Integrated Pest Management for Stinging Insects

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Abstract:
Stinging insects, such as bees, yellowjackets, and other aggressive wasps, pose a significant threat to humans in the outdoor environment. Social wasps and bees will sting when provoked or especially when the colony is threatened. Although otherwise beneficial, many of these social wasps and bees build colonies and forage very close to human activities, such as around homes, schools, parks, concession stands, festivals, and the like. The standard type of control for stinging insects tends to focus on reactive pesticide use. Several alternative approaches exist but it is unclear to what extent they work. Integrated pest management strategies are also available, but many practitioners do not use them. Most homeowners know nothing about the types of stinging insects, the risks each may pose, and ways to reduce their impact before resorting to a pesticide. In 2006 the work of NYS IPM specialists helped push forward our understanding of how traps can be used to manage wasps in outdoor settings and whether repellant trash bags can reduce foraging. In addition, a draft manuscript was written for a publication that will serve as an IPM reference tool for anyone dealing with wasps and bees in the Northeast.

Background and Justification:
Specialists in the NYS IPM Program have conducted trials on managing wasps and bees for many years. Efforts include trapping, monitoring and new nest destruction, vacuuming wall-void nests, and the use of colored paints to discourage nest building. Many tools investigated have their place in a stinging insect IPM program, especially for schools where pesticide use must be minimized. Schools in New York are under mandate to use IPM and to report pesticide uses to parents and staff. To minimize costs associated with both efforts, particularly reporting, many schools are looking for ways to avoid using reportable pesticides and instead substitute physical and alternative pest management strategies. Several municipalities in New York also have pesticide phase-out mandates that encourage them to seek alternatives. In schools and sensitive areas of municipalities, wasps and bees must be managed. Allergies, particularly in children, are more prevalent than in the past, and it is imperative that schools and parks managers minimize the risks posed by stinging insects to avoid health risks to children.

Objectives:
1. Test the premise that trapping yellowjackets around a periphery of a plot will reduce the number of yellowjackets in the center of the plot.
2. Test the claim that repellent trash bags, infused with d-limonene, will reduce wasp and bee foraging at those trash cans.

3. Develop a broad-interest publication on stinging insects that serve as a reference for identification and guideline for management.

Procedures and Results:

Testing of Yellowjacket Trapping Efficacy in Upstate New York

Stinging insects, especially yellowjackets (*Vespula* and *Dolichovespula* spp.), are among the most frequent and persistent pest problems at schools, parks, and similar locations (Murray 2000, Braband et al. 2002). Yellowjackets are also common hazards at late summer and early fall outdoor festivals.

One approach to reducing the risk is the use of baited container traps. Large numbers of yellowjackets can be caught in such traps. However, entomologists and pest management professionals are frequently skeptical about the ability of trapping to actually reduce the risk of being stung. Additionally, trapping is labor intensive. Research to date has compared trap types (Kovacs et al. 2005) and lures/baits (Wegner and Jordan 2005). Whether the traps actually reduce stinging risk has not been experimentally tested.

We tested the premise that trapping around a periphery of a plot will reduce the number of yellowjackets in the center of the plot. The assumption was made that the fewer the yellowjackets, the less the risk of being stung. We used paired plots where we trapped the periphery of one plot of a pair but not the second. In an initial pilot study, we achieved replication over time. In the subsequent expanded study, replication was over time and space. We also compared the results of our tests to applied use at community festivals and school playgrounds.

Pilot Study

During the first three years (2001-2003) of the pilot project, our study design consisted of two plots a hundred yards or more apart from each other in open fields. Each plot was a square 100 feet by 100 feet. Trapping stations were established at twenty-foot intervals around the perimeter of each plot. Each station consisted of a 10-foot length of 3/4-inch conduit pipe driven into the ground. Yellowjacket container traps were attached to the top of these poles. Each plot also had a triplet of trap stations in the center. During a two-week long testing trial, traps were maintained on all poles (periphery and center) on one plot but only on the center poles in the second plot. Plots were alternated from trial to trial. In other words, in the first trial, Plot A had traps on both the periphery and center while Plot B had traps only in the center. In the second trial, Plot A had traps only in the center while Plot B was trapped on both the periphery and center. In the third trial, the plots were switched again and so on for a total of four or five trials per year. Trapping started in August and ended in October. The pair of plots were in the same location (Geneva) in 2001 and 2002, but moved in 2003 to a different site (Canandaigua) approximately 20 miles away to address “pseudo-replication” concerns (Douglas Johnson, personal communication).

By far, the largest majority of the stinging insects caught in the traps were *Vespula* yellowjackets, and only this data has been analyzed to date. Other plentiful species

included the bald-faced hornet (*Dolichovespula maculata*), paper wasps (especially *Polistes dominulus*), and the European hornet (*Vespa crabro*). In addition, a potpourii of other stinging insects were also caught in small numbers. Few honey bees (*Apis mellifera*) were captured.

