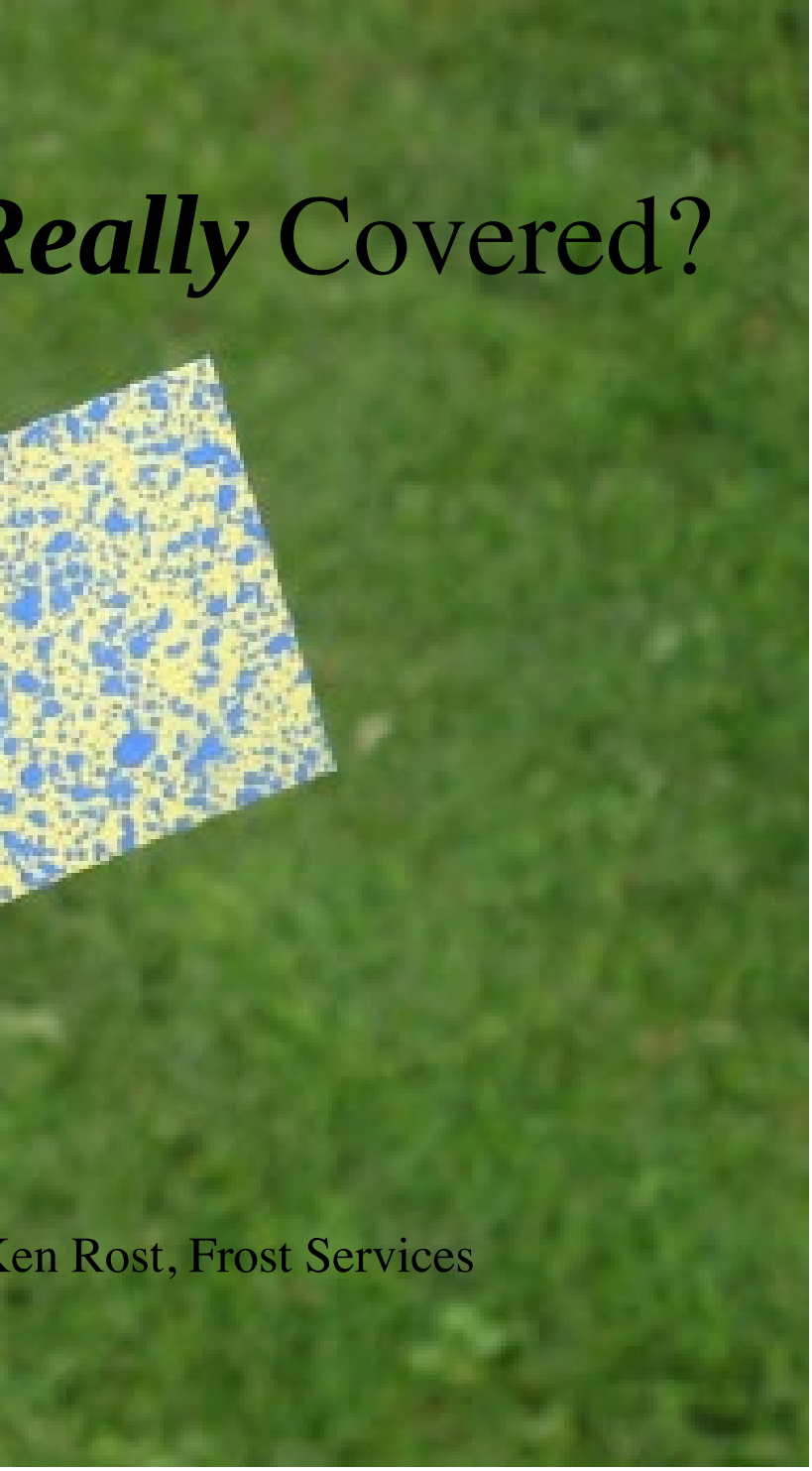
