CONTROLLING YELLOW JACKETS WITH FIPRONIL

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INTRODUCTION

- Beekeepers are affected by Yellow Jackets (*Vespula vulgaris)* or German Wasps (*Vespula germanica)*. There are several species in the Vespula family. They all cause the same issues, but these two are the most common ones.
- The main diet of Yellow Jackets are other insects, but they also like meats which has lead to them being called “Meat Bees”. **They are not bees by any means.**
- Yellow Jackets are at their highest numbers in late summer.
- Their need for food resources at late summer is immense.
- They will infiltrate weak bee hives, by killing all the bees. From there they remove all brood and take them back to their nest to feed their offspring.
- In fall they raise new queens for the next season. These queens mate and find a hibernation spot in the ground. All other wasps of the mother colony, including the mother, will die.
- Yellow Jackets have not only become a problem for beekeepers, they have also become a problem for state parks and camping sites. The risk of getting stung and possible allergic reactions are real. Anaphylaxis in honey bee stings is 0.5%, while Yellow Jackets stings has a 5% anaphylactic rate.

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WASP FAMILIES

Vespula Family

Vespula acadica, Forest yellowjacket
Vespula alascensis, Common yellowjacket
Vespula atropilosa, Prairie yellowjacket
Vespula austriaca, Cuckoo yellowjacket
Vespula consobrina, Blackjacket
Vespula flavopilosa, Downy yellowjacket
Vespula germanica, German yellowjacket
Vespula intermedia
Vespula maculifrons, Eastern yellowjacket
Vespula pensylvanica, Western yellowjacket
Vespula rufa, Vespa schrenckii
Vespula squamosa, Southern yellowjacket
Vespula sulphurea, California yellowjacket
Vespula vidua, Ground hornet
Vespula vulgaris, Common Yellowjacket

