Imperial County *Agricultural Briefs*

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Features from your Advisors

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BERMUDAGRASS STEM MAGGOT FOUND IN THE PALO VERDE VALLEY

Michael D. Rethwisch, Crop Production & Entomology Advisor, UCCE Riverside County – Palo Verde Office

On September 19, 2018, a call from a local professional crop advisor (PCA) indicated that bermudagrass hay in the Palo Verde Valley had whitened growing tips. The PCA and myself were both concerned that the field was infested with the bermudagrass stem maggot.

A visit to the field found damaged bermudagrass as well as adults of the Bermudagrass stem maggot, *Atherigona revusera*. This fly is also known in some parts of the world as the 'shoot fly'. While this species has previously been collected in California in Los Angeles and Orange Counties, this is the first documentation of its occurrence in Riverside County. It has not yet been reported from Arizona but is prevalent in the southeastern United States, where it was first reported as major pest of bermudagrass hay production.

A quick sweep sampling of 15 bermudagrass fields in the Palo Verde Valley on September 19 found the Bermudagrass seed maggot fly in about half the fields. Interstate 10 seems to be the current dividing line, as 6 of 7 fields adjacent to and north of Interstate 10 had adult Bermudagrass stem maggot flies, but the fly was not collected in fields south of Interstate 10.

Fig. 1. Adult bermudagrass stem maggot fly, *Atherigona revursera,* with grey colored upper thorax and yellowish abdomen

The adult bermudagrass stem maggot fly has very distinctive coloration and markings, making it very easy to identify when examining sweep net contents. It is fairly unusual in that it is a "2-tone" fly, meaning that the thorax and the abdomen are different colors (Fig. 1). In the net the primary color noted is grey (from the thorax), while the abdomen, although obscured by the wings, is yellowish or orange-yellowish. The two colors help to quickly identify this species, in addition to its size (3-4 mm) being larger than leafminer flies.

There are two other distinctive aspects for species identification. The adult flies have darkened front leg segments furthest from the body (Fig. 2-3)

Figs. 2-3. Adult bermudagrass stem maggot flies showing the darkened front legs on the segments furthest from the body.

The bermudagrass stem maggot fly also has four (two (2) sets of 2) dark markings on the last segments of the upper abdomen (Fig. 4). These dark markings are difficult to see on flies in a sweep net, especially when covered by the wings, but are easily noted under a microscope.

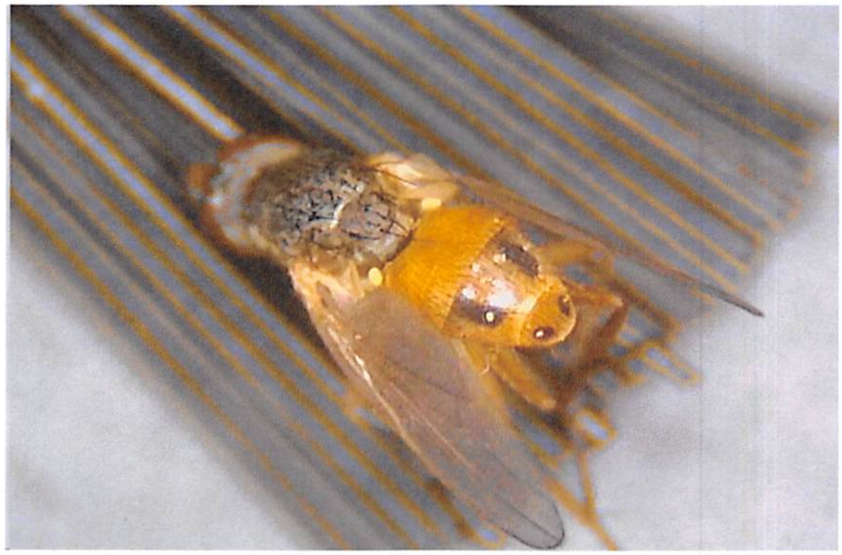

Fig. 4. Bermudagrass stem maggot adult fly with distinctive two sets of dark markings on the upper abdomen.

