Cross-commodity Guidelines for Neonicotinoid Insecticides in Arizona

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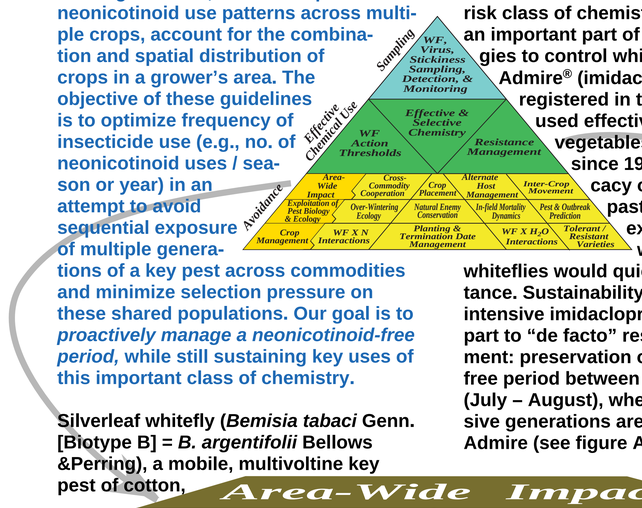
Situation

Voluntary limitations on cross-commodity use of neonicotinoids were developed with and proposed for the user community (table, lower right). The resulting common-sense guidelines, based on specific neonicotinoid use patterns across multiple crops, account for the combination and spatial distribution of crops in a grower's area. The objective of these guidelines is to optimize frequency of insecticide use (e.g., no. of neonicotinoid uses / season or year) in an attempt to avoid sequential exposure of multiple generations of a key pest across commodities and minimize selection pressure on these shared populations. Our goal is to *proactively manage a neonicotinoid-free period,* while still sustaining key uses of this important class of chemistry.



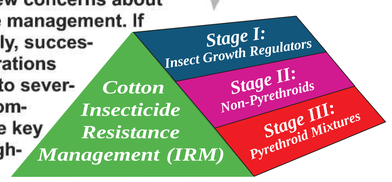
Silverleaf whitefly (*Bemisia tabaci* Genn. [Biotype B] = *B. argentifolii* Bellows &Perring), a mobile, multivoltine key pest of cotton,

melons and vegetable crops, depends on an annual cropping cycle that allows populations to move sequentially among host plants and increase over generations.

Arizona growers presently enjoy a sustained recovery from the devastating whitefly outbreaks of the early 1990's. Our success was achieved through development, adoption and implementation of an IPM strategy that includes avoidance tactics, effective chemical use and a comprehensive sampling program. This area-wide approach involves continuous stakeholder input. Because this whitefly is a shared pest among crops, growers and pest managers have shared concerns about, and responsibility for, resistance management.

Neonicotinoids are a valuable, reduced-risk class of chemistry that has become an important part of effective IPM strategies to control whiteflies in Arizona. Admire® (imidacloprid), the first registered in this class, has been used effectively in melons and vegetables for whitefly control since 1993. Sustained efficacy of Admire over the past 13 years exceeds expectations of many who speculated that whiteflies would quickly develop resistance. Sustainability of this system (i.e., intensive imidacloprid use) is due in part to "de facto" resistance management: preservation of a neonicotinoid-free period between production seasons (July – August), when multiple, successive generations are not exposed to Admire (see figure A, below).

Since Admire, additional neonicotinoids have been introduced for pest control in vegetables, melons, and cotton (table, far right), including thiamethoxam (in 2002), acetamiprid (in 2003), and dinotefuran (in 2005). Their registration and potential year-round use on multiple crops raises new concerns about whitefly resistance management. If not used judiciously, successive whitefly generations could be exposed to several neonicotinoid compounds on all three key hosts crops throughout the year.



Dialog

Cross-commodity guidelines (Palumbo et al. 2003) were developed by the University of Arizona's Cross-commodity Research & Outreach Program (CROP), a multidisciplinary working group, including research and extension scientists, growers and pest control advisors representing the diverse crops involved. Guidelines were developed through a feedback-driven process based on stakeholder input, accounting for the unique needs of each cropping community, the biology of this insect, and shared concerns about neonicotinoid resistance and sustainable whitefly management.

