INSECT POPULATION DYNAMICS IN SAN JOAQUIN VALLEY COTTON FIELDS

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Abstract

During 1995, 13 cotton fields were monitored weekly for insect population and plant development. The fields were located throughout the San Joaquin Valley, varied in size, included both conventional and certified organic practices, over a wide range in planting dates and pest control practices. The most common insects included big-eyed bugs (Geocoris), minute-pirate bugs (Orius), damsel bugs (Nabis), western flower thrips (Frankiniella occidentis), spider mites (Tetranychus), Lygus bugs (Lygus hesperus), cotton aphid (Aphis gossypii), and green lacewings (Chrysoperla). Data analysis is preliminary and four sites are lightled for discussion.

Introduction

Insect pest management in cotton has become increasingly difficult in the San Joaquin Valley (SJV) over the past five years. The presence of some insects as problems can be related to climatic conditions such as Lygus or as a result of previous pest control practices such as spider mites. Cotton aphid has become an increasingly important and difficult pest to manage during the midseason and it is the reasons for this shift in pest status is unclear (Slosser et al, 1989). Insecticide use has increased in the past five years moving from about 1.5 in 1985 to over 6 in 1995.

The purpose of this study was to carefully survey and follow insect populations in selected cotton fields across a wide range of locations and production practices.

Material and Methods

Thirteen cotton fields were monitored for insects and plant growth development. In each field, approximately 20 acres was designated as the sample area which was visited weekly. Background information collected included date of planting, production activities, variety, planting density, previous crops, and surrounding crops. Pesticide use information was collected through the season. Temperature information was recorded from the nearest CIMIS remote weather station. Degree days above 60◦ F. from planting date were calculated and used as a standard for comparison between sites.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1075-1078 (1996)
National Cotton Council, Memphis TN

Monitoring occurred weekly from May through September if conditions allowed. Presence/absence of aphids, mites, and whiteflies were recorded from the fifth leaf from the terminal throughout the season. Once the cotton height exceeded 12 inches, a sweep net was incorporated to collect insects. Insects were collected from 200 sweeps, placed in a paper bag and stored in a cooler. Once returned to the lab, they were placed in a freezer (-20 F.) for a least 2 hours. The contents of the bag were identified and counted. Identification was taken to the species level whenever possible. Weekly plant based measurements were taken including height, location of first fruiting branch, total nodes, retention of fruit in the top five nodes and the bottom five node. Final plant mapping was conducted on 20 plants from the sample area of each field.

Results

The 1995 production season was one of the worst in memory. The cool and wet spring delayed planting, retarded plant growth and development, provided ample opportunity for insects to build in surrounding crops and weeds, and limited the yield potential by 25% (Hardee and Herzog, 1996). The planting window was substantially longer than usual ranging at these selected sites ranged from 5 April 1995 to 12 May 1995 with an average date of 20 April. The final fruit retention of the first position on the bottom five fruiting branches ranged from 2% to 84% with an average retention of 55%, off from the long term average of 62% (Kerby and Hake, 1993). There was a weak trend in improved retention with later planting dates (Figure 1). The number of insecticide/acaracide applications ranged from three to seven with an average of six. On average eight insecticide/miticide compounds were utilized during the season indicating that mixtures of compounds were applied simultaneously.

Arthropod populations varied greatly in their densities, diversity and appearance between sites. The most common insects included big-eyed bugs (Geocoris), minute-pirate bugs (Orius), damsel bugs (Nabis), western flower thrips (Frankiniella occidentis), spider mites (Tetranychus), Lygus bugs (Lygus hesperus), cotton aphid (Aphis gossypii), and green lacewings (Chrysoperla). Maximum arthropod richness ranged from 11 to 17 species. The maximum densities per 200 sweeps of key insect are presented in Table 2. Insect population and diversity were affected by the use of insecticides (Figure 2). For aphids, a very similar pattern of infestation occurred over a wide range of planting dates, locations, and insecticide patterns (Figure 3).

