pt/A per season to tobacco, including POAST applied to seedbeds.

Insect Control

A variety of insect pests can attack tobacco from transplant until harvest. Most reduce yield directly by feeding on plant leaves. However, sap-feeding by aphids causes more subtle injury by reducing plant vigor and growth. They also may

introduce and spread plant viruses in the crop. Tobacco insect pests are potential pests at relatively predictable times during the growing season. Field checks and use of treatment guidelines allow early detection and assessment of problems so that sound pest management decisions can be made.

Transplant

Tray Drench Applications

Acephate 75 SP or **Orthene 75 SP** can be used at the rate of 1 lb per acre in the transplant water to provide 3 to 4 weeks of control of flea beetles, cutworms and thrips. **Orthene 97** is used at the rate of 3/4 lb per acre. Using more than the label rate may result in plant damage. Orthene 97 has a 2ee label for a transplant water tank mix with Admire. See the label for more information.

Admire Pro 4F, **Belay**, and **Platinum** are systemic insecticides that are labeled for application as a drench to float trays or flats prior to transplant. Most rates are expressed as fluid ounces per 1,000 plants. Agitate or mix the insecticide frequently to keep it from settling in the tank. The plants should be watered from above after application to wash the insecticide from the foliage into the potting soil-less media. Failure to wash the insecticide from the foliage may result in reduced control. Adverse growing conditions may cause a delay in the uptake of the product into the plants and delay control.

Insecticide	Rate	Comment
Admire 2F	1 fl oz/1,000 plants	Aphids, flea beetles, wireworms (high rate)
	1.4 to 2.8 fl oz/1,000 plants	
Admire Pro 4F	0.5 fl oz/1,000 plants	
	0.6 to 1.2 fl oz	
Orthene 97	3/4 lb/A	Flea beetles, cutworms
Acephate 75 SP	1 lb/A	
Orthene 75S		
Belay 16 WSG	5 oz/A	Flea beetles
	10 oz/A	Aphids
Platinum 2 SC	0.8 to 1.3 fl oz/1,000 plants	Aphids, flea beetles
	1.3 fl oz/1,000 plants	Wireworms

Transplant—Water Applications

For application equipment which has minimal agitation, such as tobacco transplanters, give proper attention to mixing. Keep the water suspension agitated or mix regularly to avoid settling in the transplant tank. Adverse growing conditions may cause a delay in the uptake of Admire into the plants and a delay in control.

Premix **Orthene 97** in water to form a slurry before putting it into the transplant water tank. If premixing is not done, allow time for the product to dissolve. Use of more than the label rate may result in some plant damage. Orthene 97 has a 2ee label for a transplant water tank mix with Admire. See the label for more information.

Insecticide	Rate	Comment
Admire 2F	1.4 fl oz/1,000 plants	Aphids, flea beetles, wireworms (high rate)
	1.4 to 2.8 fl oz/1,000 plants	
Admire Pro (42.8%)	0.6 to 1.2 fl oz/1,000 plants	
Orthene 97	3/4 lb/A	Flea beetles, cutworms
Acephate 75 SP	1 lb/A	
Orthene 75S		
Belay 16 WSG	5 oz/A	Flea beetles, aphids
	10 oz/A	
Platinum 2 SC	0.8 to 1.3 fl oz/1,000 plants	Aphids, flea beetles
	1.3 fl oz/1,000 plants	

Foliar Treatments for Tobacco Fields

The numbers of tobacco pests or infested plants in a field determines whether a control measure is justified. The actual numbers can vary due to a variety of factors, such as weather, natural enemies, and transplant date. Early set fields are prone to attack by flea beetles and tobacco budworms, while late-set fields are at greater risk to tobacco aphids.

Careful field monitoring is necessary to determine whether or not an insecticide application will provide an economic return through yield or quality protection.

The treatment guidelines listed in Table 7 allow proper timing of insecticide applications. Weekly field scouting is necessary to collect the information needed to use them. Check at least 100 plants per field—10 groups of ten or 5 groups of 20 up to 5 acres. Add two locations for each additional 5 acres of field size. Pick your locations randomly. Examine the plants carefully for damage or live insects. Record your counts, calculate the average, and compare them to the table values. Keep these counts so that you can look for trends in insect numbers during the season.

Table 7. Insect management calendar—treatment guidelines for key tobacco insect pests.