Life Cycle and Damage

There are multiple generations of this insect/year, with the damage often increasing as the season progresses and bermudagrass stem maggot populations increase. Work done by entomologists at the University of Georgia has shown the adult flies can live for approximately 18-20 days under southeast U.S. conditions, but survival length of adults is of yet unknown for low desert bermudagrass production conditions.

The female fly lays an egg on a leaf, with the larva hatching approximately 2-3 days later. The legless white larvae then bores into the upper portion of the bermudagrass stem where it feeds on sap in the stem. The tissue from the feeding point to end of stem (often 2-3 leaves) is killed and appears "whitened" or "bronzed" (Fig. 5), and can result in economic loss when populations and associated damage is high. The mature larva will exit the stems after feeding for 1-3 days, and pupates in the soil for 7-10 days before adult emergence.

Fig. 5. Bermudagrass stem tip "bronzing/whitening" associated with tissue death due to Bermudagrass stem maggot feeding on top and bottom stems

High levels of bermudagrass stem maggot infestations can essentially stop a field from growing. Such infestations have occurred across the Southeast and yield reductions have been estimated to range from 20 to 50%. Yield reduction locally has not yet been documented, nor have potential effects on bermudagrass hay quality been evaluated under local conditions.

The amount of damage in the southeastern United States seems to be dependent on growing conditions as well as the point in the growing cycle when flies lay their eggs. Earlier infestations after cutting have the potential to cause more damage. If favorable growing conditions with good soil fertility and moisture exist, the loss seems to have minimal impact on dry matter yield. More damage can result if forage production is limited by poor soil fertility and dry soil conditions.

University Cooperative Extension forage specialists in other states have suggested that some varieties are less susceptible to stem maggot damage than others. Fine-stemmed bermudagrass varieties are reported to be most susceptible to attack, as are highly managed, well-fertilized fields.

One unique aspect for bermudagrass in the low desert is the commercial production of seed. The effect of this insect on bermudagrass seed production is yet to be determined, but the potential for economic loss exists. PCAs and growers should be alert for this pest and its presence, especially in those areas that produce bermudagrass seed.

September 20, 2018. All photographs in this report are by the author.

HOW MUCH WATER IS NEEDED TO PRODUCE A SUNFLOWER CROP (A POTENTIAL LOW WATER USE CROP) IN THE LOW DESERT?

Ali Montazar, Irrigation and Water Management Advisor, UCCE Imperial and Riverside Counties

Introduction. Sunflower (*Helianthus annuus L.*) is one of a few crop species native to North America and has been cultivated by Native Americans throughout the U.S. for several thousand years. California growers started to cultivate sunflower commercially in the early 1900's. While California currently accounts for less than 2% of U.S. sunflower acreage, it produces more than 90% of the hybrid seed planted in the U.S. In California, sunflower seed is produced mostly in the Sacramento Valley (nearly 50,000 acres)). In 2012, Yolo county was the top sunflower producing county, accounting for almost 40% of the total reported acreage. Sutter, Solano, Colusa, Glenn and Sacramento counties also have significant acreage for sunflower production.

High tolerance to drought and heat, and early maturity of the plant may bring promises for sunflower production in the low desert of California. There was a total acreage of 1,712 under sunflower production in the Imperial Valley in April 2018 (IID monthly crop acreage report). As a potential low water use alternative crop for the low desert, it is required to develop accurate crop water use information and recommendations on irrigation management of this crop. I am conducting an ongoing study aimed at developing practical information on irrigation management of sunflower in various soil types and farming practices in the Imperial Valley. This article presents the preliminary findings of the 2018 crop season study at a commercial field.

