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Whitefly Management in Arizona Cotton 2006

SUMMARY

Effective control of whiteflies is absolutely essential to produce high quality cotton. Good stewardship of insecticide efficacy is necessary to sustain whitefly management. Use all available cultural means to avoid whitefly population buildup in individual fields and in communities. A three-stage approach to chemical control is recommended. The basic strategy is to initiate chemical control with highly selective Stage I chemistry in order to reduce the need for broad-spectrum chemistry. Postpone the use of pyrethroid insecticides until they may be needed at the end of the season. Limit the use of insecticide modes of action to no more than two, non-consecutive uses per season. Arizona's substantial gains in lowering insecticide inputs in cotton over the last decade have been due in large part to a shift to selective pest management that conserves natural enemies.

Following these guidelines, especially on a community basis, should result in better management locally and areawide. Effective integrated management depends on implementing pest avoidance practices, in-field sampling, and deployment of effective control technologies.

Our Goal: Manage whiteflies both locally and area-wide in Arizona to permit the production of high quality cotton and protect the economic interests of growers statewide.

Crop Management

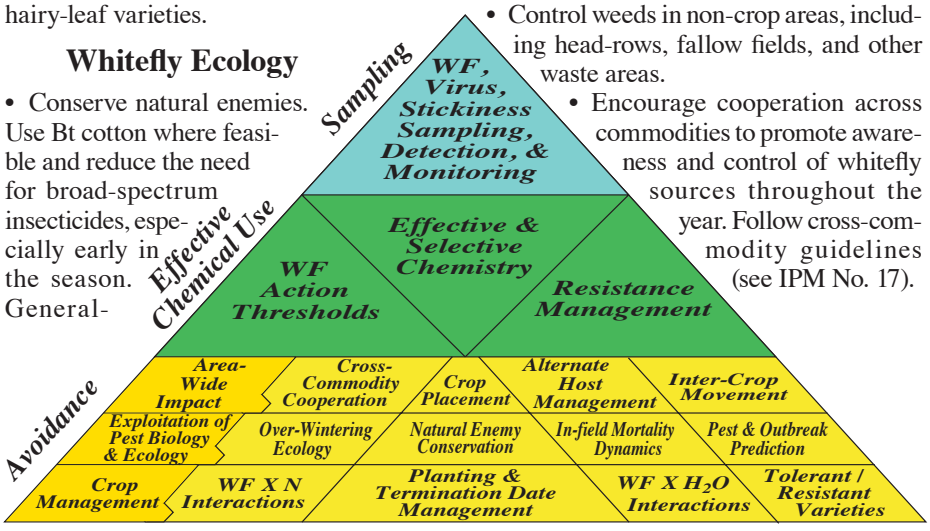
- Plant and terminate the crop as early as economically feasible. Encourage uniform planting and termination practices within your community. Late-planted and longer-season fields are at greater risk for whitefly problems.
- Minimize moisture stress to reduce whitefly problems and the need for chemical controls.
- Meet the plant's nutritional needs, especially for nitrogen (N), to minimize plant stress. Excesses or deficits of plant-available N can create conditions favorable to whiteflies.
- Select well-adapted varieties. Smooth-leaf varieties are generally less attractive and less suitable for whitefly growth than hairy-leaf varieties.

Whitefly Ecology

- Conserve natural enemies. Use Bt cotton where feasible and reduce the need for broad-spectrum insecticides, especially early in the season. Generalist predators are key sources of natural mortality of whiteflies in cotton. Predation, along with physical removal of whiteflies by dust, wind or rain, help extend the utility of selective insecticides (i.e., bioresidual).
- Recognize conditions that can contribute to whitefly outbreaks, such as better than usual weather for over-wintering success and spring development of whiteflies on weeds and other desert hosts. Whiteflies breed year-round on multiple hosts.