Insect	Treatment Guidelines
1-4 weeks after transplant	
Cutworms	Five or more freshly cut plants per 100 plants checked.
Flea Beetles	Three or more beetles per plant on new transplants, 10 or more beetles on 2-4 week old plants, 60 or more beetles on plants more than four weeks old.
3-8 weeks after transplant	
Aphids	Colonies of 50 or more aphids on at least one upper leaf of 20% of the plants from three weeks after transplant until topping.
Budworms	Five or more budworms per 50 plants from three weeks after transplant until one week before topping.
3 weeks before, and through topping	
Hornworms	Five or more hornworms (1" or longer) per 50 plants from three weeks after transplant until harvest. Do not count hornworms with white cocoons on their backs.

Tobacco Aphids

The tobacco aphid begins to show up as winged adults descend into fields and to deposit live young on scattered plants across fields. Their offspring will mature in 7 to 10 days and begin to give birth to 60 to 70 live young. Aphid numbers increase gradually at first but by 6 to 8 weeks after transplant they are increasing rapidly; populations of aphids are usually highest in mid-to-late-June. Fields not receiving a preventive treatment at transplant should be checked weekly by examining the bud area of 10 consecutive plants in at least 5 locations for colonies (clusters) of aphids on the undersides of leaves, especially in shaded areas of the field. *An insecticide application is recommended if aphid colonies are found on 20% or more of the plants that are examined.* Thorough coverage with sprays directed to the underside of leaves at the top of the plant will provide best control.

Table 8. Tobacco Aphids

Insecticides	Rate/A	Harvest Interval (days)
Acephate 75 SP Orthene 75 SP	2/3 lb to 1 lb	3
Orthene 97	3/4 lb	
Actara 25% WDG	2 to 3 oz	14
Assail 30 G	1.5 to 4.0 oz	7
Assail 70 WP	0.6 to 1.7 oz	
Fulfill 50 WDG	2.75 oz	14
Endosulfan 3E	2/3 to 1-1/3 qt	5*
Lannate 90 SP ¹	½ lb	14
Provado 1.6 F	2 to 4 fl oz	14

* Application of products containing endosulfan within 28 days of harvest can lead to increased residue on the crop. Do not spray in the heat of the day.

¹ Restricted use pesticide.

Budworms

Budworms feed in the buds of young tobacco plants causing rounded holes in developing leaves. Tobacco plants may be topped by these pests resulting in early sucker growth. Infestations tend to be greatest in the earliest-set fields in an area. Moths lay single eggs so infestations are scattered randomly over a field. Examine the bud area carefully for the black ground pepper-like droppings, small holes, or the caterpillars. Damage will increase as the caterpillars feed and grow. If the bud is destroyed, the plant will be forced to develop new terminal growth. Direct leaf damage and stunting can reduce yields significantly. Examine the buds for feeding damage and the small green to black worms. *Treat if there are 5 or more live budworms (less than 1-1/4 inches long) per 50 plants, and topping is at least one week away.* Do not count the plant as infested if you cannot find a budworm. *Bacillus thuringiensis*

Table 9. Budworms

Insecticides	Rate/A	Harvest Interval (Days)
Acephate 75 SP Orthene 75 SP	1 lb	3
Orthene 97	3/4 lb	
Agree WG (3.8% Bt aizawai)	1 to 2 lb	0
Biobit HP (6.4% Bt kurstaki)	½ to 1 lb	0
Biobit F (6.4% Bt kurstaki)	1 to 4 pt	
Denim 0.16 EC ¹	8 to 12 fl oz	14
Dipel 10 G	5 to 10 lb	0
Dipel DF	1/2 to 1 lb	0
Dipel ES	1 to 2 pt	
Endosulfan 3E	2/3 to 1-1/3 qt	5*
Lannate SP ¹	½ lb	14
Lepinox WDG	1 to 2 lb	0
Sevin 80S	1-1/4 lb	0
Tracer 4SC*	1.4 to 2.9 fl oz*	3
Warrior 1 CS ¹	1.9 to 3.8 fl oz	40
XenTari DF	½ to 2 lb	0

* Application of products containing endosulfan within 28 days of harvest can lead to increased residue on the crop. Do not spray in the heat of the day.

¹ Restricted use pesticide.

baits have given excellent control of this insect in flue-cured areas but there are no efficient ways to apply baits to large acreages. Bt sprays are most effective if applied when larvae are small and feeding actively. Use the highest labeled rates for heavy populations.

