Kansas Insect Newsletter
For Agribusinesses, Applicators, Consultants and Extension Personnel

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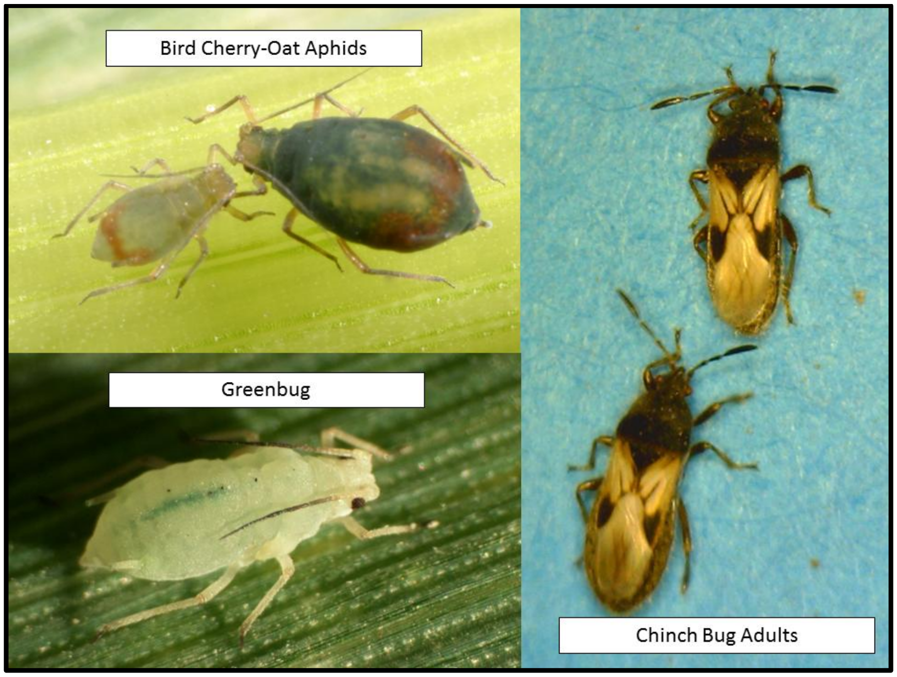
May 3, 2013 No 5

ALFALFA UPDATE

Alfalfa weevils continue to cause concern, especially because of the continued roller coaster relative to the weather. Most insecticide applications that we have evaluated did a pretty good job (80%+ control). However, these fields need to be monitored because there are still some very small larvae, so depending upon the infestation level, another insecticide application may be needed. However, if you are within 7-10 days of swathing it would probably be prudent to swath and thus avoid that application. If you do need to treat, please pay attention to the pre-harvest interval (PHI) for the product you use.

WHEAT UPDATE

There continues to be a few aphids (bird cherry oat and greenbugs) in most wheat fields around the state. Infestation levels seem to be relatively low, probably a combination of weather and beneficial insects (lady beetles and parasitic wasps). Also, a few chinch bugs are being reported from wheat fields in NC and SC KS. Most are still adults, but the nymphs will be coming. Thus, if you have plans to plant corn or sorghum adjacent to your wheat in the next couple of weeks, please check that wheat as it starts to turn golden for the risk of chinch bugs moving out in sufficient numbers to damage seedling corn/sorghum plants.



Jeff Whitworth *Holly Davis*

Sowbugs and Pillbugs

We have received a number of inquiries regarding sowbugs and pillbugs most likely due to the moist weather we have experienced this spring. Sowbugs and pillbugs are not insects but are classified as isopods or crustaceans, closely related to crayfish and crabs, and are distributed worldwide. The most common sowbug and pillbug species are *Porcellio laevis* and *Armadillium vulgare*. In Europe, sowbugs and pillbugs are commonly called woodlice. Both are oblong, oval or convex shaped, segmented, and are flattened underneath the body. They are black, gray, or brown in color, and approximately 19 mm (3/4 inches) in length when full-grown. The broad head contains a pair of eyes, two pairs of antennae, and chewing mouthparts. They also have seven pairs of legs. Sowbugs have two small, tail-like appendages (uropods) located at the end of the body; pillbugs do not have appendages. Sowbugs and pillbugs are distinctly segmented with seven hardened individual overlapping plates. Pillbugs can roll-up into a ball when disturbed (thus the common name 'roly-poly') whereas sowbugs cannot. This helps to minimize water loss and provides protection from predators.

