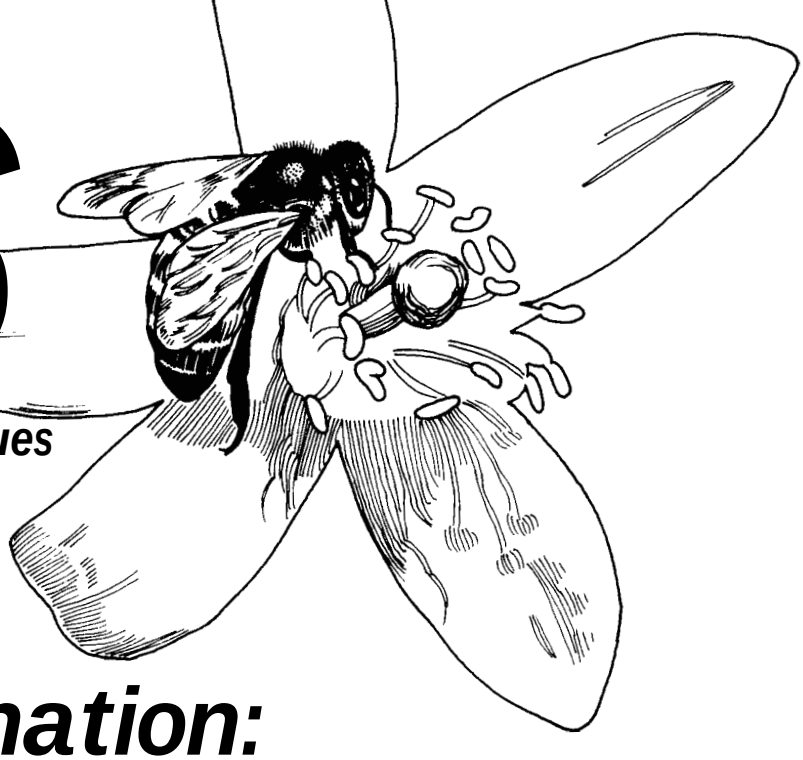
APIS

Apicultural Information and Issues
From IFAS/University of Florida
Department of Entomology and Nematology

November 1998



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APIS Volume 16, Number 11
ISSN 0889-3764

Pollination: The Forgotten Agricultural Input

SOME MAY HAVE HEARD of the successful program begun out West called "The Forgotten Pollinators"[1]. Although this campaign targets the insects involved, the pollination process is also important, especially within the context of modern agriculture. This is true whether beekeepers pay heed to the suggestions of Dr. Hallett and others about diversifying their insect culturing efforts as described in the October 1998 *APIS*[2], or my advice given in the July 1995 *APIS* that they consider becoming pollination consultants[3].

Thus, I have modified "forgotten pollinators" to read "Pollination, the Forgotten Agricultural Input." Recently I gave a paper with this title at the Florida Agriculture Conference and Trade Show (FACTS) in Lakeland. It concluded: "Much is known about the panoply of other agricultural inputs, but pollination has often been sidestepped in the process. Only when growers and commercial pollinators get a better picture of the key relationship between certain plants and their pollinators will they be able to take advantage of this forgotten agricultural input." The full paper is accessible from the *APIS* website[4]. ■

Re-examining Oxytetracycline for Foulbrood Control

BEEKEEPERS AND OTHERS continue to have questions about the use of the antibiotic oxytetracycline for *Paenibacillus larvae*, the bacterium that causes American foulbrood (AFB)[5]. Concern has recently become more relevant with discovery of oxytetracycline-resistant *P. larvae* in Argentina[6] and now the United States[7]. The registered product name for the one legal antibiotic used in beekeeping is Terramycin®, manufactured by Pfizer, Inc. Questions and concerns fall under two broad categories: 1) whether the material should be used as preventative or treatment, and 2) how it should be effectively administered to a bee colony.