Hornworms

Hornworms eat large amounts of tobacco foliage. They first appear in June and are active throughout the remainder of the growing season. Weekly field checks will allow detection of infestations that would benefit from treatment. Examine the upper third of the plant for holes or hornworms hanging from the underside of leaves. Examine the entire plant for signs of damage and live worms. *Treat if there are 5 or more hornworms (1" or longer) per 50 plants, and topping is at least one week away.* Treatments applied before most worms exceed 1-1/2 inches in length will greatly reduce yield loss.

Table 10. Hornworms

Insecticides	Rate/A	Harvest Interval (Days)
Acephate 75 SP Orthene 75 SP	2/3 lb	3
Orthene 97	½ lb	
Agree WG (3.8% Bt aizawai)	1 to 2 lb	0
Biobit HP (6.4% Bt kurstaki)	½ to 1 lb	0
Biobit F (6.4% Bt kurstaki)	1 to 4 pt	
Denim 0.16 EC ¹	8 to 12 fl oz	14
Dipel 10 G	5 to 10 lb	0
Dipel DF	1/2 to 1 lb	0
Dipel ES	½ to 1 pt	
Endosulfan 3E	2/3 to 1-1/3 qt	5*
Javelin WG	1/8 to 1-1/4 lb	0
Lannate SP ¹	½ lb	14
Lepinox WDG	1 to 2 lb	0
Sevin 80S	1-1/4 lb	0
Tracer 4SC*	1.4 to 2.9 fl oz*	3
Warrior 1 CS ¹	1.9 to 3.8 fl oz	40
XenTari DF	½ to 2 lb	0

* Application of products containing endosulfan within 28 days of harvest can lead to increased residue on the crop. Do not spray in the heat of the day.

¹ Restricted use pesticide.

Hornworms with white egg-like cocoons on their back are parasitized by a small wasp. These worms will not contribute to yield loss. By late August or early September as much as 90% of the hornworm population may be parasitized.

Check fields for hornworms about one week before harvest. Hornworms pose the greatest threat at the end of the growing season. They are voracious eaters and can continue to feed on harvested tobacco after it is taken to the curing structure. Apply a short residue insecticide if necessary to prevent taking significant numbers of this pest to the barn. There are no treatments to control hornworms effectively on housed tobacco.

Flea Beetles

Tobacco flea beetles are present in every field each season. Damage tends to be most severe in fields that are set first, especially following a mild winter when beetle survival is greatest. Flea beetles move frequently, chewing small round holes (shot holes) in the leaves. Extensive damage can occur when beetles feed in the bud of the plant. This injury can add to transplant stress and slow plant establishment. Flea beetles can be controlled with systemic insecticides applied in the transplant water or by a foliar spray if a preventive treatment was not used. *An average of 3 or more beetles per plant is enough to cause significant damage. Treat*

if there are 3 or more beetles per plant during the first 2 weeks after transplant. Established plants rarely need protection from this insect.

Occasional Pests

Some feeding by incidental pests, such as Japanese beetles and stink bugs, may be seen but usually are not severe enough to cause economic damage.

Cutworms may be present in tobacco fields because of early season weed growth. Often these insects are relatively large by the time tobacco is set in the field. Cutworms feed at the base of transplants and can cut them off at ground level. Moths are active in March and April, laying their eggs on low, spreading weeds. Damage potential is highest in late-set fields where there has been a flush of winter annual weeds. Cutworms will begin to feed on the weeds and switch to transplants when the weed growth is removed.

A foliar spray should be applied if 5 or more cut plants are found per 100 plants checked. Orthene 97 at 3/4 lb (Orthene 75S at 1 lb) or Warrior 1 CS (a restricted use pesticide) at 1.92 to 3.84 fl oz per acre can be used as a broadcast spray. Proxol 80S, applied in a 12" band over the row can be used as a rescue treatment. Rescue treatments are generally less effective when damage is confined to the underground portion of the plant.