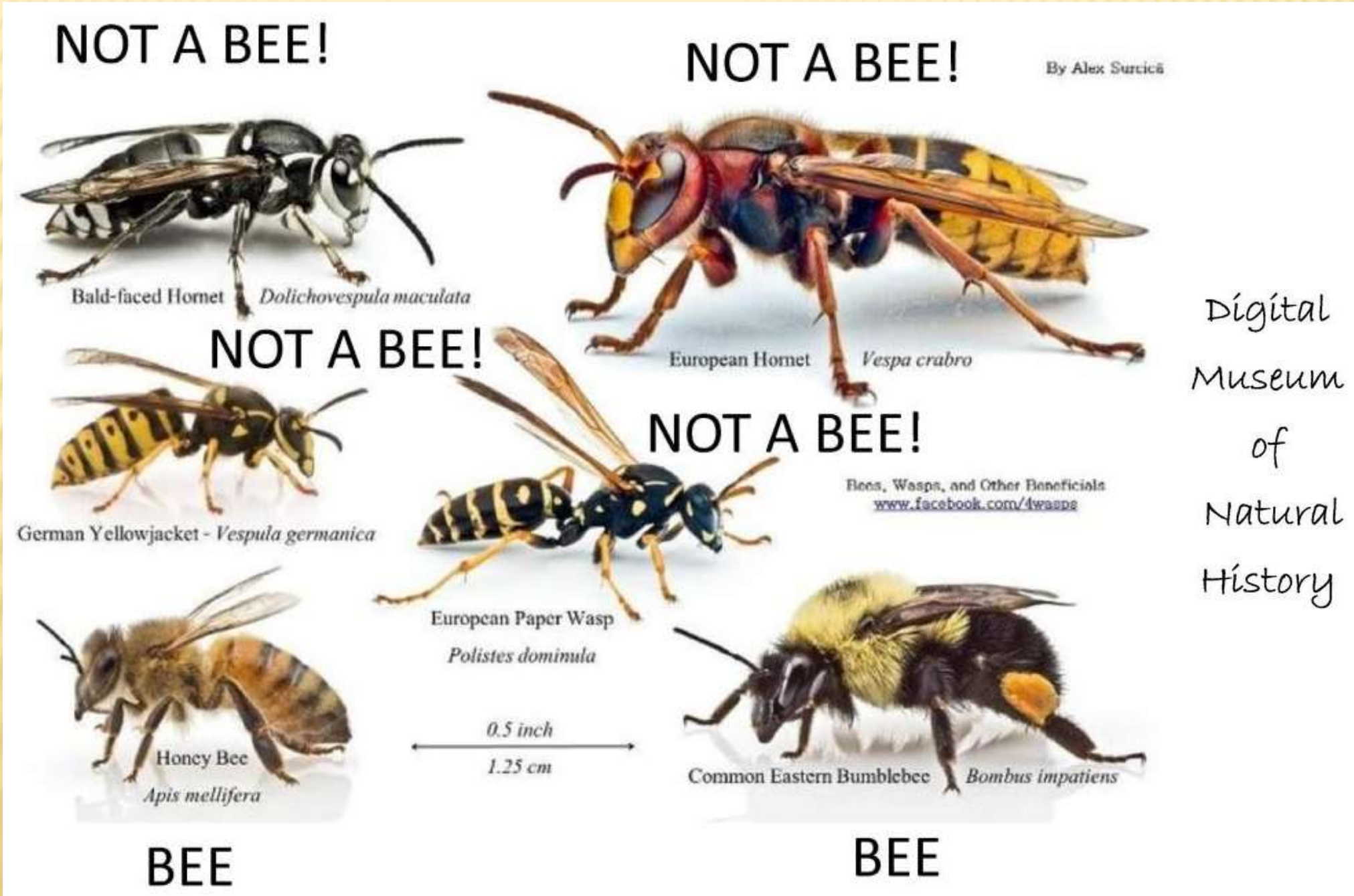
Dolichovespula Family

Dolichovespula adulterina, Vespa borealis
Dolichovespula albida
Dolichovespula alpicola
Dolichovespula arctica
Dolichovespula arenaria, Aerial yellowjacket
Dolichovespula maculata, Baldfaced hornet
Dolichovespula norvegicoides, Northern aerial yellowjacket
Dolichovespula norwegica, Vespa britannica
Dolichovespula saxonica

Paper Wasps Polistes Family

Polistes annularis
Polistes apachus
Polistes arizonensis
Polistes aurifer, Golden paper wasp
Polistes bahamensis
Polistes balder
Polistes canadensis
Polistes carnifex
Polistes carolina
Polistes chinensis
Polistes comanchus
Polistes dominula, Paper wasp
Polistes dominulus
Polistes dorsalis
Polistes erythrinus
Polistes exclamans
Polistes facilis
Polistes flavus
Polistes fuscata
Polistes humilis
Polistes instabilis
Polistes kaibabensis
Polistes laevigatissimus
Polistes major
Polistes metrica
Polistes metricus, Paper wasp
Polistes olivaceus, Macao paper wasp
Polistes pacificus
Polistes palmarum
Polistes perplexus
Polistes riekii
Polistes schach
Polistes sgarambus
Polistes sp_carolina_or_perplexus
Polistes stigma
Polistes tepidus
Polistes variabilis

COMMON INSECT IDENTIFICATION



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COMPARISON

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Honeybees compared to Yellow Jackets, Paper Wasps and Hornets

	Honeybee	Yellow Jacket	Paper Wasp	Hornet
				
Color	Varies but generally amber to brown translucent alternating with black stripes; some are mostly black	Black and opaque bright yellow stripes	Dusty yellow to dark brown or black	Black and ivory white markings
Size	½ inch	½ inch	¾ to 1 inch	¾ inch
Legs	Not generally visible while flying; pollen baskets on rear legs can be seen while walking	Two long legs are visible hanging down during flight; no pollen baskets	Long, no pollen baskets	No pollen baskets
Behavior toward humans and animals	Gentle unless hive is threatened	Aggressive	Gentle	Aggressive
Preferred Food	Nectar and pollen from flowers	Other insects, overripe fruit, sugary drinks, human food, particularly meat	Other insects	Other insects
Stinger	Barbed, kills bee when used	Smooth, retracts and can be used indefinitely	Smooth, retracts and can be used indefinitely	Smooth, retracts and can be used indefinitely
Lives in	Large colonies of flat wax-based honeycomb hanging vertically	Ground, small cavities or semi-open structures	Small umbrella-shaped papery combs hanging horizontally in protected spaces; attics, eaves	Large paper nest shaped like inverted pear; usually hangs from branches or eves

Source: Stephen G. Parise, Agricultural Production Specialist; HONEY BEE or YELLOWJACKET WASP?

