Use of an Insect Growth Regulator Applied at the 2nd Week of Cotton Squaring for Management of *Lygus* Bugs: A Cotton Insecticide Efficacy Trial – 2011-2012

Vonny M. Barlow Ph.D.
Division of Agricultural and Natural Resources, University of California, Blythe, CA 92225

Abstract:

Efficacy trials were conducted in 2011-2012 utilizing various insecticides and rates to determine their impact on *Lygus* bug infestations in commercial cotton fields located in California's southern desert. Cotton fields (var. 'DP 164') were located adjacent to alfalfa fields grown for forage. Severity of *Lygus* bug populations moving from alfalfa at harvest into cotton varies by year and can negatively impact cotton yield and quality. Treatments were applied with a high clearance sprayer to a field using a split plot (n = 2) design with sub-plots (n = 8) applied to replicated (n = 3) eight row treatments. *Lygus* bug (both life stages) and selected natural enemies (*Zelus* spp., green lacewing complex (*Chrysoperla* and *Chrysopa* spp.), *Geocoris* spp., parasitic wasp complex) were quantified every ≈7d using sweep net sampling (n = 50/treatment) for 21d following treatments. Cotton square and boll counts were quantified every ≈7d from 10 randomly selected plants/treatment plots until seasons end. Main plot treatments were applied during the 2nd week of cotton squaring on 7/1/2011. Sub-plots were treated on 7/29/2011, 8/6/2011 & 8/20/2011. Use of the insect growth regulator, Diamond 0.83 EC (266.16 ml/0.40 ha) as a main treatment yielded significantly more (P = 0.0001; df = 40) cotton on average than use of Carbine 50 WG (62.37 gm/0.40 ha) (1,286.47 Kg and 1,120.59 Kg respectively).

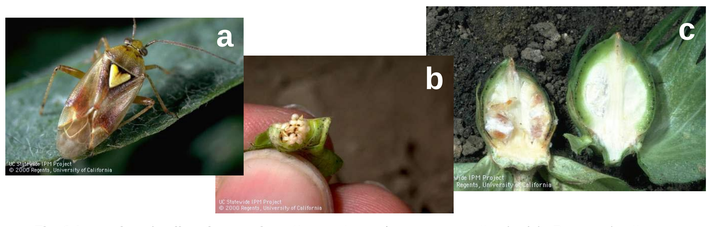

Fig. 1 *Lygus* bug feeding damage in cotton; a, *Lygus hesperus* on cotton leaf, b, Damaged cotton square showing injured anthers c, Damaged cotton boll showing shrunken and stained seeds

Introduction:

Alfalfa, *Medicago sativa* L. is one of California's largest crops with 960 (x1,000) acres in 2010 with production exceeding 6,481(x1,000) tons with a value of $782,000 (x1,000) (Anonymous 2012). As a result alfalfa is often found being grown contiguous with cotton in many areas throughout California. As alfalfa fields are harvested, great numbers of western tarnished plant bugs, *Lygus Hesperus* (**Fig. 1**) migrate from alfalfa, into nearby susceptible crops such as cotton. The presence of host crops (ie. alfalfa) in close proximity to susceptible crops (ie. cotton) increases the difficulty of managing *Lygus* pests. Repeated insecticide applications, necessitated by migration from host crops, are not only costly, but increase the possibility of secondary pest outbreaks. At least 9 species of the genus *Lygus* are of major importance to agriculture in North America. *Lygus hesperus* are widely distributed in the western regions of the United States and extends into British Columbia. Economically, it is the most important *Lygus* pest in the west and is a principal pest of cotton in the San Joaquin Valley and many other parts of California. Damage to susceptible crops (**Fig. 1**) results in yearly yield reduction and repeated pesticide applications to protect corps (ie. cotton). The use of insecticides to control *Lygus* has directly or indirectly (i.e., control measures for insects other than *Lygus* bugs) led to increasing insecticide resistance in this species. To better manage *Lygus* insecticide resistance and to better implement an area-wide integrated pest management program for *Lygus* bugs, more information is needed concerning the ability of insect growth regulators to mitigate *Lygus* dispersal from alfalfa into nearby susceptible crops like cotton.

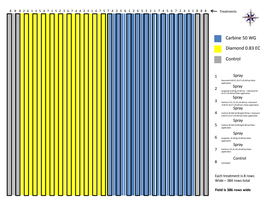

Fig. 2 Plot map showing main treatments of Novaluron and Flonicamid applied at the 2nd week of cotton squaring and the sub-plot treatments

Fig. 3 Initial foliar treatments applied at the 2nd week of cotton squaring with a commercial high clearance sprayer

Materials & Methods:

