BLUE ALFALFA APHID MANAGEMENT STRATEGIES

by

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ABSTRACT

Blue alfalfa aphid, a pest of alfalfa for over 40 years has once again become an issue beginning in the spring of 2013. Theories as to why the recent outbreaks have occurred have been proposed; breaking of host plant resistance, new strain of blue alfalfa aphid, development of insecticide-resistance, depletion of aphid natural enemies (e.g. predator and parasite) caused by use of broad spectrum insecticides.

Key Words: blue alfalfa aphid, alfalfa, IPM, host plant resistance, biological control

INTRODUCTION

The blue alfalfa aphid, *Acyrthosiphon kondoi* Shinji was first identified by entomologist in the spring of 1975 in the Imperial Valley of California. Since then it has become widespread throughout the state and has become established in Arizona, Nevada, New Mexico, and as far east as Kansas and Oklahoma. Both adults and nymphs feed on photosynthetic fluids from the leaves and stems of the alfalfa plant. Low to moderate populations of blue alfalfa aphid (BAA) may cause little to no visible yellowing of plants. Blue alfalfa aphid feed in the new growth, at the tips and young leaves. Heavily infested alfalfa by BAA is characterized by severe stunting of the stems, which have shortened internodes and smaller leaves. This is caused by the plant responding to the toxic saliva that BAA simultaneously injects into the alfalfa plant while it feeds. This toxin can cause overall stunting in plant growth and is especially severe in small plants where the toxin can reduce yield the greatest. After prolonged feeding, leaves will eventually turn yellow, starting at the veins, leaves will curl and wilt, and turn necrotic (dead). Heavily damaged plants may become entirely defoliated except for a few leaves at the end of the stems a result of the aphids moving higher into the plant. Under high aphid densities, there is a "carryover" effect where alfalfa growth is slowed into the next cutting. Weakened alfalfa plants are susceptible to infestation by weeds and general susceptibility to stress is increased; stand longevity may be decreased after damage by aphids.

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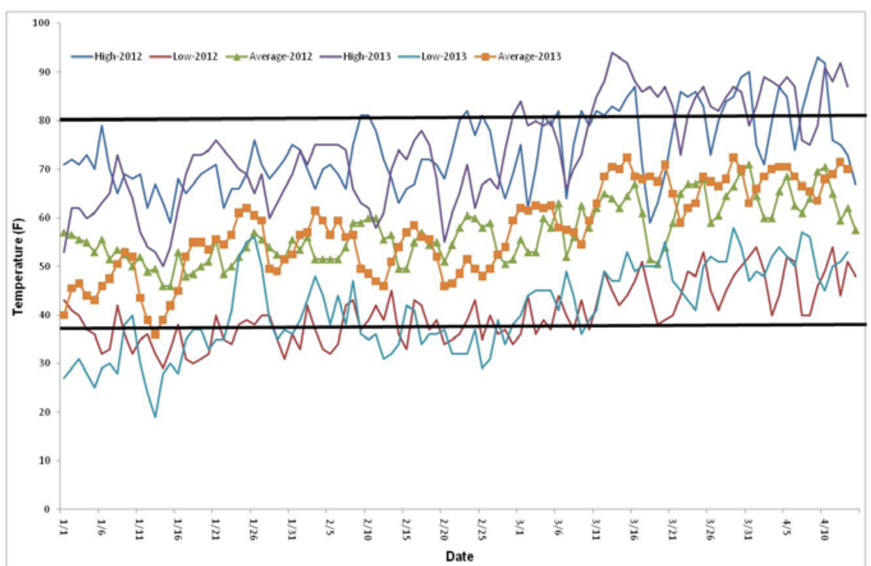
Blue alfalfa and pea aphid, *Acyrthosiphon pisum* (Harris) populations often occur simultaneously. These infestations may develop in December - February in production areas in southern California, to February - March in the Central Valley and in April - June in the northern intermountain production areas. Cooler weather is ideal for pea aphid and BAA population growth. Distinguishing between the pea aphid and BAA is critical for proper management, as the pea aphid does not inject toxins into the alfalfa plant. The result is that the threshold for pea aphid is much higher than for BAA. Identification can be done with a hand lens and using the 'aphids found in alfalfa' key located on the UC IPM website, http://www.ipm.ucdavis.edu/PMG/C001/m001epaphid.html. Both aphids are blue-greenish in color (the pea aphid has a "pinkish" biotype that is less common). The aphids are easily separated by looking at their antennae. The pea aphid has 3 to 4 narrow dark bands (annuli) along the antennae which are tan in color whereas the antennae of the BAA are uniformly brown.

HOST PLANT RESISTANCE

A significant IPM "tool" is that of host plant resistance which can differ by the many alfalfa varieties BAA resistance has been bred into. The most effective means of controlling pea and BAA is planting resistant varieties; CUF 101 is highly resistant (> 50% resistant plants) to spotted, pea, and BAA. UC Cibola is highly resistant to spotted alfalfa aphid, resistant (31-50% resistant plants) to pea aphid, and has a low resistance (6-14% resistant plants) to BAA. Prolonged periods of below-normal temperatures, however, may lower resistance to blue alfalfa aphid injury and result in some crop injury. Studies have shown that the pink biotype of the pea aphid easily overcame resistance in a number of cultivars with the exception of CUF 101.