The CROP group developed a comprehensive set of guidelines with the fundamentals of IPM at their foundation (IPM pyramid, at left). Within these guidelines, simple rules provide voluntary limitations on all neonicotinoid uses adapted for three different cropping communities prevalent in Arizona (table, below right, and in detail, lower half of the poster). *The essence of these recommendations is to maintain at least four successive generations of whiteflies in an annual cycle that are not exposed to neonicotinoids in any cropping system.*

The most unique aspect of the guidelines is that they account for spatial and temporal considerations related to pest biology and the cropping patterns. Pest managers must base management decisions on proximity of other whitefly hosts and likelihood of nearby chemical use patterns. The guidelines are flexible, providing three sets of rules that fit most cropping situations in Arizona, rather than applying a single set of rules statewide that does not factor in the local ecological and biological contexts.

These practical, easy-to-implement rule sets were taught to growers and pest managers in a series of statewide meetings and workshops, in a detailed color bulletin, and through web-based information. This collaborative, area-wide approach may serve as a model for addressing new threats in the future (e.g., Q-biotype infesting protected agriculture).

Concept

A crop community is defined by its production of whitefly-sensitive host crops over an annual cycle. *A 2-mile radius represents an effective "community" based on the whitefly's ability to migrate and reproduce among nearby crops.* Three major types of crop communities in Arizona have been defined as Cotton-Intensive, Cotton / Melon, & Multi-Crop, which consists of cotton, melons and vegetable crops.

Neonicotinoid Registrations in Arizona*

Active Ingredient	Product	Application	Crops Uses
acetamiprid	Assail	Foliar	Lettuce, Cole (Melons**)
acetamiprid	Intruder	Foliar	Cotton
dinotefuran	Venom	Foliar, Soil	All
imidacloprid	Admire, etc.	Soil	Melons, Lettuce, Cole
imidacloprid	Gaucho, etc.	Seed	Cotton
imidacloprid	Provado, etc.	Foliar	Lettuce, Cole (Cotton***)
thiamethoxam	Centric	Foliar	Cotton
thiamethoxam	Cruiser	Seed	Cotton (Lettuce & Cole**)
thiamethoxam	Platinum	Soil	Melons (Lettuce & Cole**)

*Future registrations for clothianidin are expected in Arizona
**An Arizona registration on these crops is anticipated in the future
***Registered for use, but not recommended in Arizona

Three major data sources went into the development of the cross-commodity IPM model (see lower half of poster):

(1) Description of Cropping Systems. The seasonal abundance of whitefly-sensitive host crops in each cropping community was estimated using the Arizona Agricultural Statistics for Yuma and Maricopa Counties (1997-8). Data were supplemented by estimates from pest control advisors.

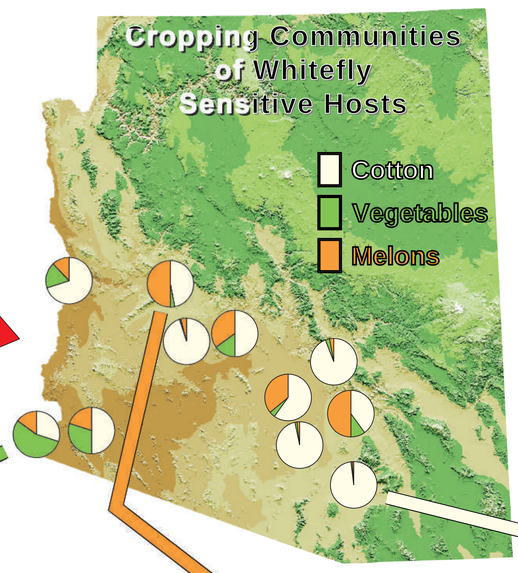
(2) Description of Insecticide Usage. Data consisted of amount of each insecticide class or key compound used on each crop during each growing season. Estimates were based on data provided by the Arizona Agricultural Statistics Service (from mandated pesticide use reporting system) and by input from a technical committee. To derive specific insecticide usage (treatment-acres), the no. of acres estimated for that time period was multiplied by estimated insecticide (%) used.