WHAT IS FIPRONIL?

- Fipronil is a broad use insecticide that belongs to the phenylpyrazole chemical family.
- Fipronil is used to control ants, beetles, cockroaches, fleas, ticks, termites, mole crickets, thrips, rootworms, weevils, and other insects. It is toxic to birds when fed in full concentration (not to ducks) and very toxic to invertebrates.
- It is a white powder in full concentration. Products on the market are diluted and usually have a low concentration. In pest management 0.1-0.0001% concentrations are commonly used.

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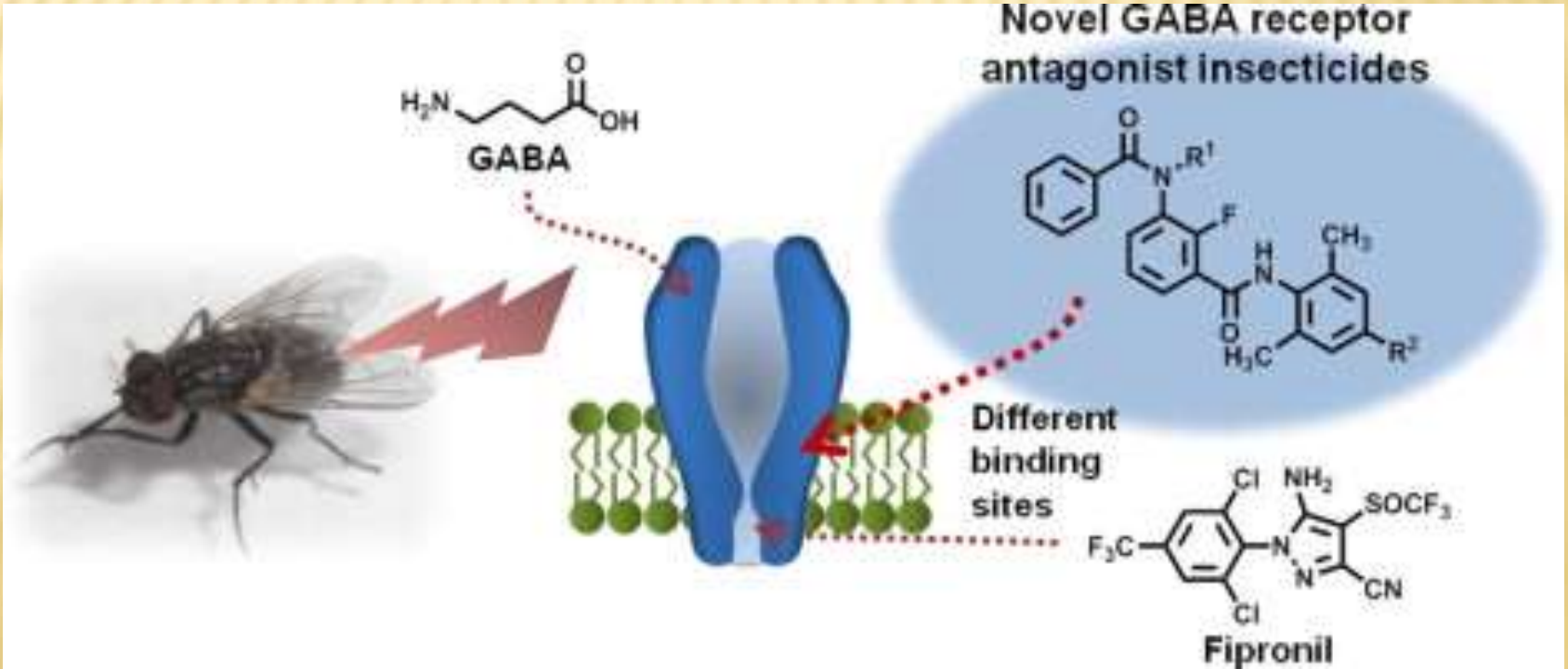
HOW DOES IT WORK?