At temperatures of 15 °C (59 °F) plant host resistance is only partially effective against aphid pests, but at 20 °C (68 °F) plant resistance is fully "functioning". Once the conditions get to 85 °F daily high and 70 °F night temperatures, resistance should be 100% active. So, in cooler weather plant host resistance is minimal while development of pea and blue alfalfa aphid is optimum. The development "window" of BAA is 27.1 °C (80.8 °F) and the lower is 3.5 °C (38.2 °F). Once we reach an average day/night temperature of 27.1 °C (80.8°F) we should see alfalfa aphid populations drop off and plant host resistance fully "functioning".



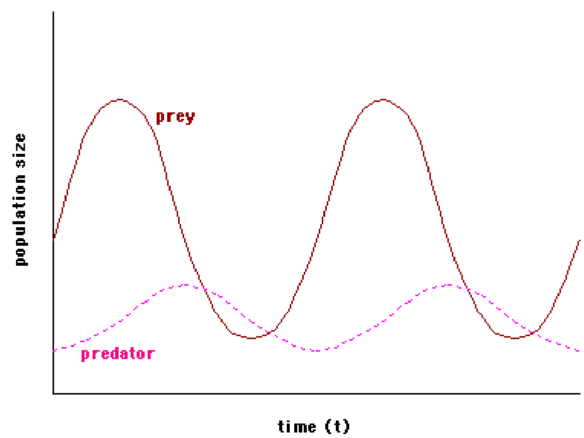
Daily high and low temperatures for 2012 & 2013 in relation to development thresholds for blue alfalfa aphid in southern California

BIOLOGICAL CONTROL

Alfalfa is an important reservoir for natural enemies of insect pests. These natural enemy populations often develop in alfalfa fields and expand into other plantings such as cotton, melons, and beans. Several species of aphid natural enemies are found in alfalfa including several species of lady bird beetles, green lacewings, western big eyed bugs, damsel bugs, and syrphid fly larvae that also play a role and should be conserved. Several species of parasitic wasps are found in alfalfa. Parasitic wasps that attack aphids in alfalfa include *Aphidius* spp., *Diaeretiella* spp., and *Lysiphlebus* spp. If you are assessing fields, watch for aphid mummies which indicate the presence of parasitoids which aid aphid management. Aphid mummies can look similar to aphids killed buy fungi. Presence of aphid killing fungi is dependent on weather conditions (for instance dry winters) which can reduce the prevalence of aphid-killing fungi which can provide good control. Do not treat alfalfa with insecticides until the economic treatment level for BAA has been reached and the predator and parasite populations have been assessed for their potential role in controlling BAA. Insecticides often destroy beneficial insects, leading to severe secondary pest outbreaks.

CHEMICAL MANAGEMENT

It is not uncommon to see some build-up of BAA and pea aphid in the spring before the temperatures warm. Alfalfa aphid infestations are not consistent from year to year with some fields heavily infested with aphid, well above threshold, and other fields have low numbers of aphids. The economic infestations of BAA are higher than in recent years. Insecticides have been warranted in many fields recently, and in some cases additional products have been used to manage aphids. Insecticides are an important component of IPM of alfalfa insect pests. The quick, remedial control provided by these inputs is critical for mitigating damage that can be caused by outbreak populations of pests. However, the use of insecticides also presents inherent drawbacks including destruction of populations of natural enemies, costs for treatment, possible environmental consequences, development of insecticide resistance rendering the product ineffective, etc. In many cases, an insecticide application is the best option for managing pests but other IPM approaches should be utilized as well.



Predator-prey population dynamics of aphid populations showing population growth of aphids until predators exert control causing the aphid populations to “crash”

An alternative to applying chemical insecticides is early harvest of the field as long as yield is not significantly compromised. Do not treat alfalfa with insecticides until the economic treatment level for a specific pest has been reached and the predator and parasite populations have been assessed for their potential role in controlling the pest. Use of broad spectrum insecticides should be avoided as their use can actually exacerbate the aphid problem by removing many critical natural enemies that manage aphids (predator-prey population dynamics). This is critical early in the season when natural enemy populations are at their lowest, which can cause a localized depletion of aphid natural enemies (e.g. predator and parasite) which in turn can lead to a BAA outbreak.

APHID BIOTYPES

Emergence of resistant “biotypes” of BAA have occurred as recently in the US in 1989 in New Mexico, and later in Oklahoma in 1991 where it was reported that BAA had greater virulence for CUF 101 and other resistant alfalfa cultivars. It is an important question that we need to address, “are we seeing the development of a new BAA biotype in California”? Just as aphids overcome insecticides by developing resistance traits they can also overcome host plant resistance. When this happens, an aphid biotype forms which appears identical superficially to the previous aphid biotype but has different “genetics”. These can be compared/studied based on feeding and survival studies on different alfalfa varieties as well as molecularly from extracted DNA. Publications from the mid-1990's showed a BAA biotype in Oklahoma that survived on previously resistant alfalfa varieties. Recently (December 2012) there was a published paper from Australia that showed a biotype of BAA collected in the State of South Australia near Adelaide in 2009 that clearly is able to survive on and kill alfalfa seedlings from formerly resistant varieties (testing on seedlings is the standard method used). Alfalfa cultivars such as Arc, Hunter River, and Trifecta that were killed in the seedling stage at a 0-1% level from BAA collected in this area in the mid-1990's (before the new biotype was present) and early 2000's are now completely killed by the new BAA biotype from 2009. There have been suggestions that this new Australian biotype could be the cause of our BAA management problem in southern and central California. There is no evidence of this.