Terramycin® has been used to successfully treat colonies showing symptoms of American foulbrood or AFB (Hoopingarner and Nelson, *American Bee Journal*, Vol. 128, pp. 120–121, 1988). Perhaps most outspoken on this philosophy was P.F. (Roy) Thurber, a

[1] http://www.pmac.net/birdbee.htm
[2] http://www.ifas.ufl.edu/~mts/apishtm/apis98/apoct98.htm#4
[3] http://www.ifas.ufl.edu/~mts/apishtm/apis95/apjul95.htm#T1
[4] http://gnv.ifas.ufl.edu/~mts/apishtm/papers/ALTPOL.HTM
[5] http://edis.ifas.ufl.edu/scripts/htmlgen.exe?DOCUMENT_AA090
[6] http://www.ifas.ufl.edu/~mts/apishtm/papers/fifth.htm#5
[7] http://www.ifas.ufl.edu/~mts/apishtm/papers/COLORADO.HTM#14

> “The best control of American foulbrood has been due to partnership between committed beekeepers and professional inspection services.”

former bee inspector, who wrote “Medication and Comb Rotation for AFB,” in the December 1980 and January 1981 issues of *The Speedy Bee*. Reading Mr. Thurber’s articles carefully one finds that rotating comb was key to his methodology, as was administering antibiotics. Others are more conservative and recommend that colonies with visible signs of the disease be burned. One of the reasons for this is that although “curing” a colony with symptoms seems to be possible, the probability that a beekeeper will be successful in this endeavor is considered by most to be extremely low. Mr. Thurber himself admits this, saying that if the process, as he describes it, is attempted only half-heartedly, it should never have begun.

Burning infected colonies is the philosophy behind most bee inspection, including Florida’s. Keep in mind the reason inspection services exist at all is because they were mandated by beekeepers during the early 1900s, when severe epidemics of AFB were experienced and hundreds of colonies were burned. Because of this possibility, most commercial beekeepers I have spoken to over the last two decades were adamant that any colony showing symptoms should automatically be bumed, no questions asked. Most do this themselves without resorting to any formal inspection service.

Historically, the best control of American foulbrood has been due to partnership between committed beekeepers and professional inspection services. A good example of the effectiveness of inspection is in New Zealand, where most recently the percent infestation has dropped from 0.81 to 0.61[8]. Several parallels also exist between New Zealand and Florida bee inspection resulting in a decrease in AFB cases[9]. However, there have been calls that inspection services have served their purpose and are no longer needed[10]. They derive from the belief that funds used in inspecting and burning colonies could be better spent educating beekeepers, an approach necessarily adopted with introduction of parasitic mites. Bee inspection services, however, often contribute in other ways important to beekeepers[11, 12].

Although treating colonies with symptoms remains extremely controversial, feeding antibiotics to prevent American foulbrood symptoms is now practiced by a large number of both commercial and sideline beekeepers in North America. Again, the only registered material for this use is Terramycin®. Routine feeding of this substance appears to be a spillover from other areas in agriculture where this practice is also routine and more antibiotics are often legal and available. Often this is not for disease control, but because animals fed antibiotics seem to be much healthier and/or heavier. The custom appears to have also been taken to heart by many human physicians, who prescribe antibiotics for everything from viruses to the common cold, conditions over which these substances have little effect. Thus, what many now characterize as “overuse” of antibiotics in both agriculture and human medicine has now come back to haunt. Resistance to antibiotics by all kinds of bacteria in fact may be the next disease epidemic[13, 14].

Dr. Mark Winston in his September 1998 *Bee Culture* column (Vol. 126, No. 9, pp. 17–18) said: “Most of us in Canada and the United States use Terramycin® in varying degrees. If you live in a rural areas without other beekeepers in close proximity, you probably don’t need to use it as often as we do, but there are few places in North America where bees are kept that Terramycin® is not a common component of a beekeeping operation.”

Dr. Winston goes on to explain that many beekeepers around the world do not share the “North American addiction to antibiotics,” such as those in New Zealand and the United Kingdom. This author saw the same thing in France in 1997[15]. Irish beekeepers also eschew use of the material (*American Bee Journal*, Vol. 138, No. 11, pp. 817–818, 1998), as do many other European beekeepers.