Sowbugs and pillbugs have a particular biology in which eggs and young remain inside females for several months inside a pouch-like marsupium. This provides protection from predators and prevents desiccation (drying-up). Females may produce two or more broods during the year with between 20 and 28 young per brood. Both sowbugs and pillbugs primarily feed on decaying organic matter and fungi because they possess weak chewing mouthparts; however, if populations are abundant they may occasionally feed on the stem and/or roots of young seedlings, and may feed on young, tender vegetation or fruit. They can cause damage to beans, lettuce, and other vegetable crops. The food source for pillbugs and sowbugs must contain copper as this element is essential to their survival because the oxygen transporting chemical in the blood is hemocyanin, which is a copper-containing molecule. In addition, pillbugs and sowbugs are known to consumer their own feces. I know last year during the "heat of summer" after I had painted our outdoor shed that I could observe pillbugs or sowbugs actually peeling the paint away to get at the moist wood underneath…that's how dry it was last year. Also, it reinforces the point that insects and other organisms do what they have to in order to survive and don't much care to read the entomology books ☺.

Sowbugs and pillbugs are noctural (night-time) feeders hiding during the day under rocks, plant debris, boards lying on the ground, and in mulch; however, they may be observed during the day-time after rains or when conditions are overcast. They may also burrow several inches into soil. Both sowbugs and pillbugs require constant moisture for survival since they cannot control or regulate water loss from their bodies as they lack a waterproof exoskeleton. Furthermore, pillbugs excrete nitrogen in the form of ammonia instead of uric acid, which results in a greater water loss. Adults may live up to 2 years or more. Sowbugs and pillbugs may occasionally enter homes, primarily damp areas such as basements and around house plants. They may enter greenhouses during the winter due to suitable environmental conditions (e.g., temperature and moisture).

Management

The primary means of dealing with sowbugs and pillbugs is by habitat manipulation. For example, raking mulch and leaf debris will expose sowbugs and pillbugs to natural enemies and pest control materials. Applications of pest control materials are generally not required indoors because sowbugs and pillbugs will quickly dry-out and die after entering homes. Commercially available products for homeowners labeled for control or suppression of sowbug/pillbug populations (primarily outdoors) may contain the following active ingredients; beta-cyfluthrin, lambda-cyhalothrin, permethrin, and gamma-cyhalothrin. There is a product commercially available that contains a combination of materials including 2-phenethyl propionate, sodium lauryl sulfate, eugenol, thyme oil, and sesame oil. Most of these active ingredients will only kill sowbugs and/or pillbugs on contact so repeat applications may be required. Another product is called Sluggo® Plus, which contains the active ingredients; iron phosphate (0.97%) and spinosad (0.07%). Iron phosphate is primarily active on slugs and snails whereas the spinosad component of the formulation is suppose to have activity on sowbugs and pillbugs. It is recommended to spread the bait granules on the soil around plants that require protection—do not place in piles. The product is more effective when the soil is moist after application although after heavy rains or irrigation it will be necessary to make repeat applications. However, don't make applications within three days of harvest. It should be noted that sowbugs and pillbugs are highly susceptible to natural enemies including birds, toads, lizards, and centipedes that may substantially impact populations of sowbugs and pillbugs.