- Fipronil kills insects when they eat it or come in contact with it. Fipronil works by disrupting the normal function of the central nervous system in insects.
- Fipronil is more toxic to insects than people and pets.
- In insects, Fipronil or its major metabolite (fipronil sulfone) noncompetitively binds to $GABA_A$-gated chloride channels, thereby blocking the inhibitory action of $GABA_A$ in the CNS. This leads to hyperexcitation at low doses, and paralysis and death at higher doses. Mammals und humans do not have GABA channels.



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FIPRONIL TESTINGS

- The amount of fipronil taken into the body across the skin depends on the product formulation.
  - Researchers applied a dose of 79% Fipronil to the skin of rats and found that less than 1% of Fipronil was taken into the body after 24 hours.
  - When test animals have eaten Fipronil, between 15-33% (goats) and 30-50% (rats) of the ingested dose was absorbed by the body. Once in the body, Fipronil is found mainly in the fatty tissue, and breaks down into smaller chemicals called metabolites. Fipronil and its metabolites are then removed from the body mostly through the feces and also in the urine.
  - Symptoms of acute toxicity via ingestion includes sweating, nausea, vomiting, headache, abdominal pain, dizziness, agitation, weakness, and tonic-clonic seizures. Clinical signs of exposure to fipronil are generally reversible and resolve spontaneously. No death in animal tests have been reported. Fipronil has not been tested in humans.
  - **This makes Fipronil safe to mammals.**
    A poisoned Yellow Jacket nest will not poison a skunk that digs up the nest and eats it all.
- Scientists have not found any evidence of Fipronil causing cancer in humans. Researchers fed Fipronil to rats in their diet for nearly two years to find out if Fipronil can cause cancer. Researchers found thyroid tumors in both male and female rats fed the highest dose. While these findings are considered to apply only to rats, Fipronil is classified as a "**possible human carcinogen**" by the United States Environmental Protection Agency (U.S. EPA).
- Fipronil is sold in concentrations of 0.01% to 0.1%. It can also be purchased as a 9% concentrate under the band name Taurus. Not near the doses used in tests.

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FIPRONIL AND THE ENVIRONMENT

- Fipronil is sprayed around foundations and injected into soil to control termites. It is less toxic than other products and relatively safe to the applicator.
- Fipronil is applied to lawns as a granulate or in a liquid application. Runoffs are of concern since Fipronil is toxic to fish and invertebrates.
- In the soil it takes up to 125 days for it to breakdown. Exposure to light breaks it down rapidly in 4-12 hours.
- Plants do not absorb it, which makes is a relative safe crop product.
- Fipronil was found to be of low toxicity to birds, but not ducks.
- Fipronil is highly toxic to bees. Dust-off from planting machinery caused honey bees not to find their way back to their hives. It should not be applied to flowering plants. In France it is prohibited to use Fipronil in seed planting machines for corn and on blooming sunflowers.
- It's fast acting mechanism and rapid breakdown in sun light makes it a safe product. Bees showed no ill effects on flowers collecting nectar the day after application. It was not found in their body or inside of hives.

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WHERE DO WE FIND FIPRONIL?

- Fipronil is the active ingredient found in dog or cat products to prevent flea and ticks infestations. Commonly known brands are Frontline, PetArmor, and PetAction.
- Combat Max roach kill products also contain it.
- Taurus concentrates for outdoor and indoor pest application and for termites.
- The most cost efficient product is Combat Max.

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VESPEX – A FIPRONIL GEL

- The most effective method of wasp control to date took close to 15 years to be approved for public use in New Zealand.
- In 2000 New Zealand started to conduct test with Fipronil in bait stations to reduce wasps. Other insecticides used prior were very toxic and posed risks to the public and environment.
- Fish based cat food was laced with fipronil and insects were being watched. Only Yellow Jackets were drawn to it and they took it back to their nest where they feed the brood with it and nests were killed within 24 hours!
- It was found to be safe to bees and paper wasps because the bait is of no interest to them. It took a decade to get this across to officials to approve Fipronil as an agent against yellow jackets in New Zealand.
- This lead to the development of a product called Vespex. The product is offered for 3-8 days in spring and late summer. A 97-99% reduction in Yellow Jackets has been reported.
- Beekeepers in New Zealand are now the number one user of Vespex.
- www.merchento.com/vespex.html Only available in New Zealand. Product is stores in the freezer.
- The Dow Corporation and BASF, among others, have filled for a patents to sell Fipronil in Hydrogel. The only difference is the bait smell. It will be available soon.