Grasshoppers usually remain in hay-fields and along waterways but under dry conditions they may move from these into tobacco. Treatment of field borders to prevent mass migration into the field should be considered. When selecting an insecticide for this use consider the possibility of residues and time from application to cutting or grazing of hay. *Treat when grasshoppers are active along field margins, or if 10 or more grasshoppers are found per 50 plants.*

Japanese beetles and **green June beetles** can be found on tobacco. Japanese beetles occasionally feed on the plants but green June beetles do not. The damage usually appears worse than it actually is. Sevin 80 S may be used for control at 1-1/4 to 2-1/2 lb/A if Japanese beetles are causing significant damage. Actara 25% WDG, Orthene 97 and Warrior 1 CS (a restricted use pesticide) are labeled for Japanese beetle control. Provado 1.6 F can be used at the rate of 4 fl oz per acre.

Stink bugs can feed on tobacco and cause the wilting or collapse of individual leaves which can become scalded. Generally the symptoms do not show until a day or two after feeding. The damage usually appears worse than it actually is. Acephate 75 SP, Orthene 75S and Orthene 97, several products containing endosulfan (Phaser and Thiodan) and Warrior 1 CS (a restricted use pesticide) are labeled for stink bug control. Treatment is not justified unless stink bugs are found in the field.

Table 11. Flea Beetles

Insecticides	Rate/A		Harvest Interval (days)
	Small plants	Large plants	
Acephate 75 SP	2/3 lb	1 lb	3
Orthene 75 SP			
Orthene 97	1/2 lb	1/2 lb	
Actara 25% WDG	2 to 3 oz	2 to 3 oz	14
Endosulfan 3E	2/3 qt	1-1/3 qt	5*
Lannate 90 SP ¹	1/2 lb	1/2 lb	14
Provado 1.6 F	4 fl oz	4 fl oz	14
Sevin 80S	1-1/4 lb	2-1/2 lb	0
Carbaryl 4L	1 qt	2 qt	
Warrior 1 CS ¹	1.92 to 3.84 fl oz	1.92 to 3.84 fl oz	40

* Application of products containing endosulfan within 28 days of harvest can lead to increased residue on the crop. Do not spray in the heat of the day.

¹ Restricted use pesticide.

Table 12. Grasshoppers

Insecticides	Rate/A		Harvest Interval (days)
	Small plants	Large plants	
Acephate 75 SP	1/3 lb	2/3 lb	3
Orthene 75 SP			
Orthene 97	1/4 lb	1/2 lb	
Endosulfan 3E	2/3 qt	1-1/3 qt	5*
Lannate 90 SP ¹	1/2 lb	1/2 lb	14
Warrior 1 CS ¹	1.92 to 3.84 fl oz	1.92 to 3.84 fl oz	40

* Application of products containing endosulfan within 28 days of harvest can lead to increased residue on the crop. Do not spray in the heat of the day.

¹ Restricted use pesticide.

Appendix 1: Information Summary Table for Tobacco Insecticides

This table is provided for a quick comparison of insecticides labeled on tobacco. Insecticides are listed alphabetically by pesticide common name (usually present in the active ingredients section of the product label). One or more brand names are included along with the Restricted Entry Interval (REI) and Mode of Action Group number.

Use pesticide products only in accordance with their labels and with the Worker Protection Standard. Do not enter or allow worker entry into treated areas during the restricted entry interval. Check the label for Personal Protective Equipment required for early entry to treated areas that is permitted under the Worker Protection Standard and involves contact with anything that has been treated, such as plants, soil, or water.

Mode of Action Group

A numerical classification system has been developed to make it easy to recognize the modes of action of insecticide products. Insecticides with the same mode of action belong to groups with unique numbers. Selection of a labeled product from a different number category (different mode of action) will help to slow down the development of resistance to either group. For example, alternate use of pyrethroid insecticides and pyrethrins sprays (Category 3) with labeled organophosphate insecticides (Category 1B). Always avoid tank mixing products with the same mode of action. These Mode of Action Group codes are on many pesticide labels and have been developed by the Insecticide Resistance Action Committee (IRAC).