Field measurements. This experiment was conducted in a 30-acre commercial sunflower field on an Imperial-Glenbar silty clay loam type of in Holtville, California (Figure 1). The field was planted in early February on a 40-inch bed (row to row spacing) with two rows of male plants after every eight rows of female plants, and a spacing of 6-inches between plants along the row. The field was furrow irrigated (common irrigation practice for sunflower in the desert region) the entire season and harvested in early June.

Fig. 1. The experimental sunflower field in Holtville (about one month after planting).

The actual crop water use (actual crop ET or ET_a) was measured using the residual of energy balance method with a combination of surface renewal and eddy covariance equipment (Figure 2). The reference ET (ET_o, as well-watered grass water use) was derived from Spatial CIMIS (https://cimis.water.ca.gov). Spatial CIMIS combines remotely-sensed satellite data with traditional CIMIS station data to produce more accurate maps of ET_o on a 2-km grid, which provides a better estimate of ET_o for the individual fields. The equation of $K_a=ET_a/ET_o$ was used to determine the actual crop coefficient (K_a) values of sunflower. Watermark soil moisture sensors were installed at multiple depths to monitor soil water status on a continuous basis.

Fig. 2. Fully automated surface renewal and eddy covariance ET station at the experimental field.

Sunflower crop water use. Daily actual crop ET from the early season through the late-season versus CIMIS ET_o data is presented in Figure 3a. Variable values of sunflower crop ET on a daily basis were observed with a wide range of 0.03 in/day to 0.38 inch/day. The results demonstrate that sunflower crop ET was lower than CIMIS ET_o the entire crop season except a few days on May (flowering period). An average of 0.08, 0.3 and 0.14 inch/day was observed as crop water use during early-season (planting through mid-March), mid-season (April through mid-May) and late-season (last 20 days before harvest), respectively.

The cumulative sunflower ET was 19.5-inch for the crop season, while cumulative CIMIS ET_o was reported 28.7-inch (Figure 3b). The difference between sunflower water use and grass potential ET estimation during the study period clearly indicates low water demands of this crop compared with fully irrigated grass.

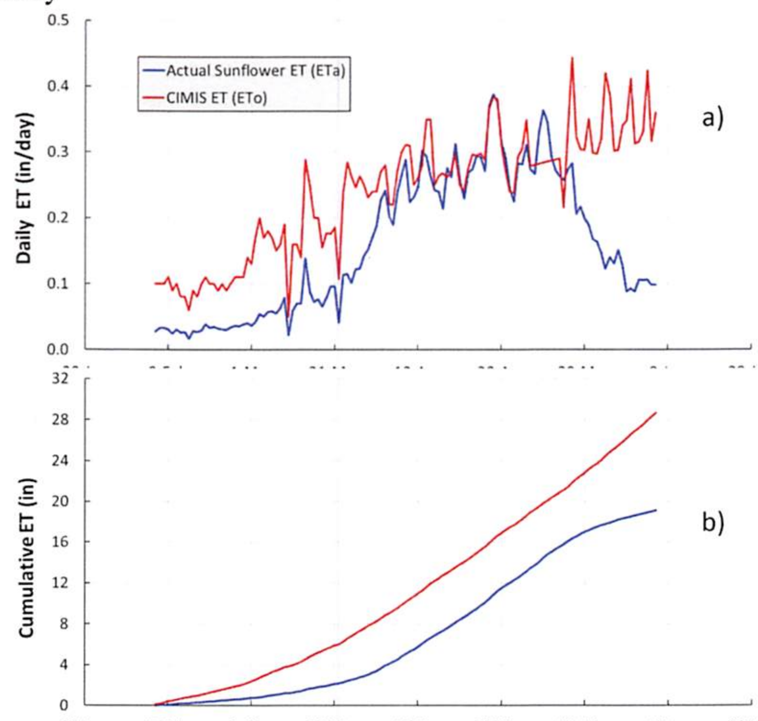

Fig. 3. Actual daily sunflower ET vs. daily reference CIMIS ET (a), Cumulative sunflower ET vs. reference CIMIS ET.