In response to Dr. Winston’s column, Steve Taber discussed his experiences with the disease and objects “strenuously to the burning of beekeeping equipment for the stated objective of AFB control.” (November 1998 *Bee Culture*, letters, p. 9). He said it can be controlled by selection for hygienic stock as discussed in the September *APIS*[16]. In the same section, ex–bee inspector, Bob Cory (Dunkirk, MD) also wrote urging new beekeepers not to employ Terramycin® on a regular basis.”

The debate about antibiotic use repeatedly raises its head, and has been discussed ad nauseum to some people’s thinking. There is evidence on both sides of the issue. In the end, every beekeeper must make a decision whether or not to treat with Terramycin®, knowing that there is the possibility that it can interfere greatly with the natural defense mechanisms of a colony[17]. Once made, however, several things must be emphasized. First, because AFB is considered endemic in colonies that are fed antibiotics, feeding becomes a **permanent commitment**. In the majority of cases when feeding has discontinued colonies have come down with symptoms. Since much equipment is purchased secondhand, it is imperative those buying it determine if a feeding program was in place. The second and more complicated consideration is how to best get the material into a colony for maximal effect.

It was Mr. Thurber who summed up the current situation well, and this was almost two decades ago: “There is and, I guess, always has been confusion about Terramycin® and its various forms and concentrations.” Originally there were three products available to beekeepers (Soluble Power, or TSP®, often called TM-25, TM-10® and TM-50®). Reference to these can still be seen in publications. It is now known that both TM-10® and TM-50® **should no longer be fed** to honey bees because they are now formulated on a cellulose base that bees cannot use[18]. Taking their place for beekeeping uses are TM-50D® and TM-100D®, which have a sugar base.

Dr. Keith Delaplane, University of Georgia, co-authored an article with Dr. Fernando Lozano, who works for Pfizer, Inc., titled “Using Terramycin® in Honey Bee Colonies.” (*American Bee Journal*,

Vol. 134, No. 4, April 1994, pp. 259–261)[19]. It emphasized several important points:

1. TM-50D® contains 50 grams of active ingredient per pound and TM-100D® contains 100 grams of active ingredient per pound.TM-50D® contains 50 grams of active ingredient per pound and TM- 100D® contains 100 grams of active ingredient per pound. TSP®, often called TM-25, contains 25 grams of active ingredient per pound, but is packaged in 6.4 ounce foil packs, each containing 10 grams of active ingredient.
2. At least three bee supply companies reformulate Pfizer Terramycin® products into medications under different brand names[20].
3. Not all Terramycin® products are safe for bees; only those that have labels for honey bees should and can legally be used.
4. The product most readily available in small quantities — TSP® — has a label that creates confusion. It uses "impractically small units (teaspoons and ounces)," and contains a reference to TM-10®, which they call a canceled product.

As mentioned above, the label is often missing from TSP®. Originally only one copy was provided in large-scale shipments and there were no instructions on the package itself. According to the Pfizer label for (OXYTETRACYCLINE HCL) Terramycin Soluble Powder #60-7000-00-1: "Use 1 level teaspoonful Terramycin Soluble Powder (TSP®) per ounce of powdered sugar per colony as a dust or 1 level teaspoonful per 5 lb jar containing 1:1 sugar syrup per colony. Apply the dust on the outer ends of the frames. Usually 3 dustings at 4-5 day intervals are required in the spring and/or fall at least 4 weeks before the main honey flow to prevent contamination of marketable honey." [Editor's note: Because TSP® is soluble, some have experienced trouble using it as a dust formulation in humid environments. The antibiotic dust will kill open brood; thus, **never** dust the **center** of the frame or broodnest!]

For syrup, the label says "it is advisable to first dissolve the TSP® in a small amount of water to facilitate mixing. Bulk feed the syrup using feeder pails or division board feeders or by filling the combs. Usually 3 applications at 4–5 day intervals are required in the spring and/or fall at least 4 weeks before the main honey flow to prevent contamination of marketable honey."