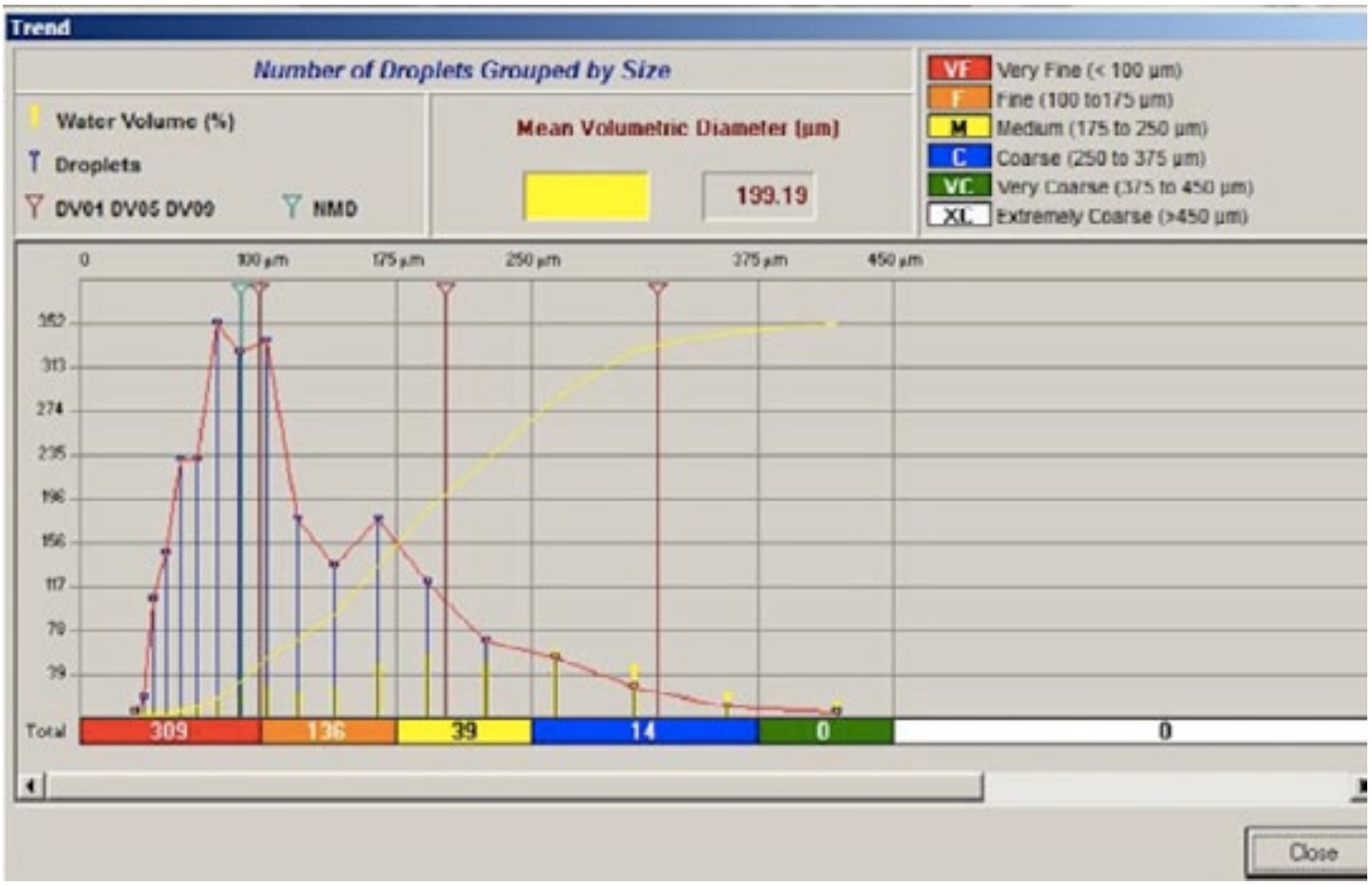