Areawide Impact

- Spatially and temporally arrange crops in your community to break the cycle of whitefly movement among fields. Minimize the direct contact between whitefly-source and whitefly-attracting crops. For example, cotton planted next to spring melons will receive whiteflies from the senescing melons.
- Efficiently manage whiteflies in all host crops. Control whiteflies in spring sources such as melons. Terminate spring vegetable and melon crops as soon as economically possible. Maintain as short a cutting interval as possible for alfalfa.
- Promptly harvest all host crops and destroy crop residues. Prevent regrowth after disking, especially in post-harvest melons, and after defoliation in cotton.
- Control weeds in non-crop areas, including head-rows, fallow fields, and other waste areas.
- Encourage cooperation across commodities to promote awareness and control of whitefly sources throughout the year. Follow cross-commodity guidelines (see IPM No. 17).



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ARIZONA COOPERATIVE EXTENSION

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This and other documents of interest relating to crop production / protection are available on the Arizona Crop Information Site at *http://cals.arizona.edu/crops*

Sampling

• Routinely check for whiteflies using adult (see IPM No. 2) and large nymph scouting methods (see IPM No. 6), especially leading up to the first spray. Start counting as soon as adults are noted in sweepnet samples.

• Use the binomial methods of counting leaf for adult and leaf disk for 3rd & 4th instar nymph infestations (see conversion tables). These techniques are the fastest and easiest methods for assessing whitefly levels.

• Concentrate early detection efforts on fields, varieties or locations where there is a history or likelihood of whitefly problems.

• Consider crop growth stage, boll load, presence of natural enemies (especially predators) and other factors that affect rate of growth of both whiteflies and the plant.

• Examine nymphs closely, preferably with 8x magnification to determine if they are dead due to predators (i.e., shrunken, deflated, or ghost-like in appearance), parasites [i.e., golden, black, or possessing asymmetrical or displaced mycetomes (paired yellow spots)] or insecticides (i.e., discolored or distorted in body-shape). Do not include dead nymphs in your counts.

Adult Count Conversion Table

	Number of leaves infested with 3 or more adults	% Infested Leaves	Average per Leaf
Wait; re-sample	1	3.4	0.3
	2	6.7	0.6
	3	10	0.8
	4	13	1.0
	5	17	1.3
	6	20	1.5
	7	23	1.8
See Matrix	8	27	2.1
	9	30	2.3
	10	33	2.6
	11	37	2.9
Use Stage I	12	40	3.2
	13	43	3.6
	14	47	3.9
	15	50	4.3
	16	53	4.7
	17	57	5.1
"Gray" area	18	60	5.5
	19	63	6.0
	20	67	6.5
	21	70	7.1
	22	73	7.7
Use Adulticide	23	77	8.4
	24	80	9.2
	25	83	10.2
	26	87	11.3
	27	90	12.8
	28	93	14.9
	29	97	18.4
	30	100	34.9

Yield Loss Possible

Large Nymph Count Conversion Table

Number of disks infested with live large nymphs	% Infested Disks	Average per Disk
4	13	0.2
8	26	0.5
12	40	1.0
16	52	1.5
18	60	2.0
20	67	2.5
22	72	3.0
23	76	3.5
24	80	4.0
25	83	4.5
26	85	5.0