Dust has generally been the most recommended method of feeding TSP®. Dust and/or syrup can also be made from TM-50D® and TM-100D®[21]. See recipes for all formulations in the September 1994 APIS[22]. The D stands for dispersable; these products are not technically soluble as is TSP®. When mixed properly dust and syrup will provide the 200 mg of Terramycin® per feeding necessary to effectively control American foulbrood.

ALTHOUGH SYRUP IS MENTIONED as a possible carrier, it is known that the antibiotic will readily break down in water, especially when exposed to light. In addition, it is considered less reliable for administering the correct dosage of antibiotic because it is based on the amount of syrup consumed. Colonies are notoriously variable in taking syrup and may ignore it altogether if resources are available elsewhere.

Dr. Bill Wilson, now at the USDA ARS Weslaco Beneficial Insects Laboratory, is credited with creating another way to feed Terramycin® ("Antibiotic Treatments That Last Longer," *American Bee Journal*, Vol. 110, No. 9, September, pp. 348, 351). This so-called antibiotic extender patty (AEP) was relatively little-used, although Mr. Thurber recommended it, until vegetable oil patties were found to reduce populations of tracheal mites[23]. Beekeepers then quickly jumped on the patty bandwagon and the technology took off.

Another reason for this was that the patty is considered a one-time treatment, equivalent to the three dust applications at four- to five-day intervals. This saved the labor of having to revisit colonies repeatedly. At least one observer has attempted to understand why this technology was adopted so quickly by beekeepers when using fumagillin for nosema control has been almost ignored, even though it has a far larger research base[24].

The use of patties is problematic. There is no label for making them using TSP® as Dr. Wilson did in his original paper, but there are for both TM-50D® and TM-100D®. The reason there is any label at all is due to the efforts of Mr. Jack Thomas of Mann Lake Supply. He was cited by Dr. Roger Hoopingarner in Michigan State University's *B-Plus* newsletter (Spring 1991) for this contribution[25]. Mr. Thomas' patties each contain 1000 mg of antibiotic, equivalent to five 200mg dustings of Terramycin®[26].

Recipes for do-it-yourself vegetable oil patties from TM-25D®, TM-50D® and TM-100D® were published in the Delaplane-Lozano article cited above, but again, no formal label for those made from the first product exists[27]. Unfortunately, a large amount of material must be prepared according to the labels on the latter two products. For example, seven pounds of TM-100D® is required to mix with 200 pounds of powdered sugar as an intermediate product. Then four ounces (800 mg oxytetracycline) of that is mixed with 165 grams of vegetable shortening and 330 grams of sugar. This presumably makes one patty, which is equivalent to four dustings, although the label does not specifically say so.

Adequate mixing is key to getting the correct amount of antibiotic uniformly distributed throughout the vegetable oil and sugar. This is not easy, and there is much room for error. Commercial-sized dough machines have been recommended over hand mixing, but beyond that other phe-

[8] http://www.beekeeping.co.nz/afbpr.htm
[9] http://www.ifas.ufl.edu/~mts/apishtm/apis96/apmay96.htm#2
[10] http://www.ifas.ufl.edu/~mts/apishtm/apis91/apaug91.htm#1
[11] http://www.ifas.ufl.edu/~mts/apishtm/apis94/apjun94.htm#5
[12] http://www.ifas.ufl.edu/~mts/apishtm/apis96/apmar96.htm#2
[13] http://www.ifas.ufl.edu/~mts/apishtm/apis94/apnov94.htm#2
[14] http://www.sciam.com/1998/0398issue/0398levy.html
[15] http://www.ifas.ufl.edu/~mts/apishtm/letters/aix2_22.htm
[16] http://www.ifas.ufl.edu/~mts/apishtm/apis98/apsep98.htm#1
[17] http://www.ifas.ufl.edu/~mts/apishtm/apis93/apjul93.htm#1
[18] http://www.ifas.ufl.edu/~mts/apishtm/apis89/apfeb89.htm#4
[19] http://www.ifas.ufl.edu/~mts/apishtm/apis94/apsep94.htm#3
[20] http://www.airoot.com/beeculture/97oct3.htm
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[23] http://www.ifas.ufl.edu/~mts/apishtm/apis94/apoct94.htm#6
[24] http://www.ifas.ufl.edu/~mts/apishtm/apis95/apdec95.htm#T4
[25] http://www.ent.msu.edu/bplus/pdf/bplus21.pdf
[26] http://www.mannlakeltd.com/terpat.html
[27] http://www.ifas.ufl.edu/~mts/apishtm/apis94/apsep94.htm#3