(3) Seasonal Whitefly Population Abundance. *Bemisia* generation times for each region were estimated using a simulation model (DeGrande-Hoffman & Naranjo, unpubl.) and temperature data based on 30-yr normals. For each generation, relative whitefly abundance for each crop was estimated by multiplying an index value by no. of crop acres present. The index and seasonal values were derived from multiple field trials.

Neonicotinoid* Limitations:
Maximum usage by crop per season

Community	Cotton	Melons	Vegetables
Multi-Crop	0	1	1
Cotton / Melon	1	1	—
Cotton-Intensive	2	—	—

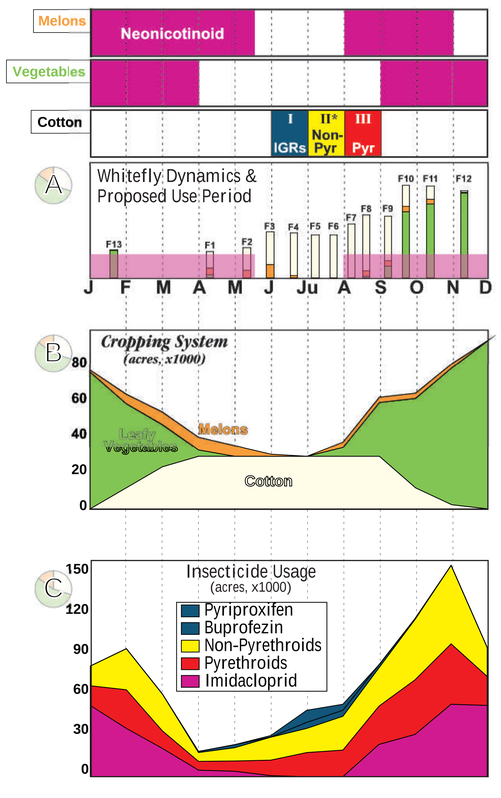
*Seed, Soil or Foliar



Response

Initial response of grower communities to the guidelines has been positive, including endorsements from Arizona Crop Protection Association, Arizona Cotton Growers Association, Cotton Incorporated, and Western Growers Association. This approach has also served as a model for cropping systems in other parts of the world. *Plans are underway to quantitatively evaluate community adoption using a spatially-explicit approach (see adjacent poster).*

Multi-Crop Community

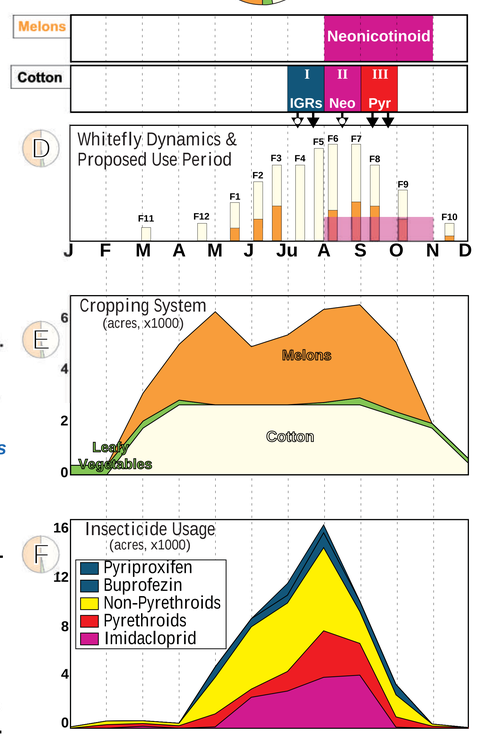


A Multi-Crop Community is defined as any area where cotton, melons, and other vegetable crops are grown within a 2-mile radius (e.g., Yuma Valley). Vegetables and melons dominate this community where cotton is treated as a summer rotational crop (B, Cropping System). Since the introduction of Admire, Multi-Crop Communities have been very dependent on soil-applied imidacloprid (C, Insecticide Usage).