Yield Loss Possible

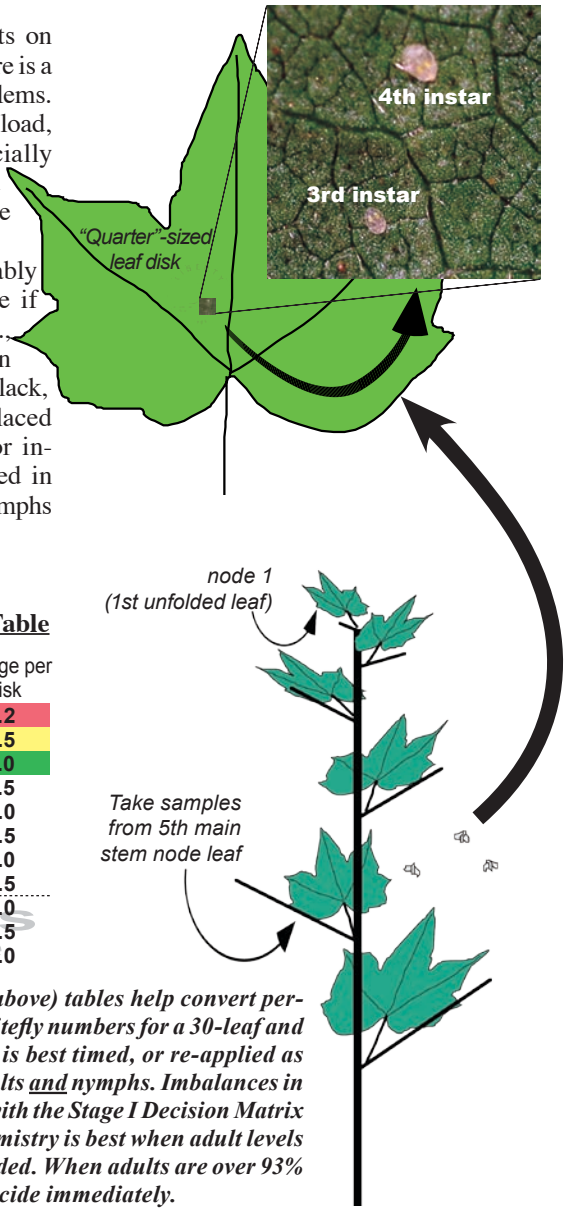

Figure 1. Adult (left) & large nymph (above) tables help convert percentages of infestation into average whitefly numbers for a 30-leaf and 30 leaf disk sample. Stage I chemistry is best timed, or re-applied as needed, in the 'green' zone for both adults and nymphs. Imbalances in these whitefly levels may be addressed with the Stage I Decision Matrix (on p. 4). Otherwise, Stage II & III chemistry is best when adult levels are high (> 75%) & adult control is needed. When adults are over 93% infestation, use a Stage II or III adulticide immediately.

Timing

The goal in whitefly management is to initiate control measures just prior to the period of most rapid pest population development. Local conditions may require modification of this general approach. **Routine sampling is required to identify the rate of population increase.** A well-timed initial application against whiteflies will pay significant economic dividends in reducing overall insecticide inputs.

Stage I Timing

If adult populations are moderate and whiteflies are reproducing, use a Stage I compound as the first treatment. Stage I compounds maximize conservation of beneficial insects that can provide significant extension of control (i.e., bioresidual).

• **Select and apply a Stage I compound when at least 40% of the 5th mainstem leaves from the uppermost unfolded leaves are infested with 3 or more adult whiteflies *and* about 40% of quarter-sized leaf disks are infested with 1 or more live, large nymphs.** (See tables for equivalents in average whitefly numbers.) If only adults or nymphs exceed critical levels, consult the Decision Matrix on page 4. A 30-leaf and 30 leaf disk sample is recommended for each management unit (see IPM No. 2 & 6 for more information).

• Do NOT use a Stage I compound first under conditions of high adult pressure, e.g., adjacent to a source of migrating whiteflies. If 75% or more of the leaves have 3 or more adults, but large nymphs are not yet found on 40% of the leaf disks, choose an effective adulticide from selective options in Stage II. **Populations should be re-evaluated for following-up with a Stage I compound, as needed.**

• Use an effective adulticide, whenever adult levels exceed 93% infested leaves with 3 or more adults. Yield loss may be imminent if populations are allowed to increase beyond this point.

• Use alternatives to Stage I compounds when there is less than 21–30 days before green-leaf drop, because of the relatively slower action of the Stage I compounds.

Stage II & III Timing

• Use a Stage II compound as a follow-up to Stage I, if needed after waiting at least 14 days to allow the Stage I compound to work. Whether a Stage II compound is used first or as a follow-up, there should be at least 57% leaves infested with 3 or more adults present before spraying. Late in the season, a Stage III compound may also be used with this timing.