Discussion

This survey of 13 cotton fields produced a large quantity of data, of which only a cursory presentation can currently be made. The wide range in locations, production practices, and insect abundance makes generalizations difficult and dangerous.

Pest and natural enemy abundance was site specific but related to location and insecticide history (Figure 2). An initial look at insect diversity using a species richness number (maximum number of species at a particular date) offers limited insight into arthropod dynamics (Table 2). The use of broad spectrum insecticides could be expected to reduce the number of predatory and parasitic species, but allow the resurgence of herbivore pests.

For discussion purpose, four fields will be highlighted. These fields had complete records, were located over a wide area, and half had broad spectrum insecticides applied early (before 1400 DD_{60}) while half did not (Tables 1 and 2). The use of broad spectrum insecticides reduced the number of big-eyed bugs (Figure 2) but was not the single cause of late season mite problems (Figure 4). Late season spider mites populations were at high densities throughout Kern County and caused extensive defoliation. Such outbreaks are considered to be a field-specific, secondarily induced problem caused by the use of broad spectrum insecticides. In 1995, spider mites were a regional problem and not necessarily the result of management decisions on a particular field or farm. For example, Kern1 received no broad spectrum insecticides, yet had late season mite infestations. The surrounding area experienced similar populations and the outbreaks should be considered a regional rather than a field or farm specific phenomenon.

Aphid infestation appears to be another regional problem. Regardless of the insecticide regime, all four fields experienced damaging levels (Figure 3). Further evidence of the regional nature of the aphid problem can be taken from resistance bioassays indicating resistance to insecticides never used in a particular field (Grafton-Cardwell and Goodell, 1995). The timing of the infestation was related to plant phenology (ca. 800 DD_{60}), regardless of the date of planting or insecticides previously utilized. The timing of the aphid buildup which occurred during the period of maximum vegetative expansion (Kerby and Hake, 1993) and may be related to the nitrogen status of the leaves (El-Fattah, 1975). During maximum biomass. Similarly, population decline occurs around 1800 DD_{60} when nitrogen has been mobilized away from leaves to bolls, regardless of insecticide or production history.

The occurrence of Lygus bugs as widespread pests is dependent on a number of weather conditions. First, there must be adequate rainfall to provide host material through late spring. Next, the temperatures must be adequate in spring to allow for population development. When these conditions are met, Lygus bug can be a severe pest. In 1995, there was adequate rainfall but temperatures were not conducive for a severe problem. Many areas experienced repeated migrations of Lygus bugs and most of the acreage being treated with an insecticide in 1995. Where populations were damaging and not treated (Figure 5), loss of early season fruit set was extreme (Table 1).

The preliminary review of these data indicate a complex interaction of environment, production practices, and location on the insect population dynamics. A single year of observation can only increase the questions concerning insect pest management in the San Joaquin Valley. Several years of observation is required to understand more fully the complex dynamics of pest, predator, and plant.

References

El-Fattah, M.I.A. 1975. Effect of certain cultural practice on the infestion of cotton by Aphis gossypii. II Sowing dates and planting spaces. Journal of Applied Ecology 78:301-305. (In Insect Pest of Cotton, Chapter 15, Aphids).

Grafton-Cardwell, B. and P.B. Goodell. 1996. Cotton aphid response to pesticides in San Joaquin Valley cotton. Proceedings of the 1996 Beltwide Cotton Production Research Conferences (in press).

Hardee, D.D. and G.A. Herzog. 1996. 49th annual conference report on cotton insect research and control. Proceedings of the 1996 Beltwide Cotton Production Research Conferences (in press).

Kerby, T.A. and K. Hake. 1993. Monitoring cotton's growth. UC-DANR. From: Cotton Production (in press).

Slosser, J.E., W.E. Pinchak, and D.R. Rummel. 1989. A review of known and potenital factors affecting the popualtion dynamics of the cotton aphid. Southwestern Entomologist 14:3:302-313.