A commercial cotton field planted with cv. 'DP 164' round-up ready cotton was selected with alfalfa fields adjacent on two sides prior to establishment of experimental plots. The experiment consisted of a 2 x 8 factorial design with a whole-plot (≈ 3.39 ha each) factor of either a foliar application of Novaluron or Flonicamid applied on the 2nd week of squaring. The sub-plot factor(s) were replicated three times (n = 3) within each main-plot treatment and consisted of eight individual treatments of 8 rows (≈ 0.14 ha) (**Fig. 2**). Sub-plots received foliar applications three times at 7-10 d intervals following the recommended labeled rate(s) (**Fig. 3**). Approximately 7d after the initial main-plot treatments were made weekly sampling began. Sampling consisted of 50 sweeps taken per eight-row treatment with a standard University of California sweep net (0.37 m diameter), for a total of 300 sweeps per sub-plot treatment. Sweep net contents were immediately transferred into individual 3.8 L plastic bags and placed in a cooled ice chest. Samples were processed afterwards by first freezing the bags and their contents and then hand sorting by insect type. Numbers of *Lygus* bug and select natural enemies were then totaled and averaged to produce the mean abundance of *Lygus* bug and select natural enemies per treatment. Cotton square and boll development were assessed every 7 d by totaling the number of squares and bolls present on ten randomly selected plants per treatment. Cotton yield was determined at the end of the season by harvesting individual treatments of 8 rows and individually weighing using a truck scale. Data was analyzed using a mixed model (nested) with P < 0.05 level of significance to analyze potential treatment differences in mean abundance of *Lygus* bug abundance and yield at harvest.

Fig. 4 Individual treatments of 8 rows were harvested and weighed

Results:

Use of Flonicamid or Novaluron applied during the second week of cotton squaring as a prophylactic treatment against emigrating *Lygus* bugs from nearby alfalfa fields did not significantly reduce population of *Lygus* adults (df = 1, P = 0.86) or *Lygus* nymphs (df = 1, P = 0.89) (**Fig. 5**). Sub-plot treatments (**Fig. 2**) evaluated for their additive effect with the initial treatment (Main*Sub-plot) during the second week of cotton squaring did not have a significant effect on *Lygus* adult populations (df = 7, P = 0.98) or *Lygus* nymph populations (df = 7, P = 0.70). Evaluation of sub-plot treatments independently showed a significant increase in *Lygus* nymphs populations in treatments made with Fanfare 2EC (df = 7, P = 0.05) compared to all other treatments. Conservation of natural enemy populations evaluated throughout the efficacy trial were not found significantly different among treatments. Populations of predatory assassin bugs, *Zelus* spp. were not found significantly different among main-plot treatments (df = 1, P = 0.24) or Main*Sub-plot treatments (df = 7, P = 0.85) (**Fig. 6**). Adult green lacewing (*Chrysoperla, or Chrysopa* spp.) populations were not found significantly different among main-plot treatments (df = 1, P = 0.26) or Main*Sub-plot treatments (df = 7, P = 0.37) (**Fig. 6**). Populations of Big eyed bugs, *Geocoris* spp., were not found significantly different among main-plot treatments (df = 1, P = 0.72) or Main*Sub-plot treatments (df = 7, P = 0.96) (**Fig. 6**). Parasitic wasp populations were not found significantly different among main-plot treatments (df = 1, P = 0.74) or Main*Sub-plot treatments (df = 7, P = 0.85) (**Fig. 6**). Cotton square/boll maturation monitored over the course of the season steadily progressed from cotton square to mature boll in greater numbers in main-plot treatments receiving Flonicamid compared to Novaluron (**Fig. 7**). End of season boll maturation to harvestable cotton lint showed that Main*Sub-plot interactions did not produce significantly more cotton (Kg) among treatments (df = 7, P = 0.99) (**Fig. 8**). Main-plot treatments with the insect growth regulator Novaluron significantly (df = 1, P = <.001) produced a mean of 14.31% greater yields than treatments with Flonicamid (**Fig. 9**). Evaluation of sub-plot treatments independently showed a significant decrease in cotton yield (Kg) in Fanfare 2EC treatments (df = 7, P = <.001) (**Fig. 8**).

Acknowledgments:

Thanks to Bob Hull of Hull Farms Inc., Joe VanDyke of VanDyke Farms and Richard Wellman of Certified Crop Care Inc. Thanks also to Makhteshim Agan of North America, Wilbur-Ellis Agribusiness and Compton Ag Services, LLC for material support. Thanks to the University of California summer technicians; Derek Cormell, Chris Judd and Jacob Penley for their technical assistance.

