The cranberry plant and its associated arthropods generally disregard calendars and almanacs. Since plants and arthropods can only develop as fast as current temperatures allow, their developmental status is best measured by keeping track of heat units. Such units are often referred to as “degree-days,” and they combine temperature (degrees above a threshold) and time (days). Keeping a running total of degree-days (DDs) provides an objective measurement of the organism’s growth (i.e., its “physiological age” rather than its time-based age). With a DD running total, we can link this number to observed development in the field (eggs hatching, adult flights). After years of observation, we can assess the development of field populations by keeping track of daily weather. Having such information in-hand helps pest management professionals to assess 1) when their traps need to be deployed, 2) when egg-laying is starting, and 3) when pest pressure is at its peak. Timing of these biological “events” becomes particularly important when unusual weather descends upon us, as it did during the spring of 2012.

To illustrate how DD accumulations can be useful for pest management, we will focus on the 2012 Sparganothis fruitworm emergence. This moth is a major pest in all cranberry growing regions, and we are slowly piecing together its biology. We recently examined seven years of Sparg flight data from central Wisconsin, and these weekly trapping records showed when the flight often began, as well as when it was halfway over (peak flight). Trapping records came from over 90 marshes, dating back to 2003. We then dug up the old weather records for central Wisconsin from the National Oceanographic and Atmospheric Association, Weather Underground, and other repositories of meteorological information. We found that Sparg consistently emerged between 946 and 1,046 DDs, and its peak flight typically occurred around 1,519 DDs (see Historical Flight Patterns Figure.)

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Our degree-day calculations used the growth thresholds of the cranberry plant (41°/85°F) as a proxy for Sparg because we do not yet have the lower/upper thresholds for this insect. Growing DDs for plants are often similar to those of insects, so they are a reliable proxy.

Knowing that the Sparg flight was likely to start around 1,000 DDs, we predicted that the 2012 flight would arrive about 3 weeks early this year. The first moth trap-catches came on May 23rd, which corresponded to 990 DDs. In terms of calendar dates, the May 23rd start of moth flight was about 3-4 weeks early. In recent years, first Sparg flights have started in early to late June. As this article is being written (June 14th), DD accumulations suggest that peak Sparg flight is actually happening now. Therefore, the trap catches this week (and for the next week or so) will provide a good estimate of the relative size of the Sparg population at a given marsh.

So, why was the Sparg flight so early this year after we had a relatively cool April and a normal May? The reason is that the record high-temperatures in March were exploited by the plants and insects to get a head start on the season. Looking at the degree-day accumulations (see Degree-Day Accumulations: 2012), it is apparent that there was a sharp rise in DDs during mid-March. This was more than just unusual. These temperatures broke all-time records for March.

Then, in April the rate of accumulation slowed (note how the slope of the line is very slight during April). As May temperatures warmed, the plants and insects were able to quickly resume their high growth rate (note how the slope of the line increases in May). Because the plants and insects had “banked” lots of heat from March, it did not take long in May for the insects to fly and the plants to flower. It was not surprising that by May 23rd the first Sparg males were found in traps (at 990 DDs) and the first flowers were seen on some marshes. These observations were very early in terms of calendar dates but right on time in terms of DDs.

Knowing when the flights start is a critical element of IPM because this information tells us when to expect the hordes of caterpillars that will soon begin chewing on cranberry plants.
Removal of Arthropods in the Spring “Trash Floods”

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During the spring “trash flood,” a tremendous volume of plant material floats to the surface as water levels rise. This “trash” is removed from the beds by various means (e.g., by backhoe; Fig. 1) and is generally trucked away to other areas of the marsh. Since the trash floods are often used as a means of insect control, growers have been wondering if insect pests can be controlled by drowning as well as by physically removing the survivors from the bed. To address this question, we took samples of trash material from beds being flooded for insect control during the spring of 2011 (Fig. 2). This was a large-scale study involving 46 beds from 11 marshes.

On average, the per-acre volume of plant material removed from any given bed was 0.51 yd\textsuperscript{3} (cubic yard). On a 4-acre bed, for example, there were over 2 yd\textsuperscript{3} of leaves, stems, berries, and various other “stuff” removed. We took our samples (2-liters/bed) and then sorted through them under microscopes to separate the arthropods (Fig. 3). All arthropod specimens were curated in ethanol and identified. Based on our counts (per-liter), we could extrapolate how many arthropods were present per cubic yard, and thus how many arthropods per-acre were present in the trash.

Interestingly, the single most abundant organisms we found were not arthropods, but rather aquatic snails (2,892 specimens/acre). Among the arthropods, the most abundant group we found was the Coleoptera (beetles; Figs. 4-5), which were represented by 18 families and totaled over 1,300/acre. Top among the beetles were the Staphylinidae (290/acre), Scarabaeidae (219/acre), Elateridae (141/acre), Carabidae (131/acre), and Curculionidae (51/acre). While the Scarabaeidae (white grubs and June beetles), Curculionidae (weevils), and Elateridae (wireworms/click-beetles) are significant pests and thus good to eliminate; the Staphylinidae and Carabidae are largely predacious and probably eat many pests.
This brings us to the second most abundant group: the spiders (Fig. 6). Over 121 spiders/acre were removed in the trash floods. Since spiders are absolute carnivores, it is possible that thousands of beneficial arthropods were removed in the trash.