Raymond Cloyd

IMPACT OF "CLIMATE CHANGE" ON ARTHROPOD PESTS

The issue of "climate change," "global warming," or "environmental change" continues to generate controversy among scientists and non-scientists (look at our current weather patterns). However, this newsletter article is designed to strictly discuss, or more accurately predict, the potential impacts of "climate change" or the factors associated with "climate change" on arthropod (insect and mite) pests and how this may influence pest management. Nonetheless, it is important to have some basic background information regarding the factors associated with "climate change."

Background

The information associated with "climate change," in most cases, cannot be predicted with any degree of certainty. However, some questions affiliated with "climate change" include the following:

1) Have human (anthropogenic) activities contributed to "climate change" or is "climate change" a natural phenomenon? Well, the overall average temperature of the earth has changed less than a degree (e.g., 0.6 to 0.7°C) over the past 100 years. In addition, the earth's geological record indicates numerous shifts in the climate throughout the ages.

2) What may be the possible factors contributing to "climate change?" It has been consistently proposed that human-made emissions of carbon dioxide (CO_2) due to burning fossil fuel, and other gases that may trap infrared radiation emitted from the surface of the earth are responsible for the so-called "greenhouse effect." However, it has been suggested that natural forces such as solar cycles and/or volcanic eruptions are also associated with contributing to the "greenhouse effect."

3) What is the impact of "climate change" on biodiversity? There are predictions that any changes, due to climatic or environmental factors may increase the risk of extinction of certain species.

Impact of "Climate Change"

Ok…so what is the potential impact of "climate change" on plant-feeding arthropod (insect or mite) pests or herbivores? This is closely associated with 'phenological synchrony.' As such, "climate change" may increase asynchrony between host plants and herbivores resulting in adverse consequences. Also, it is important to understand that the effects of "climate change" may be direct or indirect, and are very complex (Figure 1). Direct effects are associated with the distribution and abundance of arthropod pest populations with climate being the primary factor that limits geographical distribution of arthropods. In addition, temperature and moisture may influence survival, development, and reproduction. The indirect effects of "climate change" are affiliated with host plants, competitors, and natural enemies. For example, drought stress may cause changes in plant chemistry (e.g., concentration of amino acids) and plant structure that could either increase or decrease host suitability. Furthermore, the distribution and abundance of natural enemies including parasitoids, predators, and pathogens may be affected, which influence their ability to regulate arthropod pest populations, thus resulting in potential outbreaks.

There are a number of factors associated with "climate change" that may impact the relationship among climate, arthropod pests, natural enemies, and host plants. These include 1) distribution, abundance, and quality of host plant; 2) pest physiological and behavioral processes; 3) natural enemy effectiveness; 4) plant growth rates and plant health; 5) distribution and abundance of pest population; and 6) the presence of competing species. However, what may have the greatest effects on arthropod pests as it relates to “climate change” are carbon dioxide (CO_2) and temperature.

Impact of Carbon Dioxide and Temperature

There are a number of potential relationships or factors associated with “climate change” and arthropod pests. For example, increased carbon dioxide levels may 1) result in higher consumption rates by insects; 2) invasive insect species may out-compete native insect species (e.g., Argentine ant in California); 3) increased migration of invasive insect species and non-invasive species into new regions/areas may occur; 4) extended frost-free periods may increase the duration and intensity of arthropod pest outbreaks; and 5) there may be a higher potential for the occurrence of insect-borne human diseases such as malaria and dengue fever. In regards to the last point, “climate change” may affect the incidence of insect-borne diseases such as malaria and dengue fever by increasing the range of insect vectors, extending seasons of transmission and enhancing reproduction and biting rates. Furthermore, development of the dengue virus inside the mosquito vector (e.g., *Aedes aegyptii*) may be shortened under “higher” temperatures thus increasing the proportion of mosquitoes that may become infectious at any given time.