As with many other crops, sunflower yield is most sensitive to water stress (due to low stored soil water) just before flowering through seed development. In the low desert region, these growth stages occur during mid-April through May (Figure 4). Water stress earlier in the growing season, during vegetative development, does not affect sunflower seed yield as much as stress during the reproductive growth stages.

Sunflowers have an extensive root system, which are capable of using large amounts of available soil water from deep in the soil profile. In a study of sunflower root development and soil water use in Kansas, researchers found 87 to 96 percent of observed roots in the sampled soil profile were above 65-inches, although some roots were found as deep as 106-inches. Some studies have shown dry growing season conditions can stimulate the development of a deeper root system than what occurs under wetter conditions. In the current study, the grower started the growing season with a full soil profile and kept soil moisture status at relatively desired levels (Figure 5). The soil moisture data reveals that even though water content at shallower depths (6-12 inches) contributes more in plant growth at early season, water availability at deeper depths has a critical role in crop production and plant growth the remainder of season (below 12-inch depth down to 48-inch). At this specific field, no irrigation event happened after the first week of May through harvest day. As a result, the soil water potential at the upper soil layers (6-18 inches) reached out 100 centibars at May 20th, however the lower depths (24-48 inches) could provide water to the crop.

Fig. 4. Infrared image of the experimental field on April 26th (plants at the flowering stage).

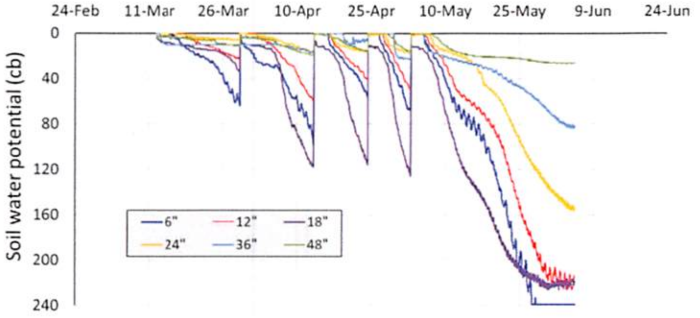

Fig. 5. Soil water potential in multiples depths over the mid-season through late season.

The sunflower plant is drought tolerant and has an extensive, heavily branched root system which permits it to extract deep soil moisture. Accordingly, preplant irrigation can have a longer benefit to sunflower than some other crops. Short periods of drought may not greatly reduce seed yield because crops are less stressed due to the large root volume. The critical yield period occurs 20 days before and after flowering. We need to make sure that adequate water is available to the crop at the time the sunflower bud reaches about 0.75 to 1 inch in diameter. Having three irrigation events is likely required at the critical yield period.

Sunflower crop coefficient curve. The K_a values estimated of field over the season was used to develop a preliminary crop coefficient curve for sunflower (Figure 6). The average value of this coefficient for the entire crop season was 0.68 which clearly demonstrates low water demand of sunflower compared with alfalfa, sugar beets, and other types of grass produced in the Imperial Valley. The results indicate that the crop coefficient value varies from a minimum of 0.19 to a maximum of 1.1. The average value of 0.24, 1.00, and 0.35 was determined as crop coefficient value of sunflower crop at early-season, mid-season, and late-season, respectively. While the K_a value obtained for sunflowers in this research is about 20% greater than the value proposed by FAO for the early-season, it is at average 11.5% lower than values identified by FAO for mid- and late-season. This proposed crop coefficient curve can be used and tested subsequently to estimate seasonal crop water uses for sunflowers in the Imperial Valley. The proposed curve and crop coefficients values are still preliminary and need to be verified through more data collection during the upcoming years.