Three-Stage Management of Bemisia Whiteflies in Cotton

Stage & Timing of Use	Insecticides (MOA Group No.)	Rate	Safety to Beneficials	Control Interval[1]	Strategic Fit[2]
Stage I *Chemistry (Full Selectivity)* — **Timing:** *40% disks infested with ≥1 large nymph and 40% leaves infested with ≥3 adults*	*buprofezin,* Courier 40SC (Group 16)	12.5 oz	Excellent	14–30 days	• no more than 1 use per season; • 1st spray for long-term control and bioresidual; • safe on beneficials; • appropriate up to 30 days before green-leaf drop; • molting inhibitor, effective against nymphs.
	pyriproxyfen, Knack Insect Growth Regulator (Group 7C)	8–10 oz	Excellent	14–30 days	• no more than 1 use per season; • 1st spray for long-term control and bioresidual; • safe on beneficials; • appropriate up to 30 days before green-leaf drop; • juvenoid, effective against eggs and mature nymphs.
	spiromesifen, Oberon 2SC (Group 23)	8–10 oz	Excellent at these rates*	14–30 days	• no more than two, non-consecutive uses per season; • 1st spray for long-term control and bioresidual; • safe on beneficials at this rate range*; • appropriate up to 21 days before green-leaf drop; • lipid synthesis inhibitor, effective primarily against nymphs.
Stage II *Chemistry (Partial Selectivity)* — **Timing:** *57% leaves infested with ≥3 adults*	*spiromesifen,* Oberon 2SC (Group 23)	12–16 oz	Good at these rates	14–30 days	• no more than two, non-consecutive uses per season; • follow-up spray for long-term control; • good, but partial, safety for beneficials; • lipid synthesis inhibitor, effective primarily against nymphs.
	acetamiprid, Intruder WSP (Group 4A)	1.7–2.3 oz	Moderate	14–30 days	• no more than two, non-consecutive uses per season**; • follow-up spray for moderate to long-term control, or; before Stage I, late season or to control mass migrations; • partial safety for beneficials; • neonicotinoid, effective against all stages.
	dinotefuran, Venom 20SG (Group 4A)	10.7 oz	Moderate	7–14 days	• no more than two, non-consecutive uses per season**; • short-term control; partial safety for beneficials; • neonicotinoid, effective against all stages.
	thiamethoxam, Centric 40WG (Group 4A)	2 oz	Moderate	7–14 days	• no more than two, non-consecutive uses per season**; • short-term control; partial safety for beneficials; • neonicotinoid, effective against all stages.
	Other Non-Pyrethroids	various	Poor to Fair	5–10 days	• broad spectrum, short-term control only, late season; • primarily adulticidal; only limited control of other stages.
Stage III *Synergized Pyrethroids* *(see Stage II timing)*	*Pyrethroid combinations* (Group 3)	various	Poor	7–14 days	• no more than two pyrethroids per season; • broad spectrum, short-term control only, late season; • primarily adulticidal; only limited control of other stages.

[1]*Control interval dependent on rate, timing, immigration & pressure, and bioresidual.*

[2]*No active ingredient should be used more than twice, applied non-consecutively.*

**Provisional guidelines pending additional data on safety to beneficials.*

***No more than two neonicotinoids as a class per season; only one suggested in Cotton-Melon Communities; not recommended in Multi-Crop Communities; including any seed, soil or foliar uses (see Palumbo et al. 2003, IPM No. 17, for more details). Foliar imidacloprid sprays (e.g., Provado® or Leverage®) are not recommended for use in cotton, because of insufficient activity against whiteflies.*

MOA, Mode of action; Colors indicate different classes of chemistry.

Stage I Decision Matrix		*Adult Counts*	
		< 40% infested leaves	40–57% infested leaves
Large Nymph Counts	less than 40% infested disks	Wait. Re-sample in 3–7 days	Wait; Re-sample in 3 days; **or** use a selective Stage II adulticide; **or** apply Knack
	at least 40% infested disks	Wait; re-sample in 3 days; **or** apply Courier or Oberon	Use a Stage I material

Insecticides

Choice of material depends on several factors for managing risks of economic loss, of producing unmarketable lint due to honeydew, and of resistance to our most valuable chemistry. Adherence to all the non-chemical and chemical tactics described in this bulletin should expose growers to the lowest overall aggregate risk.