WSP is a special paper with a yellow film on one side that turns to blue color when it gets wet. It was developed by Syngenta over 30 years ago and it is widely available through spray parts suppliers. When droplets hit WSP they form a blue dot relative to the size of each droplet. This gives us an indication of the droplet sizes that are coming out of the nozzles. The number of drops and the total blue area on the paper gives us an indication of the volume of liquid applied over a specified area. We can compare this applied volume to the rate of application from the sprayer and see how efficient the application was. We can also use WSP just to indicate the presence of droplets. An example is to check if drift is occurring in a no-spray area. Here are a few ways that WSP can be used:

Checking Droplet Size – Labels on spray products include a recommendation of droplet size. To maximize the efficacy of the product, we need to be within the range of their recommendations. We can check this by positioning the WSP flat on the ground and simply spraying over the paper with the spray boom. After the droplets dry on the paper we can look at the size of the blue dots to determine the relative droplet sizes. There is a 'spread factor' for the size of the blue dots that corresponds to what liquid is used. Water has a known spread factor but a full tank mix of spray product may have

another unknown spread factor. I recommend doing these tests with just water. There are two methods of determining the relative droplet sizes from the WSP. The first is to simply compare the size of the blue dots to a known standard of measured droplets. These comparison samples are usually supplied with the WSP. The second method is to scan the card and use specialized software to analyze the droplet sizes. Not everyone needs to have this software, but a professional spray consultant (Frost Inc.) should have it and be able to analyze your WSP samples.

Checking Volume Applied – The methods for checking the actual volume applied are the same as above, except that there is no comparison method and we need to use the software to analyze the volume. We also need to add the speed of the sprayer into the equation. If we know the sprayer applied rate, we can compare it to the measured applied rate on the WSP to find out how efficient the application was. Variables such as mid-air evaporation and drift prevent us from ever achieving 100% efficiency, but a good indication of relative efficiency can

