SUSCEPTIBILITY MANAGEMENT OF *LYGUS* IN THE WEST

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Abstract

Lygus management has become more important in Arizona cotton in the last few years due to a series of factors. Two of these factors, widespread availability of insect growth regulators (IGRs) for whitefly control and transgenic 'Bt' cotton for lepidopteran control, have resulted in a drastic reduction in the number of *Lygus*-active insecticides sprayed in our cotton systems (see Ellsworth, this volume). In 1995, an average of 12.5 foliar insecticide sprays for all insects (1.26 directed at *Lygus*) were made in Arizona cotton, many of which had some degree of *Lygus* activity (see Williams, 1996–1998). In 1997, this was reduced to 5.33 applications (2.10 directed at *Lygus*), and about 0.5 of these were IGRs which have no *Lygus* activity. This reduction in use has effectively opened a window during which *Lygus* can cause damage and promoted this pest to major status. Another factor that has also raised the prominence of this pest in our landscape is the substantial increase in alfalfa acreage, including some seed alfalfa, in Arizona.

When any 'old' pest comes into prominence, there are often complaints about insecticide spectrum, residual, and performance. In addition, in spite of the reduction in overall foliar insecticide use, resistance to insecticides is an ever-present threat which may be present and may or may not be impacting insecticide performance in each area of production (Dennehy, this volume; Pacheco, this volume).

Whatever the causes that have elevated *Lygus* pest status, we must consider susceptibility management of this and all other pests when constructing sustainable integrated pest management strategies. While this paper was invited to address the problem over the entire West and over multiple crops, my focus will be on Arizona cotton only. The necessity of this approach becomes obvious after considering the large differences in management and chemical efficacy between California (Godfrey, this volume) and Arizona (Pacheco, this volume). Nonetheless, the tenets of susceptibility management are equally relevant across all regions and all crops. They are in their simplest forms: 1) limit insecticide use to the lowest practical level; 2) diversify insecticide use patterns; and 3) partition insecticides among crops and pests such that modes of action are segregated as much as is practically possible.

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Limit Insecticide Use to the Lowest Practical Level

Resistances in insects to insecticides is commonplace in systems that depend on insecticides. Our challenge is to overcome this "inevitability." In our zeal to do so, we have, at times, advanced our attention to the secondary keys to susceptibility management, e.g., diversifying our insecticides, rotating or mixing chemistries, etc. Most are reactionary to the resistance at hand. All areas of resistance management need to be explored before times of crisis; however, the best thing we can do at all times is limit insecticide use to the lowest practical level. The remainder of this paper focuses on how to achieve these lowest levels: 1) conduct adequate sampling; 2) adhere to threshold guidelines; 3) use efficacious compounds (i.e., avoid "empty" applications), and 4) avoid the problem through all other measures possible.

Sampling

Sampling is the key to any integrated pest management solution. *Lygus* beltwide are sampled with any of a dozen or more methods. In Arizona, we currently recommend the use of a sweep net combined with square damage surveys and a knowledge of crop growth and development. The sweep net should be used to obtain samples of 25 sweeps from each of four sites within an average-sized field. Taking fewer sweeps than this and at fewer locations through the field can subject the user to high error rates and lead to poorly-timed applications. 'Half-grown' squares should also be collected in groups of 25 from each of four locations. A half-grown square is defined as a square with bud tissues representing about 50% of the total volume of the square. Each square should be collected at random and examined internally by splitting it in half with a knife or by hand. In addition to these methods, the practitioner should have some knowledge of crop development relative to the fruiting cycle and the production objectives. We are currently examining these and other sampling methods to develop more efficient and more field-friendly systems in Arizona cotton.

Thresholds

With the sampling information in hand, the grower or the advisor must make decisions to treat based on thresholds. Our current recommendations in Arizona are to treat when levels are: 1) 15–20 total *Lygus* per 100 sweeps; and/or 2) 25% of the squares with signs of damage; and 3) *Lygus* nymphs are present. The third criterion is important, because *Lygus* adults can be transitory, especially adjacent to alfalfa that is periodically cut. Also, *Lygus* eggs take approximately seven days to hatch under our conditions and most of our insecticides fail to control them directly. Thus, waiting for the appearance of nymphs ensures that the spray will be most effective. Otherwise, a re-treatment is often required. These threshold criteria serve as guidelines, and adjustment is required to accommodate all scenarios of crop development and production objectives. For example, earlier levels of *Lygus* should be watched more closely, while *Lygus* during or past cut-out should be left untreated well above these threshold levels.

In a test of *Lygus* thresholds using NuCOTN 33B this past year, we tested three *Lygus* action levels and an untreated check in a randomized latin square design. Alfalfa was used to "seed" the experiment with sufficient *Lygus* for testing. The levels per 100 sweeps and the number of sprays triggered for each were: 7.5 (4 sprays), 15 (2 sprays), 30 (1 spray), and untreated (0 sprays). Interestingly, not only did yields plateau at one level (15 / 100), but they decreased significantly thereafter. In other words, yields were significantly higher in the 15 threshold than in all other treatments including the more "conservative" 7.5 threshold. We are currently analyzing the data to better understand this yield depression, including examinations of the natural enemy fauna of the four treatments. Suffice it to say, however, two additional sprays to accomplish lower yields is added incentive to adopt a susceptibility management plan and limit insecticide use.