Captures of yellowjackets started slow, peaked in September, and dropped off rapidly in October. Although never significantly different (Stuent's T-test, $P<0.5$), more yellowjackets were caught in the center traps in plots without peripheral traps than in the center traps in plots with peripheral traps. (The power of statistical testing was weakened by the low number of observations, 4 or 5 trials in a year.) This may indicate a trend for the peripheral trapping to reduce the number of yellowjackets inside the plots.

In the first and third years of the study, number of yellowjackets trapped declined once the peripheral traps were switched and gradually built up as each two-week trial progressed. Possibly yellowjackets were homing in on the plot with the most traps and took awhile to change their behavior once the peripheral traps were moved. If so, this would indicate that the traps were attracting, and not just merely intercepting, yellowjackets.

In 2004 and 2005, we "played" with the experimental design by changing when the center traps were set (2004) and the length of the trials (2005). We felt that we did not gain any advantages over the previous design. The most consistent result both years was an apparent trend (as also observed in 2001 and 2003) for increased captures as a trial progressed.

Expanded Study

With funding from the Pest Management Foundation, we increased the scope of the study in 2006 to four sets of paired plots. Two sets were at the same locations (Geneva and Canandaigua) used during the pilot study. A third set was in Geneva about one mile from the other location. The fourth set (Ithaca) was approximately 50 miles southeast of Geneva. Using the same protocol as the pilot study from 2001 through 2003, five two-week trials were run for each pair of plots. The following results and conclusions are based on preliminary analysis of the study's data.

Yellowjacket captures were "spot checked" for identification. Species identified were the German yellowjacket (*Vespula germanica*), hybrid yellowjacket (*V. flavopilosa*), eastern yellowjacket (*V. maculifrons*), and *V. vidua*.

The mean average capture was lower for the center traps with peripheral trapping (19.4 yellowjackets) than for the center traps without peripheral trapping (29.8 yellowjackets). With 20 observations (4 sets of plots with 5 trials each), Student's T-test analysis showed a statistically significant difference ($P< 0.05$) between these means.

Although not yet confirmed statistically, all 4 pairs of plots had increasing captures as a two-week trial progressed. This supports a similar general trend during the pilot study as evidence that the traps attract, and do not merely intercept, foraging yellowjackets. The

only time when we saw a reversal of this trend was during the pilot study in 2002. Yellowjacket activity may have been affected by the unusually dry conditions that summer.

Small Scale Study

During 2006, we had an opportunity for a limited study on smaller acreages. This consisted of one set of paired plots, each plot 40 feet by 40 feet. Peripheral trapping locations were 20 feet apart resulting in a perimeter of 8 traps. Two traps were in the center of each plot. The center was approximately 20 feet from the periphery. Conceptually, this might be considered using the traps in a smaller "lawn" situation rather than seeking to protect a larger area.

Results were affected by the limitations of evaluating only one pair of plots over three two-week trials. However, location of the plot (one was adjacent to a busy road) appeared more important to the yellowjacket capture rate than peripheral trapping. In the peripheral trapped plot, there were consistently more yellowjackets per trap in the center than in the periphery. Thus, with this size of plot and trap density, we had no evidence that peripheral trapping reduced the numbers of yellowjackets in the center.

We also had no consistent trends in the capture rates as we progressed through a two-week trial. This may have been influenced by the close proximity of the two plots to each other (100 feet apart contrasted with 100 yards or more for the larger study).

Applied Testing

Trapping yellowjackets for the purpose of reducing stinging risks at community festivals has been done in at least two locations in upstate New York. Cayuga County has been trapping at two annual events in Emerson Park for at least five years (Bruce Natale, Cayuga Co. Planning Office, personal communication). Trapping at the Clothesline Art Festival in Rochester, NY has been conducted for over three years (Peter Castronovo, University of Rochester, personal communication). In both situations before the use of the traps, the number of instances of first aid administered for stings was described as "numerous". Concurrent with trapping, such cases were noticeably reduced, usually to less than six.

In 2000 and 2001, we experimented with the use of traps at two school districts, one each in eastern New York State (Albany County) and western New York State (Livingston County). The traps were placed around elementary school playgrounds. We compared trapped playgrounds to non-trapped playgrounds in both districts by regularly surveying for stinging insect nests and surveying teachers and school nurses about known or perceived risks. Collectively over both years and both school districts, almost 10,000 stinging insects were captured. The vast majority (98%) was *Vespula* yellowjackets. However, we have real questions whether we reduced the risk of being stung at the playgrounds, especially given the previously mentioned evidence that the traps attract yellowjackets.

Conclusions

Based on our current results, the best use of yellowjacket traps is probably when there already exists a strong attractant, such as concession stands, for yellowjackets. I would not recommend using the traps if such attractants do not exist which is the case for many playgrounds. The distance of the traps from the site to be protected is probably important. For festivals, the recommended procedure is to start trapping one week before the festival begins and continue trapping through the duration of the event. Traps will need to be regularly serviced, possibly daily, while they are up.

Future Analysis and Work

We will be confirming and expanding upon the current analysis of, especially, the 2006 expanded study. Included will be evaluations of the relative impacts of variables, such as plot location, trap location, trial, and weather, on the yellowjacket capture rates. We will also analyze the capture rates of bald-faced hornets and paper wasps.