Table 1. Summary of planting dates, number of insecticide applications, number of different compounds applied to sites, and final boll retention of the first position, bottom five fruiting branches. Highlighted sites are featured in discussion.

Site	Planting Date	Number of Insecticide/ Miticide Applications	Total Number of Compounds	Percent Retention First Fruiting Position First Five Fruiting Branches
Kern 1	15-Apr	4	4	2
Kern 2	15-Apr	5	9	52
Kern 3	20-Apr	7	10	52
Kern 4	7-Apr	7	9	46
Tulare 1	5-Apr	3	5	56
Tulare 2	26-Apr	4	6	58
Kings 1	7-May	7	12	46
Kings 2	23-Apr	6	10	56
Fresno 1	12-May	7	11	72
Fresno 3	4-May	5	6	84
Fresno 4	12-Apr	5	8	46
Fresno 5	7-Apr	7	12	66
Madera	23-Apr	3	5	76
Average	20-Apr	6	8	55

Table 2. Maximum number of insects collected from cotton fields on a single sample date, insects/200 sweeps.

Site	Lygus	Geocorus	Orius	Nabis	Carnea	Maximum Number of Insect Species and Date	
Kern 1	75	74	141	32	65	17	7/24
Kern 2	28	182	28	522	47	14	7/10
Kern 3	10	16	27	6	44	17	8/14
Kern 4	7	14	19	1	23	10	6/26
Tulare 1	16	37	16	13	39	16	8/16
Tulare 2	20	67	33	1	31	14	7/5
Kings 1	8	24	28	0	6	14	8/9
Kings 2	79	31	44	0	10	15	6/28
Fresno 1	18	8	37	0	18	11	8/26
Fresno 3	31	533	53	7	44	17	7/18
Fresno 4	36	12	101	1	42	13	7/18
Fresno 5	23	17	100	2	14	14	7/18
Madera	27	91	145	9	24	15	8/8

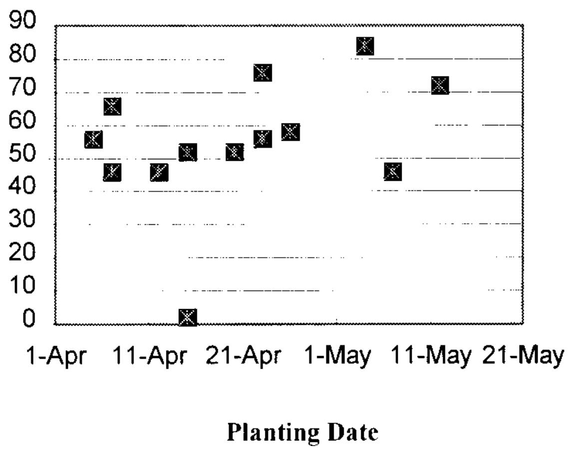

Figure 1. The percent retention of first position fruit on the first five fruiting branches as related to planting date (r = 0.36, P< 0.10).

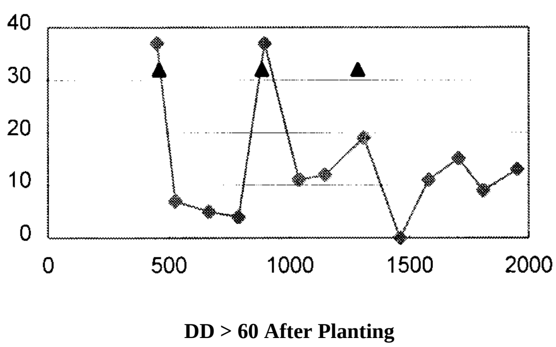

Figure 2. Big-eyed bugs /200 sweeps (line) as affected by insecticide applications (triangles). Site is Tulare1.