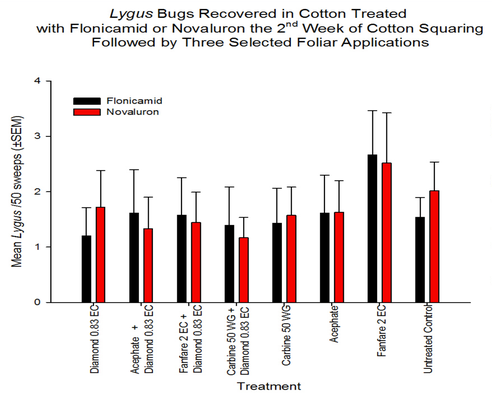

Fig. 5 *Lygus* bug response to whole and sub-plot treatments

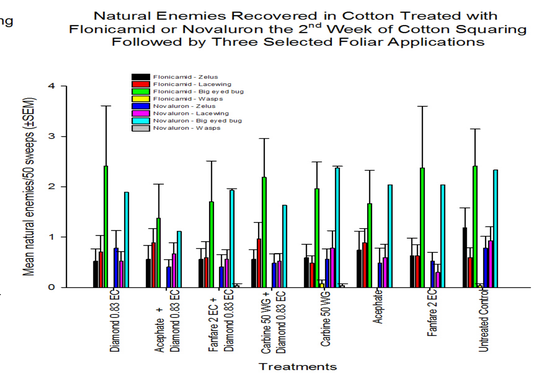

Fig. 6 Natural enemy response to whole and sub-plot treatments

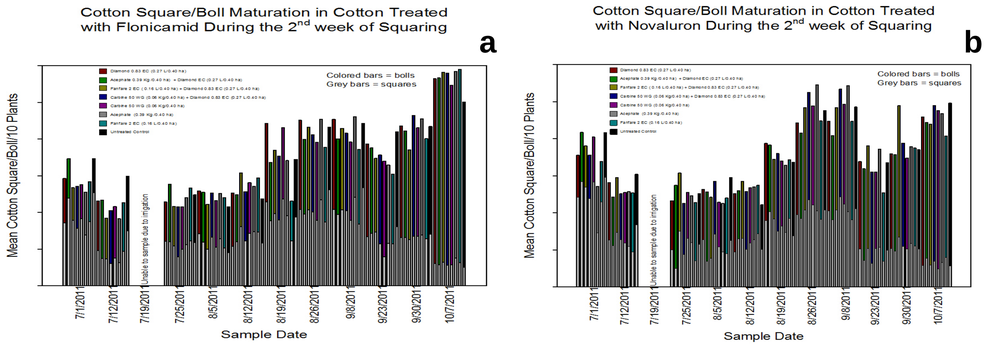

Fig. 7 Cotton square/boll maturation over course of the growing season; a, Cotton treated with Flonicamid, b, Cotton treated with Novaluron

Discussion:

The work presented here demonstrated that the prophylactic use of an insect growth regulator (IGR) during the second week of cotton squaring did not mitigate *Lygus* bug populations significantly (**Fig. 5**). *Lygus* migrate from crops that act as refugia, such as alfalfa and safflower into nearby susceptible crops (e.g., cotton) making management difficult. Use of an IGR would be expected to prolong *Lygus* nymph development during which significant mortality occurs during molting. An explanation for this lack of treatment effect may be methodology of sweep sampling itself. Sweep sampling is typically taken from the top 1/3 of the cotton plant and cannot uniformly sample for *Lygus* nymphs that can be found feeding and crawling throughout the cotton plant canopy. Sweep sampling also mechanically disturbs the plant canopy, causing adult *Lygus* bugs to take flight. Although *Lygus* populations were not found significantly reduced in the main or treatments evaluated for their greater than additive effects (Main*Sub-plot), a significant cotton yield increase was observed in the IGR treatment (**Fig. 9**). This suggests that use of an IGR was mitigating *Lygus* bug damage even though sampling could not adequately reflect this. The inclusion of an IGR in a spray program for the management of cotton pests might play a role in the management of insect pests of cotton (rather than continuous use of pyrethroids) as part of an integrated pest management program.

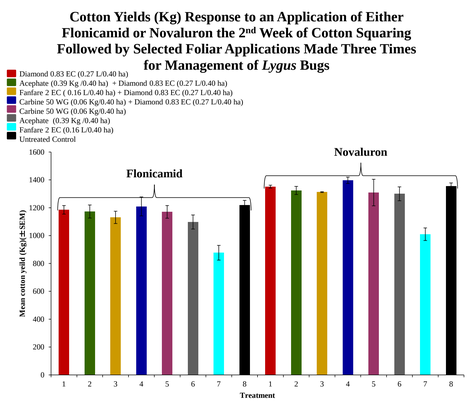

Fig. 8 End of season cotton yields (Kg) in whole and sub-plot treatments

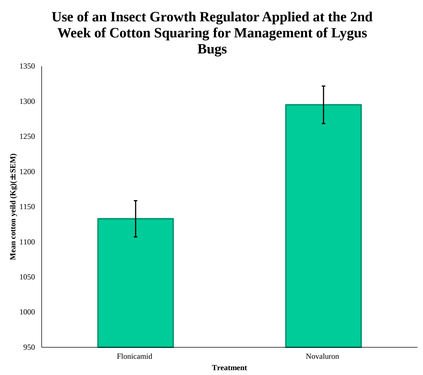

Fig. 9 Comparison of cotton yields (Kg) in whole-plot treatments of either Flonicamid or Novaluron