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FIRST BAIT TESTS IN CALIFORNIA

- In 2006 University of California Riverside started on bait tests with Fipronil.
- The only registered bait (Onslaught®, microencapsulated esfenvalerate) was not effective as a bait toxicant against Yellow Jackets.
- Swanson's brand canned minced white chicken and Purina Friskies Ocean Whitefish Dinner were consistently the most accepted bait bases tested. Baits consisting of 0.0025 to 0.025% fipronil were the consistently most effective baits tested.
- Test with Dinotefuran baits (0.001 to 0.025%) provided inconsistent results. The Dinotefuran was usually too toxic, killing workers before they could adequately recruit and scavenge the bait.
- Poison baits made up of other insecticides like Chlorfenapyr, Chlorantraniliprole, Indoxacarb, and Spinosad were not effective.

Fig. 4, *left*, Assortment of canned pet foods for acceptance trial; *right,* yellowjackets displaying preference by foraging some foods while neglecting others.

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FURTHER TESTING FOR A POSSIBLE COMMERCIAL PRODUCT

- University of California Riverside expanded on their findings.
  - **Problem:** Users must mix their own meat bait, which can be messy and costly, and fresh meat has practical limitations, among them cost, decay, and desiccation. Further decayed meat baits were of no interest to Yellow Jackets.
  - **Solution:** Development of an experimental synthetic alternative bait that can be sold to consumers in the USA. Remember they have Vespex in New Zealand, which is not approved in the USA.
- The alternative to meat used in the new research is a mix of canned chicken juice and the pesticide Fipronil in a matrix of hydrogel, a gel made of polymers that readily absorbs large amounts of water and swells as a result.
- The polymer used is polyacrylamide, a compound used in sewage treatment and as a thickener for materials such as grout. Hydrogel is readily available commercially and, even better, the "hydrogel bait," as the researchers call it, is inert to biological processes and does not deteriorate like meat.
- In the store you would buy the Fipronil hydrogels in dry form. You add water and done.
- Dow Corporation filed a patent for a fipronil hydrogel product.

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PRACTICAL APPLICATION IN HAWAII

- The western yellow jacket wasp (Vespula pensylvanica) invaded Hawaii's national parks and refuges following its spread throughout the islands in the late 1970s. The endemic arthropod fauna of Hawaii is thought to be especially vulnerable to these predacious social Hymenoptera, and methods of wasp control have been a priority for conservation biology in Hawaii.
- The bait was applied in hanging bait stations for two to three days. That was sufficient time to kill entire underground colonies.
- The only trial where fipronil failed to terminate yellow jacket nest activity occurred late in the fall when wasps switch from feeding on protein to carbohydrate foods. Based on their data, 0.1% fipronil in chicken bait appears to be an effective tool for suppressing local Vespula yellow jacket populations in the park and other natural areas during the period of peak wasp activity in the summer and early fall months.
- The state parks in Hawaii have been baiting since 2011.
- Other state parks in the US have also been using it.