nomena may come into play, such as electrical charges between oil, sugar and antibiotic that can interfere with proper dispersion. Mr. Thomas' product is manufactured using a proprietary process to ensure uniformity and homogeneity[28]. If the material is prepared incorrectly, an adequate amount of antibiotic may not reach the bees, causing symptoms to show up.

Other considerations also make patty technology more complex. The first has to do with the fate of the vegetable oil in a honey bee colony. Mr. Thurber claimed that colonies would eat the oil only as a last resort. He recommended they be placed so the bees would be forced to consume them. He said at least one of the following is necessary: the patty must interfere with 1) brood feeding, 2) foot traffic, 3) ventilation and temperature control, and/or 4) evaporation. He concluded that often this could only be accomplished by rearranging the brood nest. To my knowledge, it is not known whether bees eat the patty at all. Tracheal mite control seems to be due to oil on the exterior of the insect, not inside. If the material is simply removed by bees, then the antibiotic may not reach the insect's collective intestine, resulting in less than effective control.

Another variable is the oil itself. The original research by Dr. Wilson was based on Crisco®. However, a number of oils may be involved in the manufacture of this product. Canola, soy and corn oil have different properties. Could these translate into either differences in the use of the patty by bees, or the final effectiveness when mixed with sugar and antibiotic? Others available to beekeepers may be simply called vegetable oils, hydrogenated oils, or semi-solid oils for frying. It is not clear that the type of oil used would make any difference. Finally, long-term storage may vary greatly depending on the ingredients used.

> "The Florida Bee Inspection Service is urging beekeepers to carefully consider their treatment philosophy."

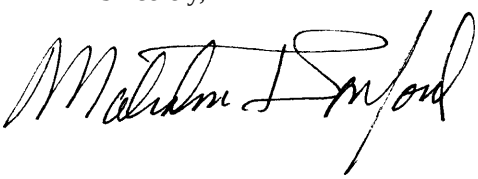
Mr. Kerry Clark, British Columbia's provincial apiarist, wrote to the Bee-L list in November 1996 that a recent change in beekeeper's habits makes appearance of bacterial resistance to Terramycin ® more likely. He said this was widespread, nearly continuous use of vegetable oil patties for tracheal mite control. According to Mr. Clark, it seems reasonable that most beekeepers would also add Terramycin® for foulbrood control in the same treatment to save labor. Thus, the one ingredient that was missing over the last four decades, continuous antibiotic selection pressure on the AFB causative bacterium, is now present, Mr. Clark said.

Mr. Clark also said that continuous use provides much more opportunity for the antibiotic to wind up in the beekeeper's honey crop. While vegetable oil patties may be recommended for tracheal mite control, and while the same patty can be used to apply antibiotic, the latter should be used only for short periods, he concluded[29].

The appearance of resistant bacteria and anecdotal reports suggesting that Terramycin® may not be working as well as it once did appear to validate some of the concerns expressed above. Whether patty technology alone, however, is responsible for this remains conjecture.

Drs. Hoopingarner and Nelson's 1988 paper cited elsewhere reported that dusting resulted in significantly less brood in treated colonies than those exposed to other formulations (syrup or patty). Thus, they concluded at that time that there was a need to re-evaluate this particular method. Nevertheless, many who have opted for extender patties in the recent past are reported to be returning to the traditional dusting technique. The Florida Bee Inspection service is advising beekeepers to carefully consider their treatment, and if there is any doubt about its effectiveness, switch to another formulation.

Sincerely,



[28] http://www.ifas.ufl.edu/~mts/apishtm/apis92/apjul92.htm#3
[29] http://www.ifas.ufl.edu/~mts/apishtm/apis97/apsep97.htm#3

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