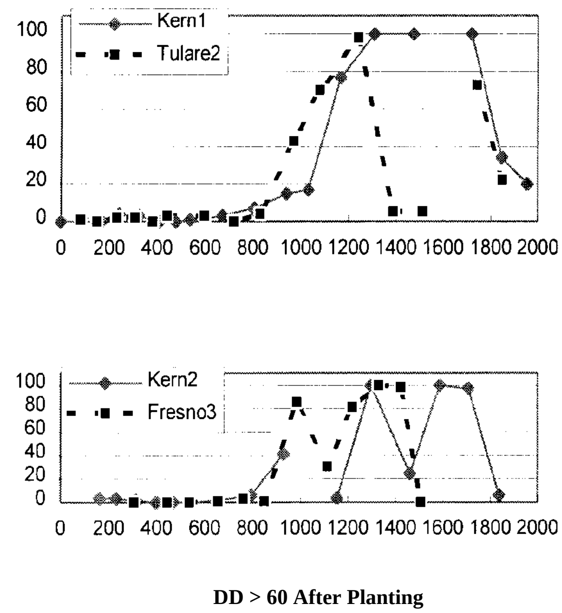

Figure 3. Aphid infestation in four cotton fields based on percent of fifth leaf from terminal with presence of aphids. Top graph has fields with no insecticides applied prior to 1400 DD>60 from planting. Bottom graph has fields with insecticides applied early during growth phase of population.

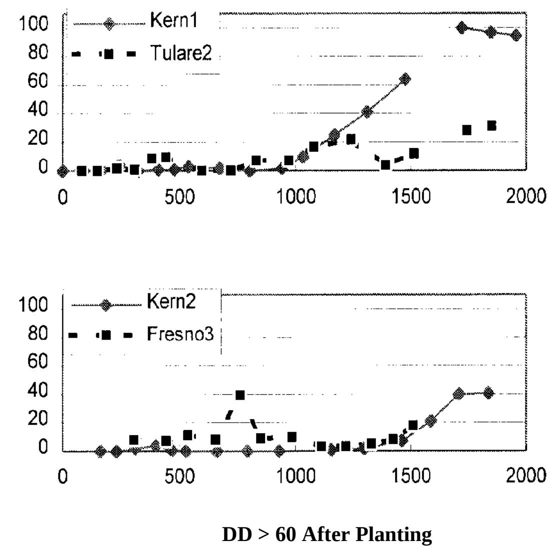

Figure 4. Spider mite infestation in four cotton fields based on percent of fifth leaf from terminal with presence of mites. Top graph has fields with no insecticides applied prior to 1400 DD>60 from planting. Bottom graph has fields with insecticides applied early during growth phase of population

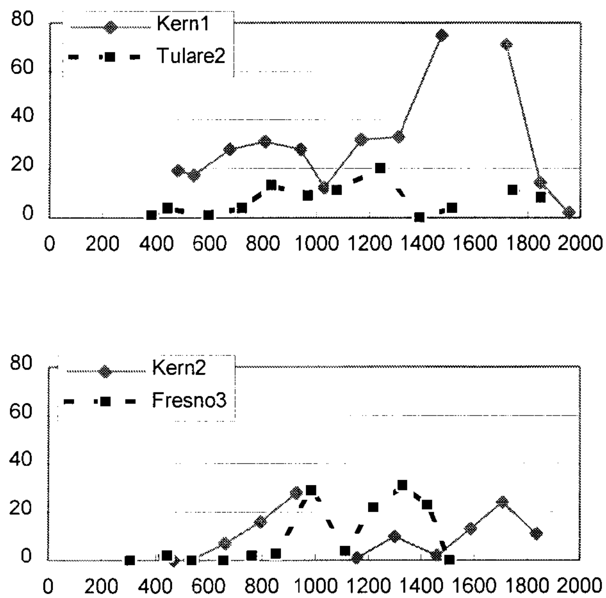

Figure 5. Lygus bug infestation in four cotton fields (bugs/200 sweeps). Top graph has fields with no insecticides applied prior to 1400 DD>60 from planting. Bottom graph has fields with insecticides applied early.