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THE RECIPE OF SUCCESS

Yellowjacket taking home the bait

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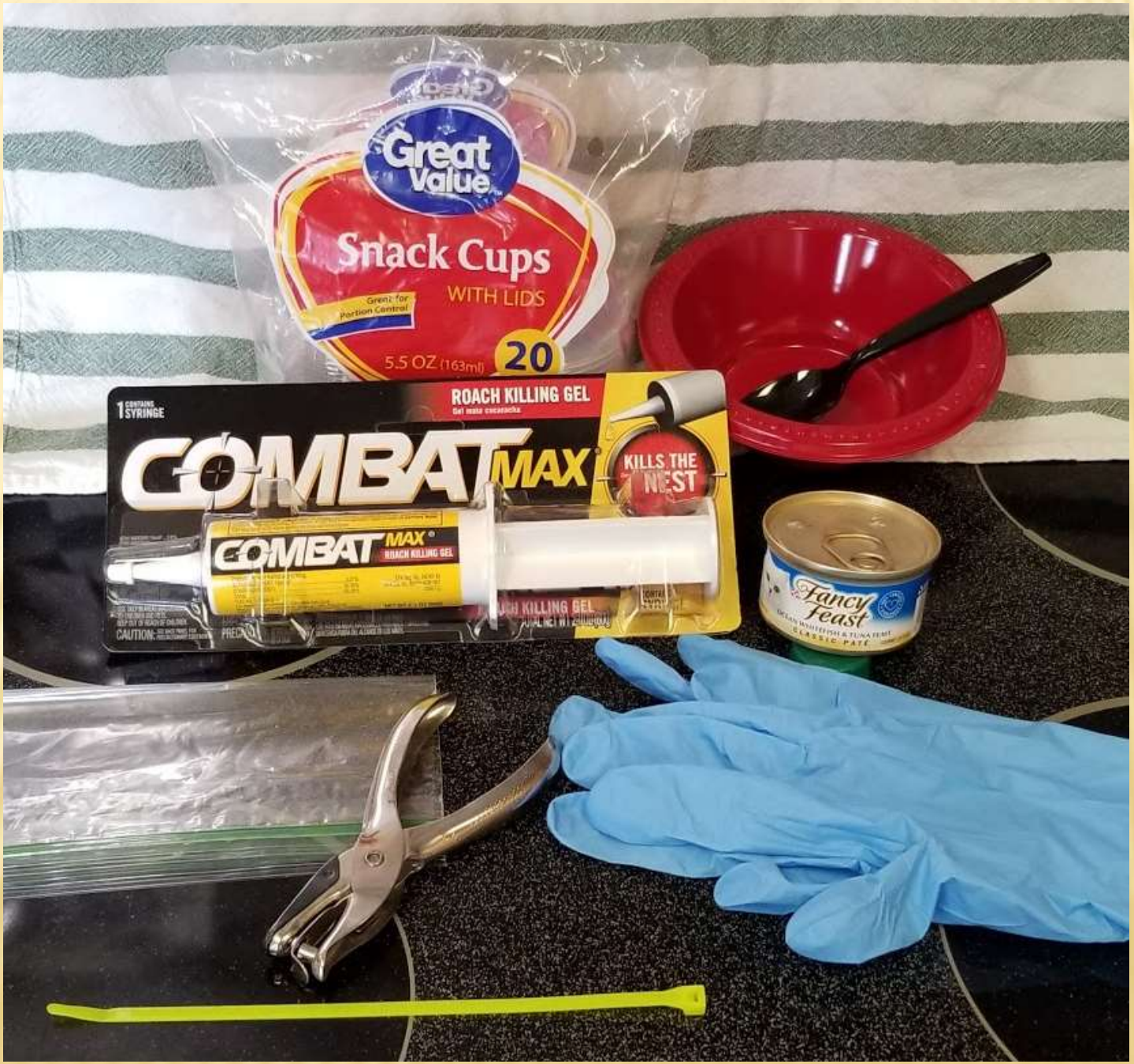
WHAT IS NEEDED?



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PRODUCT LIST

- Combat Max Roach Killing Gel, 1 Syringe, 2.1 Ounces ($7.93)
- Disposable Nitrile medical gloves ($4.98 for 50)
- Purina Fancy Feast Grilled Ocean Whitefish & Tuna Feast canned cat food ($1.48)
- Great Value 5.5 ounces Snack Cups with Lids ($2.97 for 20)
- Disposable mixing bowl ($2.15 for 50)
- Disposable tea spoon ($3.13 for 100 spoons)
- Hole paper punch ($2.96)
- Disposable Snack size Ziplock type bag for transport ($1.94 for 100 bags)
- Disposable 1 quart Ziploc type bag to dispose of used equipment ($2.12 for 20 bags)
- Zip Ties 14.5 inches long ($5.97 of a pack of 50)

- Prices are based on products found at Walmart. Most of these items are already in our households.