The proposed use period for neonicotinoids (A, pink bar below) provides for only one soil, foliar or seed use in each melon or vegetable crop (A, pink bars above). *No uses are permitted in cotton.* This strategy allows for at least 4 unselected generations of whiteflies in cotton (e.g., A, F3–F6) and maintains the neonicotinoid-free period, which is so important for sustaining effective uses in melons and vegetables.

Adherence to guidelines in cotton is very important. Cotton growers have several effective, non-neonicotinoid alternatives for whitefly control, including the IGRs pyriproxyfen and buprofezin, non-pyrethroids, and pyrethroid combinations (C). The area-wide suppression of whitefly populations in Multi-Crop Communities to date has been successful largely due to the adoption of the Cotton IRM program and voluntary limitations on neonicotinoid use.

Cotton / Melon Community

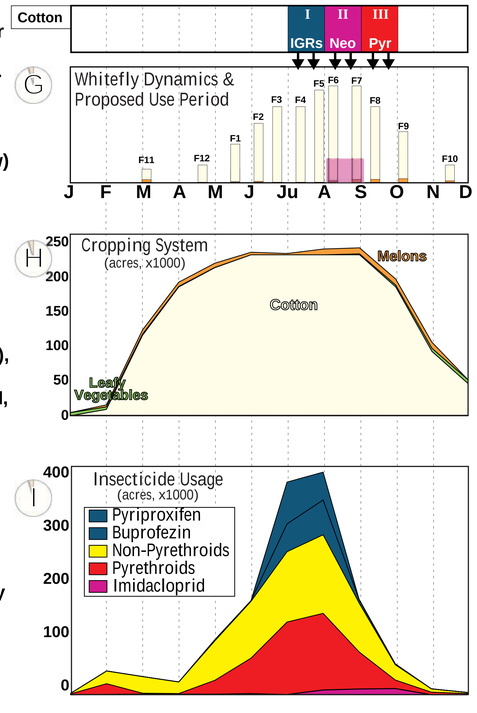


A Cotton / Melon Community is defined as any area where cotton and melons are grown within a 2-mile radius (e.g., Harquahala Valley). In these communities, spring and fall melon production seasons overlap (E, Cropping System). Soil-applied imidacloprid is used primarily in fall-planted melon crops (F, Insecticide Usage).

The proposed use period for neonicotinoids (D, pink bar below) is August through October. *No more than one neonicotinoid use is allowed in cotton,* and it should coincide with soil applications in fall-planted melons.

The selective insect growth regulators, pyriproxifen or buprofezin, in cotton help to preserve natural enemies that suppress whitefly populations until late season. This helps synchronize neonicotinoid usage across the two crops and maximizes unselected generations of whiteflies (F, Insecticide Usage).

Cotton-Intensive Community



In a Cotton-Intensive Community, cotton is the dominant host crop grown during the course of a year (e.g., Buckeye Valley) and is isolated from both melons and vegetables (H, Cropping System).

The proposed use period for neonicotinoids (G, pink bar below) is during Stage II of the Cotton IRM usually some time in August. *Up to two, non-consecutive foliar uses are permitted in cotton.*

Whitefly resistance management in cotton relies on a 3-stage approach that includes IGRs (stage I, no more than 1 use each), non-pyrethroids (stage II) and pyrethroid combinations (stage III, no more than 2 uses of this class season-long).

Use of IGRs during stage I, prior to any other chemistry, provides chemical and biological residual that suppresses whitefly populations well into the season. These strategies maximize the efficiency of the available chemistries while reducing the chances of resistance developing to any chemical class or individual compound (I, Insecticide Usage).

Reference

Palumbo, J.C., P.C. Ellsworth, T.J. Dennehy, R.L. Nichols. 2003. Cross-commodity Guidelines for Neonicotinoid Insecticides in Arizona. IPM Series No. 17. Publ. No. AZ1319. University of Arizona, College of Agriculture and Life Sciences, Cooperative Extension, Tucson, Arizona. URL: *http://cals.arizona.edu/pubs/insects/az1319.pdf*

Funding for this project was provided by the University of Arizona's Cross-commodity Research & Outreach Program (CROP) funded by grants from USDA-CSREES Western IPM Center and the Arizona Pest Management Center and by grants by Western Region IPM Program and USDA-CSREES Pest Management Alternatives Program.