Ants, the third most abundant group (115/acre), vary widely in their ecological function, so it is difficult to characterize their role on the marsh.

The fourth most commonly found arthropods were the Noctuidae (cutworms, loopers; Fig. 7), suggesting that these large caterpillars were readily floated out of the beds (78 cutworms/acre).

Many other insect families were found, mostly from parasitic wasp families (e.g., Ichneumonidae, Pteromalidae), Hemipteran bugs (Piesmatidae, Miridae, and Pentatomidae) and various fly groups (syrphid flies, crane flies, marsh flies).

In all, there were at least 50 different families of insects documented within the Wisconsin marshes we studied. The total number of arthropods removed per-acre from the beds was approximately 2,127 specimens. ✤ ✤ ✤
The presence of Japanese beetles, *Popillia japonica*, on our cranberry marshes has increased over the past few years. 2012 marks the most activity seen in our beds by this potential new threat to our crop. Starting in mid June we see the adult stage of this beetle on our trees, shrubs, plants, and now our cranberries. Most activity remains on the weeds in our beds, but adults can incidentally get to our vines and they ARE eating. They are skeletonizing the cranberry leaves and I have seen them eat the terminal bud on some uprights. This injury to our vines can weaken plant health and may result in a reduction in yield if the vines are not able to rebud before the next growing season.

Japanese beetles overwinter in the grub stage. When the soil temperature reaches 50 degrees F, the grubs move up the root zone. Feeding lasts from 4 to 6 weeks followed by pupation.

The adults start laying eggs as soon as they emerge mid-summer. Eggs are laid a few inches under the soil in turfgrass. The environment needs to be kept moist for the eggs and early hatched grubs to survive. This is why we see the most activity in irrigated lawns and turf even in drought years. Hopefully, this drier year will aid in unsuccessful survival of the grubs in areas where our sprinklers do not reach.

Japanese beetles appear to favor many of the weeds in our beds so it may be advisable to leave them during this time period and wipe them a bit later than normal to allow the heaviest infestations to stay on the weeds and not move to the cranberries. Hourly help could instead walk through major areas of feeding and hand pick the adults and put them into a bucket of soapy water. It may also be advisable to block off sprinkler spray that hits our dikes to prevent egg laying near our beds (a moist area under grass). Finding potential host plants around the perimeter of our beds and eliminating or relocating them may also be necessary to keep them away from our cranberries. This may be a daunting and impossible task as they enjoy a huge menu of plant/tree/shrub species to dine on. However, if you have for example rose bushes nearby, removing and relocating them should be fairly easy. Trapping the adults is currently not recommended by many researches due to evidence showing that the traps attract more adults then they capture.

At this time chemical controls have not been necessary in cranberry. However, in the future, if this non native insect becomes a pest it looks like Orthene, Sevin, Imidan, and Neem (organic) can be somewhat effective if labeled for control at reducing populations either at the grub or adult stage.

**References to products in this publication are for your convenience and are not an endorsement of one product over similar products. You are responsible for using pesticides according to the manufacturer’s current label directions. Follow directions exactly to protect the environment and people from pesticide exposure. Failure to do so violates the law.**
July 27, 2012 — With the extremely early start to the 2012 growing season, it is no surprise that we have seen extended hatchings of a variety of cranberry pests. A third generation of BHFW made their appearance in some areas over a week ago.

Flea beetles are usually just starting to turn up on our marshes at this time in July. This year the flea beetles have been present since early to mid July. The question on many of our minds is “How many more are to come and how long are they going to stick around feasting on our vines?”

The intense heat, mixed with high wind speeds has made it difficult for many growers to keep their entire beds hydrated and canopy temperatures below 95 degrees F. However, we have already seen early rot in the field along with scald. All of the extra irrigating mixed with excessive temperature creates the ideal environment for rot to develop. It is important to allow the area under the canopy to dry out for parts of the day to avoid this. We still have a lot of growing season left, which means already present rot has even more time to continue to spread.

Despite all of the challenges that we have faced this season, crops look good in most areas. We had adequate pollination weather and fruit set was good even with the excessive temperatures. Berries are sizing nicely now and bud set for next year is occurring. Most growers are pleased with their crops and hope to meet or exceed their historical averages.

The time to take plant tissue samples is when all the nutrients have stabilized. Growth needs to slow and all fruit formed, but before the stem tips get woody. This can be difficult to determine, but it appears that taking samples a bit earlier this season may be necessary. If the vines are actively growing and there looks to be a chance for a double crop on some vines, the nutrients will be in flux and samples should be taken when observations indicate a slowing of growth. This timing may be different from marsh to marsh and between varieties. We need to make an educated estimation as to when this timing will occur and to always use the Aug 15 to Sept 15 as a guide.

Reservoirs levels are low, in some areas by 2 feet. If we do not get significant rain from now until harvest, we will be faced with another challenge. Growers may have to recycle water and only harvest a few beds at a time if they have no other sources of water. If this occurs, the time to harvest can be extended beyond our comfort levels and extend the potential environmental risk our fruit is exposed to. Thankfully, we have plenty of time to replenish water supplies and positive thinking, along with a rain dance or two, may help.