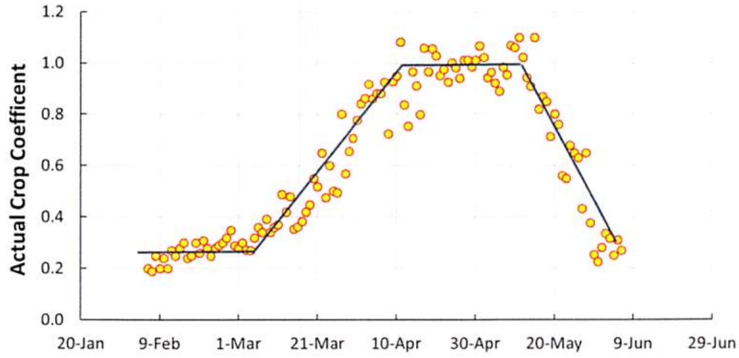

Fig. 6. Sunflower crop coefficient curve at the experimental field (a 120-day crop season period).

Preliminary estimation of sunflower crop water needs. The proposed crop coefficient curve and the average of long-term daily ETo (1996-2016) from CIMIS station at Meloland (CIMIS#87) were used to estimate seasonal crop water use for sunflower production in the Imperial Valley. The crop coefficient curve was justified for a 135-day crop season period (February 1st through June 15th). Consequently, a seasonal crop water use (crop ET) of 22.5-inch (1.9 ac-ft/ac) was estimated for sunflower crops in the Imperial Valley. This amount may vary due to irrigation practices and soil types.

Excess irrigation for salinity management in the Imperial Valley is necessary. Keep in mind that excess water for salinity management in the low desert region can be considered beneficial water use. A 3-inch annual rainfall of the region is insufficient to accomplish this task. In other words, 1.9 ac-feet/ac is just an estimation of seasonal crop water use for sunflower. Excess water for salinity management purposes must also be applied. The amount of additional irrigation water to drain salt from the effective crop root zone depends on the soil circumstances and level of salinity. If pre-irrigation is used to create better tillage and seedbed conditions, or if surface methods are used for stand establishment, salt management may be adequately met.

The irrigation water that needs to be applied in an individual field depends on crop water requirements and the efficiency of the irrigation system. Furrow irrigation is the most common irrigation practice for sunflower production. If we assume an average irrigation efficiency of 70% for a particular sunflower field irrigated by furrows (conventional furrow irrigation), the approximate irrigation water applied per acre of this field (considering 1.9 ac-ft/ac as crop water needs) would be 2.7 ac-feet. Part of this excess irrigation water may be considered to be necessary for salinity management.

PREEMERGENCE HERBICIDES ARE IMPORTANT TOOLS FOR WEED MANAGEMENT

Pratap Devkota, Weed Science Advisor, UCCE Imperial and Riverside Counties

For weed management, there is no such thing as a silver bullet which kills weeds effectively with a single application. An effective weed management program is an integration of several tools for maintaining season-long weed control. Chemical methods are still the most common weed control practice in the low desert cropping system. For successful weed control with this method; however, preemergence (PRE) and postemergence (POST) herbicides have to be incorporated in a sound approach. There are several reasons why the PRE herbicides should be included for an effective weed management program.

Preemergence herbicides, often referred to as residual herbicides, are considered the backbone for chemical weed control programs. Many weed species emerge subsequently with the crops and start competing for nutrients, sunlight, and other resources. Weed competition at a critical weed-free period (i.e. growth stage when crop is most susceptible to yield reduction due to the weed competition) during crop growth can significantly reduce yield. Application of PRE- herbicides at appropriate timing helps to maintain weed control from early in the season and prevent weed competition during the critical weed-free period. PRE-herbicides have to be applied within a few days after crop planting and prior to weed emergence. Moreover, PRE-herbicides have to be incorporated (if needs mechanical incorporation) appropriately and activated with an adequate amount of irrigation. Too much irrigation to the applied herbicide can result in surface runoff or leaching deeper into the soil profile rather than the depth where the weed germinates.

There are some important considerations for appropriate selection and application of PRE- herbicides.