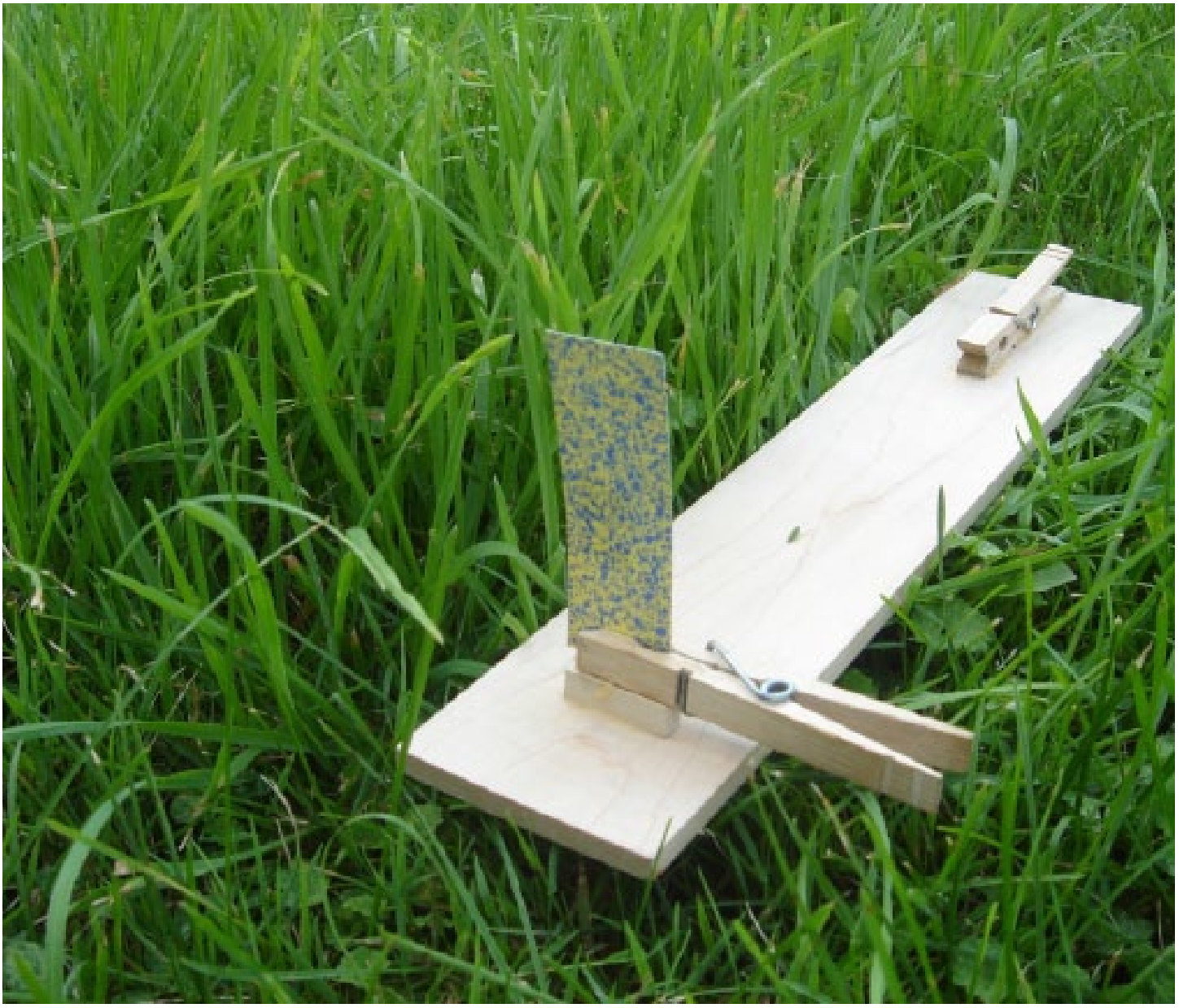


be learned from this exercise.

Checking for Drift – Everyone has neighbors and they are usually concerned about what you are spraying and if it could possibly be drifting onto their property. Besides neighbors, every spray application is completely surrounded with a no-spray zone. We need to be sure that the products we are spraying are only going on the intended spray area. We all should know this and don't need to be lectured again on all the reasons why. WSP is a great tool to test and verify that we are only applying on the intended spray area. Simply placing a WSP in a holder about 1 foot off the ground and every 10 feet along a border will indicate if any spray droplets have drifted off the intended spray area. If you are dealing with a concerned neighbor and you have controlled your drift, showing them the evidence on the WSP may put their mind at ease.

Checking for Coverage – When we talk about coverage we are referring to the ability to get as many droplets all over our intended target. The more droplets we get

on all sides of the target, the more effective the spray products are to do their work, specifically if they are contact type spray products. When we were checking for droplet size and volume, we placed the WSP flat on the ground, but in a three dimensional world, our spray targets are rarely flat on the ground. If we orient the WSP to mimic the structure of a turf grass blade, we can get a better picture of how well we are doing with our spray jobs and try different things to increase coverage. This thinking has led to multiple angled nozzles to spray forward and back as the spray boom moves over the target and it's easy



to demonstrate with WSP. Simply clip two WSP's taped back-to-back to a base and orient them vertically like a blade of grass. Align the WSP perpendicular to the direction of travel. Spray over them with a flat fan nozzle and compare the coverage on the front WSP to the back. Repeat the test using a twin-fan nozzle and you should note more coverage on the back WSP side.

You may already feel that you have a good handle on your spray coverage and/or where your drift risks are. However if you want to gain a little more confidence and learn more about where your sprays are going, water sensitive paper is a good tool to use.

