COTTON AS A MODEL IPM SYSTEM IN THE SOUTHEAST: A DREAM OR POTENTIAL REALITY

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Abstract

Cotton production historically has depended upon high input of broad-spectrum insecticides to control several important pests that include the boll weevil, *Anthonomous grandis grandis* Boheman; plant bugs, *Lygus* spp.; the tobacco budworm, *Heliothis virescens* (F.); the cotton bollworm, *Helicoverpa zea* (Boddie); the beet armyworm, *Spodoptera exigua* (Hubner); the fall armyworm, *Spodoptera frugiperda* (J. E. Smith); and the soybean looper, *Pseudoplusia includens* (Walker). Potential pests such as stink bugs (*Acrosternum hilare* [Say], *Euschistus servus* [Say] and *Nezara viridula* [Linnaeus]) were also controlled with applications for other insects. Natural enemies were decimated, pest resurgences were common, and a classical "pesticide treadmill" was the rule. Resistance to organochlorines and organophosphates became widespread in such major pests as *H. virescens* and *H. zea*. These pests are rapidly developing resistance to the pyrethroid class of insecticides. Several developments since the mid-1980's have allowed us to derive IPM remedies for this situation.

The highly successful "Boll Weevil Eradication Program" has removed *A. grandis grandis* as an economic pest in the Southeast from North Carolina into Mississippi. This was accomplished using fall diapause sprays combined with pinhead square applications the next season. In most South Carolina production areas, this allowed us to reduce insecticides from ca. 12-15 "pre-eradication" to 8-10 "post-eradication" applications.

Research during the 1990's demonstrated that cotton recovered from extensive loss of squares in early season without any adverse impact on maturity, yield or quality of the crop. These studies, conducted under a variety of conditions in South Carolina, North Carolina, Virginia and Mississippi, enabled us to elevate thresholds for early-season treatment of populations of *Lygus* spp. and *H. virescens*. In South Carolina, insecticides are seldom needed prior to mid-July for *H. zea, H. virescens* and other lepidopterous pests. As a result, predaceous arthropods have increased and applications fell to ca. 5 or 6.

In 1996, a key development for cotton IPM was the release of varieties genetically modified to express the delta endotoxin of the Cry 1A(c) strain of *Bacillus thuringiensis* subsp. *kurstaki* (Berliner). These Bollgard varieties provided excellent control of several lepidopterous pests. However, *H. zea, S. frugiperda, S. exigua* and loopers (primarily *P. includens*) required supplemental controls and non-lepidopterous pests (plant bugs and pentatomids) became more important in this reduced-insecticide environment. As effective treatment thresholds were developed for pests in these Bollgard varieties, insecticides were further reduced to ca. 1-3 applications. Also, certain of these applications may be in the from of new lepidopterous larvicides (Dow's Tracer®, DuPont's Steward®, etc.) that have little or no activity against major predaceous arthropods.

Finally, we expect that the future introduction by Monsanto of Bollgard II genotypes that express both Cry 1A(c) and Cry 2A(b) proteins (Table 1.) will further reduce the need for insecticidal applications. Where Bollgard II varieties are grown and beneficials are conserved, no supplemental treatments may be necessary for lepidopterous pests. However, sucking bugs will likely become even more important and insecticidal applications in Bollgard II production systems may be dependent on their populations and damage levels. We anticipate that an average of ca. 0.5-1.5 applications may suffice in most areas of South Carolina.

By carefully utilizing the above developments, model IPM systems can be derived for cotton in the southeastern United States.

Table 1. Comparison of *H. zea, P. includens* (SBL)and *S. frugiperda* (FAW) larvae in conventional and one-and two-strain B.t. cottons. 2000.

	$\bar{x}$ no.[a] in 3 meters of row [b]				
Cotton	**H.zea> 1st instar on:**			**SBL**	**FAW**
Genotype	**7/21**	**7/31**	**9/5**	**(9/5)**	**(9/5)**
'DP50'	31.8a	7.3a	13.8a	16.5a	1.0b
'DP50B'	0.5b	7.3a	0.5b	15.3a	5.3a
M-15985	0.3b	0.3b	0.0b	0.3b	0.0b

[a]Means followed by same letter in column are not significantly different.
[b]3 beat cloth samples.

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