A possible future area of research might be the investigation of the optimum distance of the peripheral traps from each other and the "protected' site.

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Testing Repellent Trash Can Liners for Reduction of Wasp and Bee Foraging

During September 2006, a trial was conducted to compare insect-repellent trash can liners with ordinary liners to test the effects of the insect-repellent quality. The plastic of these special bags has been infused with the oil of d-limonene. Six mesh garbage cans

were set up in rows of three in an area between a food service building (a café) and the horticulture gardens of SUNY Farmingdale, in Farmingdale, NY. The cans were pre-baited on a Friday and remained over a warm September weekend with cat food and orange soda, and without plastic liners. Fish-flavored soft cat food and orange soda have been verified as preferred attractants of yellowjackets. Within one hour the set up attracted between 3 and 8 yellowjackets per garbage can, and this pattern continued as long as food was available.

On Monday morning three days after pre-baiting, more orange soda was made available for 2 hours, and then each trash can was lined with a plastic bag. Ordinary black can liners were alternated with black repellent liners, so that 3 bags of each type were displayed and the only difference between them was the repellent ingredient. More orange soda was splashed on the inside walls of each bag and allowed to run down inside the bags. By mid-afternoon, wasps and bees were so numerous at these trash cans that counts were impossible to take in an accurate fashion. A video camera would have to be used to record the number of visiting wasps and bees. To account for the significant rise in the number of visitors, closer observation was made. The trial trash cans with bait were inundated with honey bees. Other species included German yellowjackets, (*Vespula germanica)*, some Eastern yellowjackets (*Vespula maculifrons*), and an occasional European paper wasp (*Polistes dominulus)*. Despite the fact that brand new repellent trash can liners had been installed to three of the six trash cans, bees and wasps showed no significant response to the repellency of the special bags. There were nearly as many yellowjackets on all plastic trash can liners, regardless of repellency. I saw a slight difference in the numbers of honey bees that landed on plain versus scented bags. The honey bees were a little reluctant to land on the scented bags. But it apparently made no difference to the yellowjackets. To document these results, I videotaped the foraging of insects on both types of trash can liners and took photographs.

Unfortunately, these results are not promising for the management of stinging insects. Even though there could have been a slight, yet difficult to measure, difference in the repellency of wasps and bees of the special trash can liners, it would not be enough to offer a margin of protection, especially in a "no-choice" situation where only repellent bags were to be used. Yellowjackets, paper wasps, and honey bees were not significantly repelled by the d-limonene infused trash can liners.

Stinging Insect IPM Manual Development

Currently there is no single source of information about wasps and bees that disturb humans in the Northeastern US. Cooperative extension fact sheets and guidelines can be found on the internet and are available locally, but they are often brief and pesticide oriented. Furthermore these fact sheets contain little information that would enable an individual to determine the species of insect they have come across, and therefore weigh the risks of the presence of that insect versus control measures.

With funding from the USDA-CSREES program, the Natural Resource, Agriculture, and Engineering Service (NRAES) has agreed to act as publisher of a manual tentatively titled "Integrated Pest Management for Wasps and Bees". This manual is being

developed by the NYS IPM Program based on the years of experience in testing alternative management strategies, as well as regular outreach efforts to New Yorkers.

As of the end of 2006 the manual is in first draft form and is being peer-reviewed. The content of this publication includes basic biology of significant wasps and bees that can become pest problems. The chapters are arranged in an order that ranks wasps and bees according to their relative "threat level" to human health, such as "high risk" for yellowjackets and "low risk" for solitary wasps, mainly representing the risk of being stung. The material describes identification of and damage caused by each species. The chapter on management is organized by tool category, including trapping, habitat modification, and pesticide use. There is a section highlighting Africanized bees and the importance of bees as pollinators and wasps as predators. The book stresses the concept that wasps and bees are inherently beneficial and should only be managed if they pose a direct threat to humans. This manual will be available to the general interested public, as well as to extension personnel, pest control and landscape professionals, and master gardeners.

Results and Discussion
IPM specialists of the NYS IPM Program have focused on the safe and effective management of stinging insects for several years. The goal is to find safer and more effective low risk methods of managing wasps and bees that satisfy requirements of NY State and several counties to reduce or report pesticide use, and to adopt IPM. Through the research and demonstration projects of IPM specialists, it has become clear that integrated pest management is the best management practice for wasps and bees in the human environment. As we streamline some practices, such as trapping yellowjackets in outdoor recreational settings, both money and time will be saved for those using trapping. Repellent trash bags may be a tool of the future, but today these do not seem to work any better than ordinary trash bags. Many schools and municipalities have adopted IPM as a policy but many lack the practical information to implement IPM in specific situations. The development of the stinging insect IPM manual will provide detailed steps on identifying wasps and bees, their relative threat, and IPM tools for management based on the accumulated years of experience of the NYS IPM staff. It is anticipated that the projects of 2006 will have impact on wasp and bee management in years to come.

Project locations:
Yates County, Ontario County and Suffolk County, NY. The manual will become available nationally through a Northeast-based program, NRAES.

Samples of resources developed: (if applicable) nothing available at this time.