It is essential to understand the relationship between insect pests and increased carbon dioxide levels and temperatures. For instance, insects may consume more when plants are exposed to elevated levels of carbon dioxide because less nitrogen may be present in leaf tissues and certain insect pests such as caterpillars may consume more leaf tissue (compensatory feeding) in order to obtain the required amount of nutrients. In addition, an increase in the carbon-to-nitrogen balance (ratio) in plants may influence 1) insect feeding, 2) concentrations of defensive chemicals in plants, 3) compensation responses by plants to insect herbivory, and 4) competition between pest species. Temperature increases may also impact species diversity and distribution of certain insect pests such as the mountain pine beetle (*Dendroctonus ponderosae*). Nevertheless, current insect pests may extend their ranges into new areas by means of geographical movement (northward).

So, what is the influence of elevated carbon dioxide levels on plant defenses? First of all, plants have two groups of chemical defenses: carbon-based and nitrogen-based. Carbon-based defenses include tannins, lignins, and phenolics that are designed to slow insect growth and development. These types of defenses are present at higher concentrations under elevated levels of carbon dioxide. Nitrogen-based defenses include alkaloids and cyanogenic glycosides that are directly toxic or repellent to insect pests. These types of defenses are present at lower concentrations under higher levels of carbon dioxide. As such, chewing insect pests such as caterpillars and beetles that consume more plant tissues when plants are exposed to increased levels of carbon dioxide may actually ingest more toxins and thus may be killed faster and in greater numbers. This indicates that “climate change” is not all bad!

Furthermore, it is possible that “climate change” may increase the range of expansion of certain insects. Migration, both in terms of latitude and altitude, of new insect pests, may result in modifications in the ecosystem thus allowing populations of new species to increase. This may force other species to extinction because these new species may be better competitors at higher temperatures although this may not always be the case. Population dynamics are not predictable as insect pests may be constrained by natural enemies, host-plant availability, and competition with other insect species. Furthermore, the rate at which insect species can establish populations permanently into new areas that are suitable will be limited by the rate of spread of host plants into new areas, which would impact specialist and generalist herbivores differently.

What about the effect of "higher" temperatures? This will likely benefit some insect species more than others, which is probably due to the impact on life history parameters (e.g., reduced offspring production) of natural enemies such as parasitoids and predators. A reduction in natural enemy populations (due to "climate incompatibility") may lead to more arthropod pests present and thus plant damage, and more insect outbreaks as temperatures increase. It should be noted that population dynamics across new geographical ranges will be unpredictable with more insect pest outbreaks occurring due to expanding ranges quicker than natural enemies. As such, this may transcend into more pesticide applications (mentioned later).

Insect development, survival, distribution, and abundance are directly affected by temperature (because they are cold-blooded) and as temperatures increase these parameters also tend to increase. Thus, arthropod pest populations may develop faster and plant damage may occur more rapidly and possibly last longer than previously. Furthermore, higher temperatures may influence the effectiveness of insect pathogens (e.g., fungi, bacteria, and viruses) and natural enemies (e.g., parasitoids and predators), which may negatively affect sources of natural mortality. In addition, an increase in temperature could lead to temporal and/or geographical separation leading to arthropod pest outbreaks. It is likely that higher temperatures will favor those arthropod pests with multiple generations more so than those with single generations resulting in insect pests breeding throughout the year. Also, in regards to insect-vectored diseases, warmer temperatures may translate into additional insect generations, which may increase transmission rates of plant pathogens including viruses transmitted by aphids.

What about the impact on over-wintering? Well, increased temperatures, which may lead to expanded warm seasons or shortened winters, could lead to earlier emergence and later over-wintering of arthropod pests. This may also result in greater survival of arthropod pests during the winter.