- Know the field's weed history and select herbicide product accordingly
- Know the herbicide characteristics: period of residual activity, modes of action etc.
- Consider appropriate timing for herbicide application
- Consider the herbicide rate depending on soil type
- Herbicide application for thorough ground coverage
- Timely incorporation and activation of applied herbicide
- Consider crop rotational restrictions from herbicide application
- Read the herbicide label carefully and follow the instructions

An effective weed control program should consist of PRE-herbicides which maintain residual weed control (i.e. provide extended control of newly germinating weeds) for longer periods. The PRE-herbicide application provides residual weed control for 4 to 8 weeks depending upon the product, soil type, and environmental condition (**Figure 1**). The effective residual herbicides provide a longer window for the crop establishment. Residual herbicides can go a long way into controlling problematic weeds in specialty crops, especially the crops grown in the low desert region, where limited POST-herbicides are registered for use. PRE-herbicides are particularly important for the situation where fields have known or suspected cases of resistant weeds. PRE-herbicides also help in reducing the selection pressure for herbicide-resistance development from POST -herbicides applied later in the season.

Fig 1. Difference in weed infestation at the plots without (left) and with (right) preemergence herbicide at 6 weeks after application.

In general, it is critical to implement herbicide programs consisting of preemergence herbicides for achieving season-long weed control. Moreover, a careful consideration has to be made for selecting herbicide products with multiple modes of action. PRE-herbicides are the most important tool for maintaining weed control early in the crop season, ensuring optimum yield, and economic return. A successful chemical weed management plan should focus on implement- ing programs consisting of PRE and POST-applied herbicides for achieving season-long weed control. Inclusion of herbicide programs with products from multiple modes of action help to control wider weed spectrum, prevent/delay resistant weed development, and manage existing herbicide-resistant weeds.

- *For further information on this topic please contact: Pratap Devkota, Weed Science Advisor, UCCE Imperial and Riverside Counties.*

Detailed information on the Agenda and CEU will be released soon

29th Annual Fall Desert Crops Workshop

Location: Farm Credit Services Southwest
Ag Center Room
485 Business Park Way
Imperial, CA 92251
Time: 7:00 AM to 12:00 PM

NO COST TO ATTEND!!!

To register or for more information contact...

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IMPERIAL VALLEY CIMIS REPORT AND UC WATER MANAGEMENT RESOURCES

Ali Montazar, Irrigation & Water Mgmt Advisor, UCCE Imperial & Riverside County

The reference evapotranspiration (ET_o) is derived from a well-watered grass field and may be obtained from the nearest CIMIS (California Irrigation Management Information System) station. CIMIS is a program unit in the Water Use and Efficiency Branch, California Department of Water Resources that manages a network of over 145 automated weather stations in California. The network was designed to assist irrigators in managing their water resources more efficiently. CIMIS ET data are a good guideline for planning irrigations as bottom line, while crop ET may be estimated by multiplying ET_o by a crop coefficient (K_c) which is specific for each crop.

There are three CIMIS stations in Imperial County include Calipatria (CIMIS #41), Seeley (CIMIS #68), and Meloland (CIMIS #87). Data from the CIMIS network are available at: http://www.cim is.water.ca.gov. Estimates of the average daily ET_o for the period of October 1 to December 31 for the Imperial Valley stations are presented in Table 1. These values were calculated using the long-term data of each station.

Table 1. Estimates of average daily potential evapotranspiration (ET_o) in inches per day

Station	October		November		December	
	1-15	16-31	1-15	16-30	1-15	16-31
Calipatria	0.21	0.18	0.13	0.11	0.09	0.09
El Centro (Seeley)	0.22	0.18	0.14	0.12	0.10	0.09
Holtville (Meloland)	0.20	0.16	0.13	0.11	0.09	0.08

For more information about ET and crop coefficients, feel free to contact the UC Imperial County Cooperative Extension office (442-265-7700). You can also find the latest research-based advice and California water & drought management information/resources through link below:

http://ciwr.ucanr.edu/.