Hypro WSP tech sheet

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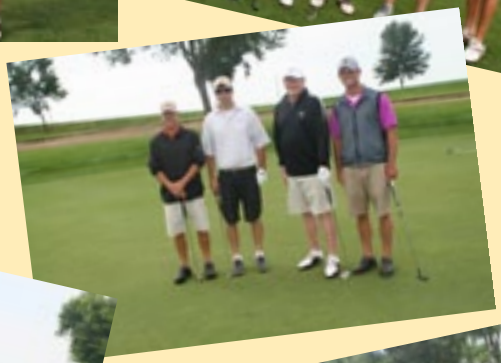

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Protecting Bees and Beneficial Insects in the MN Golf Industry

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Pollinators and Beneficial insects and the Golf Industry

In the February 2014 online article from the GCSAA (www.gcsaa.org/gcm-magazine/2014/february/gcm-february-2014-environmentally-friendly-golf) there is an online article on "Environmentally friendly golf: Reducing chemical use and adopting best management practices can make golf courses playable and environmentally friendly". The article points out that managed honeybees and native pollinators can flourish on golf courses. Management of turf to remove weeds reduces the impact of systemic insecticides on any flowering weeds growing in turf. Management of pest insects on flower beds can use contact rather than systemic insecticides to protect beneficial insects and bees. Retrofitting the flower beds with plants that offer a season long display of flowers will conserve many beneficial insects that will help manage turf pests. The article goes on to discuss a research project funded by USGA on a golf course in Bethpage NY State Park that was a collaboration of Cornell University, the NY State IPM

program, and the golf course and has continued for 13 years. A manual describing these practices serves as the backbone for training personnel from 29 New York state park golf courses in a pilot implementation program. The manual has also been used by superintendents attending training sessions in New York State and at the GCSAA educational seminar on reduced chemical golf course management during the past two years. Please check out the article.

In this article, I wanted to provide some basic information on the neonicotinoid issue with bees and provide a reference for what insecticides are toxic to bees.

We Need Pollinators To Makes Seed and Fruits

Honey bees and native bees, such as bumble bees, pollinate 30% of the plants that produce the vegetables, fruits, and nuts that we consume. More than 100 crops in North America require pollinators. Pollination by bees contributes over $18 billion worth of additional crop yields. In addition, bees pollinate native plants that require seed to sustain future populations. Both native bees and managed honey bees are in decline due to habitat loss, loss of high quality pollen (protein), loss of nectar plants, pathogens, and pesticide use.

Honey bee colonies in Europe and North America have faced some difficult problems for a long time. Beekeepers have been battling the devastating effects of a parasite of bees called the Varroa mite, which was introduced into Europe in the 1970's and in the US in 1980's and is very difficult to control. Honey bees are also faced with a number of diseases and viruses that compromise their immune systems and health in general. Since WWII, with the increase in monocultures and herbicide use, there

has been a serious decrease in flowering plants that bees utilize.

Beginning in 2006 a yearly die-off of honey bee colonies occurred throughout the US. The cause of this mortality is still unknown but was coined, colony collapse disorder. Most researchers now agree that honey bee decline is due to multiple, interacting causes, including the effects of bee specific diseases and parasites, lack of floral resources that provide good bee nutrition, and lethal and sub-lethal effects of pesticides. It is known that insecticide use in general can take a toll on honey bees and native bees when the bees are exposed to high enough concentrations. However, it is unclear how much the neonicotinyl insecticides contribute to honey bee poor health or even mortality. Recent research indicates that bees exposed to relatively low doses of neonicotinyl insecticides (10 ppb) may have suppressed immune systems, which makes them more susceptible to some bee diseases. Research also shows that neonicotinoids can have multiple sublethal effects on bees, including disorientation, effects on learning and a reduction in pollen collection and storage. More research needs to be conducted to determine residue levels that bees are exposed to in agricultural and urban environments.

Neonicotinoid Insecticides May Harm Pollinators

- The class of neonicotinoids insecticides (imidacloprid, dinotefuran, clothianidin, and thiamethoxam) are highly toxic to honey bees and other pollinators. They are systemic, meaning that they are taken up by a plant's vascular system and expressed through pollen, nectar and guttation droplets on leaf tips from which bees forage and drink.
- Research has shown that sublethal exposure to neonicotinoid insecticides causes significant problems for bee health, including disruptions in