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IMPORTANT MESSAGE

- Read the instructions of the roach gel first.
- Pay attention to the safety label including handling instructions.
- Do not use dishes or silverware you intend to use for food. Use disposable products only.
- Wear protective gloves while handling the product.
- This mix is highly attractive to pets like cats and dogs. Make sure to dispose of the contaminated equipment in a safe manner and make it inaccessible to your pets. Best to dispose used equipment inside of a storage bag to eliminate the attractive smell.

PREPARATION

- Prepare 4 cups by punching two holes on opposite sides. This is so you can have the zip tie go through it for hanging. Add additional holes, but make those larger by punching several times. It does not need to be pretty, but functional. These holes are for the wasps to enter and to take the bait back to their nest.
- Mix the cat food with the roach gel. There is no fixed amount of Fipronil that is suggested in literature. I have seen varying amounts of 0.0025-0.001% Fipronil have been suggested. Combat Max Roach killing gel contains 0.1%. So simply eyeball it. Make sure to wear disposable nitrile gloves, since it can irritate the skin.
- Divide the poison mix over 4 prepared cups. Add lids. These are important to keep birds and other non-targeted species out. Add zip tie for easy hanging.

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READY TO HANG OUTSIDE

- Hang up outside. Keep it high and out of reach of pets and children. The yellow jackets will take the poisoned protein source back to their nest and kill the brood. You will notice a difference after one week.
- Use this trap only when you have a large yellow jacket populations causing issues.
- Use non-poison WHY traps throughout the season and to see when you can stop feeding the Fipronil bait.
- Each container holds only enough for one day, which is heaping teaspoon. Do not put more then that into the trap. It will only dry up overnight, and the Fipronil is inactive the next day.
- **Traps must be replenished daily!**
- Treating for 3-8 days should be sufficient. Yellow jackets forage up to 500 yards from their nest.
- https://tinyurl.com/fipronil traps

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ANOTHER BAIT VERSION

- I've looked online and have seen various trap version to keep birds etc. out of the bait. Metal cages are commonly used. I came up with the snack cup with lid idea. While looking I found an interesting version…
- https://beemaniacs.com/knowledge-base/dealing-with-yellow-jackets-wasps-and-other-honey-bee-predators/
  This one is not entirely bird proof, but you can use your wooden bee package box and cover the top with chicken wire. This is not water proof like the one I came up with. On the other hand you want the bait to be just enough for one day.
- Remember Fipronil falls apart with light in 4-12 hours. The roach gel is tinted to slow the process. Do not make large amounts - wasps will not finish in a day.

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IS THERE A CONCERN ABOUT HONEY BEES?

- **A recent study shows that it is safe around bees.**
- "We did not detect fipronil in any of the worker bee, bee larva, honey or pollen samples (n = 120 per product) collected from 30 hives over a 2-year period."
- Edwards ED, Woolly EF, McLellan RM, Keyzers RA (2018) **Non-detection of honeybee hive contamination following *Vespula* wasp baiting with protein containing fipronil.** PLOS ONE 13(10): e0206385. https://doi.org/10.1371/journal.pone.0206385

Site	Activity	Date	Number of samples[d]
Big Bush (season 1)	Hives sampled (prior[a])	20 Feb 2015	80
	Wasps treated[b]	20–24 Feb 2015	
	Hives sampled (after[c])	27 Feb 2015	80
Big Bush (season 2)	Hives sampled (prior)	3 Feb 2016	80
	Wasps treated	6–10 Feb 2016	
	Hives sampled (after)	12 Feb 2016	80
Pelorus Bridge	Hives sampled (prior)	4 Feb 2016	80
	Wasps treated	22–26 Feb 2016	
	Hives sampled (after)	26 Feb 2016	80
			TOTAL 480 assays

[a] Hives were sampled prior to wasp treatment in the hive environment.

[b] Wasp bait was placed in bait stations in the environment of the bee hives.

[c] Hives were sampled after wasp treatment in the hive environment. Hives located in associated non-treatment areas were also sampled on the same date as in the treatment areas.

[d] Four products (honeybees, bee larvae, honey and pollen) were sampled in 10 hives in each of the treatment and non-treatment areas. In 2015, hive scrapings were used in place of fresh pollen.

https://doi.org/10.1371/journal.pone.0206385.t001

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