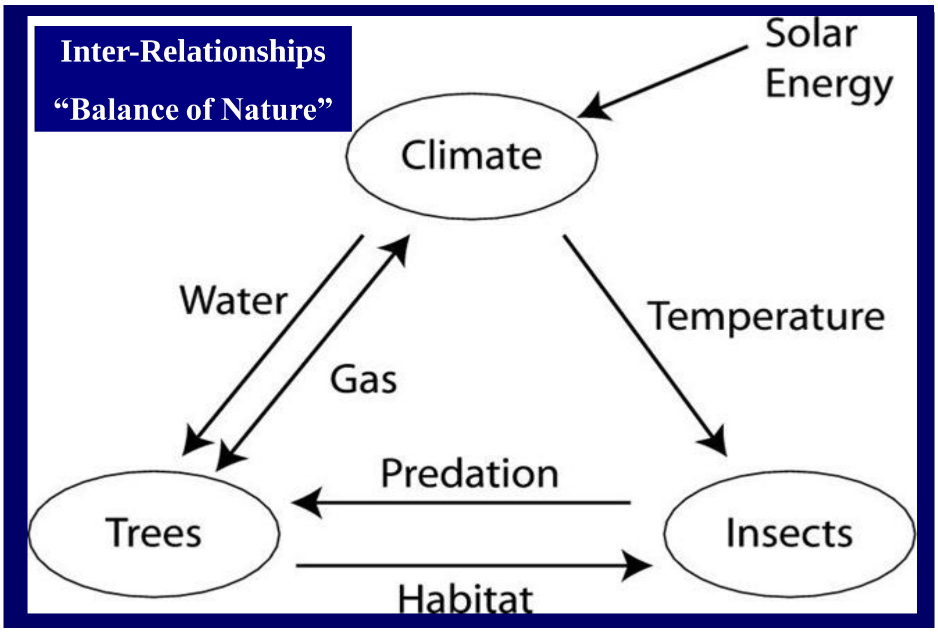
What are the potential issues in the USA associated with the impact of "climate change" on arthropod pests? There are a number of factors that need to be considered including 1) expanded ranges of certain arthropod pests already present; 2) increased arrival or migration of more arthropod pests; 3) changes in ecosystems that may allow certain arthropod species or populations to reach outbreak proportions, which could result in extinction of other species; and 4) expanded time period (earlier and later) in which arthropod pests would be present during the growing season. In the end, how will these factors and those described above influence pest management?

Impact on Pest Management

The question to address at this point is: will we have more problems with certain arthropod pests and what will be the potential impact on pest management? In general, this could lead to increased pesticide (in this case, insecticides and miticides) use throughout the growing season with more frequent applications, resulting in higher incidences of resistance occurring in arthropod pest populations because of the increased selection pressure placed on these populations. In addition, this may directly and indirectly impact natural enemies thus influencing any natural mortality. Additional factors to consider in regards to pest management include long-term harmful effects to plants (phytotoxicity) due to the amount of pesticide applications, and associated infestations of arthropod pests for extended periods of time. This may lead to natural infestations of multiple arthropod pests species or guilds such as chewers (e.g., caterpillars and beetles), suckers (e.g., aphids, scales, and leafhoppers), and/or wood-boring insects occurring simultaneously on the same plant.

Finally, what about the potential effects of "climate change" on pesticides? This may include decreased residues or persistence, reduced toxic action on arthropod pests, increased treatment rates or dosages required, increased number of pesticide applications, and fewer times suitable for pesticide application (influenced by temperature and wind, which may prevent or delay application).

In summary, although what has been presented in this article is mostly speculation, the fact that we know how arthropod pests will respond to changes in environmental conditions, especially temperature, allows us to make "some-what" accurate predictions of what could occur in regards to changes in insect abundance, distribution, and how this may impact pest management strategies. However, it should be emphatically noted that Mother Nature is going to do her own "thing" because she knows what is best!



Raymond Cloyd

Please accept my sincerest gratitude for all the help and support you have provided to me for the last four years as your Insect Diagnostician! I really enjoyed and learned from the experience and got to work with some of the nicest people in this state! Please support Eva Zurek, the new Diagnostician, as much as you have supported me these last few years.

Thank You!!!

Holly Davis

Sincerely,

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