Use the Right Compound for the Job

Once the decision is made to spray and all other avenues of avoiding this have been exhausted, the user needs to select the best insecticide for the job while still considering the needs of diversifying the chemical arsenal. The industry is replete with anecdotes, personal opinions, testimonials, and other observations of the relative efficacy of our current *Lygus* treatment options. Nonetheless, testing of comparative insecticide performance is relatively straightforward and surprisingly uniform across years and across sites (see Pacheco, this volume). Currently, our recommendations are to use Orthene® (=acephate), Vydate C-LV®, or Monitor® as first choices. Supracide®, endosulfan, or dimethoate may also provide some level of suppression, but are considered second tier compounds, most useful when trying to address some other primary problem. Synthetic pyrethroids have not shown consistent efficacy and are not recommended for *Lygus* control in Arizona. Combination materials, in efforts to overcome putative resistance or otherwise enhance efficacy, have not performed better than appropriately chosen solo materials. In most situations, no more than two sprays should be used against *Lygus* per season. Rotating these two sprays between organophosphates (e.g., Orthene or Monitor) and the carbamate (Vydate) may be a prudent, if not wholly satisfying, rotation until other modes of action become available.

To further re-enforce these recommendations, a series of commercial, grower-cooperator and small-plot trials were conducted this past year. Five locations in four counties of Arizona were sites for replicated on-farm testing of *Lygus* control chemicals. Two sites were sprayed aerially at 5 GPA; two by conventional ground equipment at 9 and 15 GPA; and one by electrostatic ground sprayer at 5 GPA. Collectively, 7 Orthene combinations, 4 Vydate combinations, 4 pyrethroid combinations, and four solo materials were tested (Orthene, Vydate, Monitor, and Supracide). At three locations, two sprays were required; one location needed just one spray; and one location received one spray during the test and was later managed by the grower. While each location was unique in terms of the progress of the infestation and crop development, the results were extremely consistent. Adult numbers were transitory and often refractory to the sprays. At some sites, adult numbers spontaneously declined due to a variety of non-insecticide factors. *Lygus* adults are notoriously repelled by water-stressed cotton as was present at one site. Alfalfa was adjacent to most of these tests and served both as a source but also as a sink for adult *Lygus* after some re-growth had occurred. Cotton in cut-out can also cease to be relatively attractive to *Lygus* adults causing movement out of the crop. Nymph numbers, however, declined precipitously in virtually all post-spray evaluations. In no case did a combination spray significantly out-perform or out-yield the less costly and less disruptive singular sprays of either Orthene or Vydate. It should be noted here that most of the insecticides tested were at their highest labelled rates whether used alone or in combination.

There was no additive, synergistic, or economic advantage to mixing insecticides for *Lygus* control. So, one major stride that can be made in limiting insecticides is to choose the proper material at an appropriate rate and discontinue mixing with additional insecticides for *Lygus* control. Growers and their advisors often mix compounds but at lower than optimal rates. This is particularly destructive to any susceptibility management plan, because it results in "empty" sprays—the ones that do not work but result in continued selection pressure. Growers should instead opt for the appropriate insecticide at the optimal rate (often higher) that works. Combinations for the control of a larger pest spectrum is sometimes required; however, this is an overused tactic for "hedging" an application. Once the pest spectrum is identified and sampled properly, a singular material can be selected appropriately more often than is currently happening. The past success of the synergized pyrethroids against whiteflies has contributed to this industry "norm." Mixing chemistry as a norm, unless otherwise indicated as with whiteflies, should be avoided if at all possible.

Small plot trials this past year revealed very similar trends to the commercial-scale trials. Orthene or Vydate used alone performed and yielded as well and usually better than all of the combination materials tested, even Orthene+Vydate. Some insecticides were such poor choices that they failed to control *Lygus* and resulted in higher levels of *Lygus* and other pests than in the untreated check. Pyrethroids failed to control *Lygus*, except when mixed with a *Lygus*-effective compound. As disrupting as *Lygus* sprays tend to be on the natural enemy fauna of a cotton field (see Ellsworth et al., this volume; Ellsworth, this volume), growers should make sure they are using the right material. In a second series of tests, we also examined unregistered chemistry that might be of potential future use to the cotton industry. While most provided little to no protection from *Lygus*, one material, fipronil or Regent®, stood out as having excellent *Lygus* activity. The Arizona cotton industry could well use this new mode of action for *Lygus*.

Avoid the Problem From the Start

It sounds simple, but it's true. The first and best step towards susceptibility management is to avoid the problem from the start—not just resistance, but the need to treat *Lygus* at all. Though not always possible, this should be the objective of any IPM plan in cotton. For *Lygus*, there are several measures that can be followed. Plant early, produce your crop early, and terminate early. Avoid planting near known *Lygus* sources, especially safflower and alfalfa. Where this is not possible, use these sources as trap or catch crops. Then treat them before *Lygus* "escape" (safflower), or strip-cut or otherwise manage the availability of the host-trap (alfalfa) so that *Lygus* are never forced to leave. Use tolerant or resistant varieties when available; some pubescent varieties have reported "tolerance" to *Lygus* and other plant bugs. Do not water-stress your cotton. Even though *Lygus* prefer well-watered cotton, withholding water to manage *Lygus* is definitely the case of the cure killing the patient. Manage your other pests with a minimum of foliar insecticides like IGRs for whiteflies and Bt cotton for pink bollworm. This will help lower insecticide selection forces in your crop and conserve your natural enemy community.

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Disclaimer

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