Common Name	Brand Name	Restricted Entry Interval (hours) ¹	Mode of Action Group
Acephate	Acephate Bracket Orthene	24	1B
Acetamiprid	Assail 30 G Assail 70 WP	12	4A
Bt aizawai	Agree WG Xentari DF	4	11B1
Bt kurstaki	Dipel DF Javelin WG Lepinox WDG, etc.	4	11B2
Carbaryl	Sevin XLR Plus	12	1A
Carbofuran	Furadan 4F ⁴	48 ³	1A
Chlorpyrifos	Lorsban 15 G Govern Nufos Warhawk Whirlwind Yuma	24 ²	1B
Clothianidin	Belay 16 WSG	12	4A
lambda-Cyhalothrin	Warrior ⁴ Silencer ⁴ Taiga ⁴	24	3
Disulfoton	Di-Syston 15 G ⁴	48 ²	1B
Emamectin benzoate	Denim EC ⁴	48	6
Endosulfan	Endosulfan EC	24	2A
Ethoprop	Mocap 15G ⁴	48 ²	1B
Imidacloprid	Admire 2F Admire Pro Alias Couraze Pasada 1.6F Provado 1.6F	12 ²	4A
Methomyl	Lannate ⁴	48	1A
Pymetrozine	Fullfil	12	9B
Spinosad	Tracer	4	5
Thiamethoxam	Actara Platinum	12	4A

¹ For use in storage bins no reentry is allowed. See label for details.

² If the product is soil-injected or soil incorporated, the Worker Protection Standard, under certain circumstances, allows workers to enter the treated area if there will be no contact with anything that has been treated.

³ Exceptions apply for corn, sunflowers, and sorghum. See label for details.

⁴ Restricted use pesticide.

Appendix 2. WPS Checklist

Prepared by Lee Townsend, Extension Entomologist

This information was prepared to help farmers comply with WPS. It does not cover all details of the requirements. Sources and costs of signs and equipment are given as educational examples, only. Prices vary with source and quantities purchased. See the WPS section of the label for product-specific instructions.

Notification—Signs for Posting Information at Central Location

- WPS Safety Poster
Gempler P928
\$ 3.85
- Nearest Medical Facility Sign (or make your own)
Gempler X1584
\$ 8.60
- Reusable Pesticide Application Poster (or make your own)
Gempler P942
\$ 7.35
Post before application is made, keep posted until 30 days after REI expires.

Field Location and Description	Product Name and EPA Registration Number	Active Ingredient(s) in Product	Time and Date of Application	Restricted Entry Interval

- Corrugated WPS Sign
Gempler 2256
\$ 2.75

All greenhouse applications require posting. Some labels require field posting. Posting must be done before application and remain until 3 days after REI expires. Signs must be visible from all entrances into treated areas.

- Oral notification—Inform workers of treated areas before application or before they begin work, tell them not to enter treated areas during the REI. Some pesticide labels require both oral warnings and posting of treated areas.
- Pesticide handlers must understand all labeling information for the pesticides they are using and must have access to labeling.

Decontamination—must be within ¼ mile of workers/handlers. Maintained for 7 to 30 days after REI applies (see label)

Workers—Water to wash hands, soap, single use towels. Must not be in area being treated or under REI.

Handlers—Water to wash entire body, soap, single use towels, clean towels. Also must be where personal protective equipment is removed and in mix/load area. Supplies must be enclosed.

Personal Protective Equipment (PPE)

Employer must provide and maintain clean PPE required by label and pesticide-free area to store and put on and take off equipment. Dispose of heavily contaminated PPE as hazardous waste. Check the label for specific PPE needed for mixing, loading, and application.

- Chemical resistant gloves (15 mil unlined nitrile)
Gempler 10212 (36 pair)
\$79.95
- Unhooded DuPont Tyvek Coverall
Gempler TC
\$ 5.70 each
- Low-cost Anti-Fog Chemical Splash Goggles
Gempler 10507
\$ 3.95
- Moldex Pesticide Respirator
Gempler G80002
\$ 25.20
Replacement cartridges
Gempler G8100PR
\$ 11.15/pair

Emergency Assistance—act promptly if any worker/handler may be poisoned.

- Provide transportation to medical facility
- Supply medical personnel with product name, EPA registration number, and active ingredient(s). Describe pesticide use and give details about exposure.

Training—valid for 5 years if records or EPA card is available. Certified pesticide applicators do not need WPS training and can perform WPS training. Training aids are available from CES office.

- Workers need basic training before they begin and complete training within 5 days. A worker is anyone who does tasks such as harvesting, weeding, or watering.
- Handlers mix, load, transfer or apply pesticides. They also may do many other specific tasks, such as incorporating soil-applied pesticides, clean PPE and dispose of pesticide containers.
- WPS Training Receipt
Gempler G95003 (worker)
Gempler G95004 (handler)
\$ 7.85/50