- Select proven, consistently performing, effective insecticides for long-lasting control. These include Courier®, Intruder™, Knack®, and Oberon®. Synergized pyrethroids deployed late in the season and other insecticides (e.g., Centric® & Venom™) can also help with shorter-term and adult control.
- Maximize free pest control by predators through selection of products with greater selectivity and safety for beneficial insects. This approach is most effective when these products are deployed as the first sprays against whiteflies, delaying the need for broad-spectrum approaches until later in the season.
- Do not mix broad-spectrum insecticides with selective insecticides for whitefly control unless a mixture is required to address a complex of pest problems simultaneously.
- Use the lowest recommended, effective rate for each compound that achieves the level of control required. Using rates lower than recommended or than is on the label is likely to lead to unsatisfactory control, and necessitate additional sprays and costs. **These additional sprays may lead to more rapid development of insecticide resistance within a population.**

Resistance Management

Resistance to insecticides can reduce the performance of key chemistries in the field and causes economic losses. Effective strategies for delaying resistance include limiting the number of sprays, diversifying the classes of chemistry and modes of action used, and partitioning or sharing chemistries across commodities. Users should consult IPM No. 17 (Palumbo et al. 2003) for guidance concerning the neonicotinoid insecticides. The integrated resistance management (IRM) plan is intended to provide season-long control and conserve valuable active ingredients for the long term.

This 2006 plan capitalizes on gains made in pest management over the last 10 years. By emphasizing selective strategies, growers maximize the free pest control that is available to them; thus saving money in control costs, and reducing risks of resistance and of costly secondary pest outbreaks. **The basic strategy is to initiate whitefly chemical control with fully selective compounds (Stage I Chemistry), to reduce the need for broad-spectrum chemistry for all pests, to postpone the use of all pyrethroids until the end of the control period, to limit the pyrethroid and neonicotinoid classes to just two uses each (see below), and to use no other active ingredient more than twice per season.** All non-chemical means should be used to help limit the need for chemical controls, and careful sampling for both nymphs and adults should be routinely conducted in order to best time control measures.

Three stages of chemistry are proposed according to their efficacy and their level of selectivity or safety on beneficials.

Stage I Chemistry, Full Selectivity

- Use Stage I compounds when whiteflies exceed thresholds, but not if adult levels are excessive (see 'Timing'). Stage I chemistry is most effective when used during the period of initiation of rapid whitefly increase and while early season beneficials are still abundant enough to augment pest control.
- **Use no more than one each of the insect growth regulators** (IGR, i.e., Courier or Knack); **apply these compounds to full fields only**, as they have no adulticidal activity and perform better on larger areas.
- If Oberon is selected as a Stage I compound, use the more selective Stage I rates (8–10 oz./A). Higher rates are less selective and may be used as part of Stage II. Use no more than two, non-consecutive applications of this compound season-long. Oberon may also provide efficacy on mites where they also are of concern.

Stage II Chemistry, Partial Selectivity

- Use Stage II compounds when whiteflies exceed thresholds. This will generally occur after at least one use from Stage I and before any use of Stage III chemistry.
- **Rotate among classes of insecticides and modes of action.**
- Do not use mixtures of more than two compounds, and then only if dictated by the pest spectrum present.
- **Use no active ingredient more than twice per season.**
- **Use neonicotinoid insecticides no more than twice per season.** Consult IPM No. 17 for further details. In areas where cotton and melons are within a two mile radius, do not use more than 1 neonicotinoid application in cotton; in areas where cotton, melons and vegetables are all within a two mile radius, do not use the neonicotinoid class in cotton. These suggested limitations pertain to all applications of neonicotinoids whether they are seed, soil or foliar uses.

Stage III, Synergized Pyrethroids

- **Delay pyrethroid use until the end of the control season.**
- Plan to use the pyrethroid class only if needed and no more than twice per season.
- Rotate the classes of the compounds tank-mixed with the pyrethroid and rotate among pyrethroids (e.g., Danitol® + Orthene® & Capture® + endosulfan).
- Earlier use of pyrethroids and other broad-spectrum insecticides (e.g., many organophosphates, carbamates, and cyclodienes) could eliminate important natural enemies useful in the control of whiteflies and many other pests.

Reference

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