

Temporary Registration of Fluvalinate-Tau for Honey Bee Mite Detection and/or Control

This Decision Document has been prepared to provide a summary of the information received in support of the active ingredient fluvalinate-tau, and to outline the regulatory action taken on this pest control product. This document reflects input from specialists within Agriculture and Agri-Food Canada, and from key advisors in pesticide regulation at Health Canada and Environment Canada. Based on the review of all available information and in consideration of agronomic benefits, a regulatory decision has been made to grant temporary registration to *Technical Fluvalinate-Tau* (Pest Control Product Registration Number 23022) and the formulated products *Apistan*[®] *Anti-Varroa Mite Strips* (PCP Registration Number 23023), *Apistan*[®] *Queen Tabs* (PCP Registration Number 22896) and *Apistan*[®] *Package Bee Strips* (PCP Registration Number 22897) for the detection and/or control of Varroa mites on honey bees. Full registration is contingent upon the submission and review of data addressing the remaining efficacy, toxicology, and environmental fate and degradation data gaps.

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1.0 Summary

The Varroa mite, *Varroa jacobsoni* (Oud.), is a serious pest of honey bees in Europe and the United States. It has been increasing in intensity and geographic distribution in Canada since natural incursions of the mite from the United States were first detected in New Brunswick in 1989. Limited Varroa mite infestations have now also been found in Québec, Ontario, Manitoba, Saskatchewan, and British Columbia.

Fluvalinate-tau (commonly referred to in literature as fluvalinate) is a synthetic pyrethroid which has been used in other countries for the control of Varroa mites on honey bees. The three formulated products are *Apistan*[®] *Anti-Varroa Mite Strips* (10% active ingredient), *Apistan*[®] *Queen Tabs* (1.0% active ingredient) and *Apistan*[®] *Package Bee Strips* (2.5% active ingredient). *Apistan*[®] *Anti-Varroa Mite Strips* are to be used in honey bee hives, whereas *Apistan*[®] *Queen Tabs* and *Apistan*[®] *Package Bee Strips* are to be used only for the treatment of packaged queen bees and bee colonies, respectively, before and during transport.

Exposure of the applicator to fluvalinate-tau while handling *Apistan*[®] products is likely to be negligible because of the requirement to wear chemically-resistant gloves. Exposure of the honey crop to fluvalinate-tau is also likely to be negligible because the *Apistan*[®] *Anti-Varroa Mite Strips* are to be used only during non-honey flow periods when the honey supers are off the hives. The environmental impact of *Apistan*[®] *Anti-Varroa Mite Strips* is expected to be minimal during the treatment period because the strips are confined to the honey bee hives. However, the potential for adverse effects on the environment following the disposal of any *Apistan*[®] product cannot be fully evaluated based on the information submitted to date.

Agriculture and Agri-Food Canada has granted temporary registration to *Technical Fluvalinate-Tau* (Pest Control Product Registration Number 23022), *Apistan*[®] *Anti-Varroa Mite Strips* (PCP Registration Number 23023), *Apistan*[®] *Queen Tabs* (PCP Registration Number 22896) and *Apistan*[®] *Package Bee Strips* (PCP Registration Number 22897) for the detection and/or control of Varroa mites on honey bees. This decision was based on health and safety considerations, the fact that there are no other products registered/regulated for the control of Varroa mites in Canada and that the Canadian honey bee industry annually generates approximately \$50 million worth of products, with pollination by honey bees adding an estimated \$0.5 billion per year to the value of horticultural crops produced in Canada. Full registration is contingent upon the submission and review of data addressing the remaining efficacy, toxicology and environmental fate and degradation data gaps.

2.0 Background

2.1 Status of Varroa Mite in Canada

The Varroa mite, *Varroa jacobsoni* (Oud.), is a parasite of honey bees which can cause severe damage to the honey bee brood. Heavy infestations can cause a reduction in honey production during the early stages of infestation, and ultimately result in the loss of the colony. Because the mite attaches itself to the body of the honey bee, it can easily infest other hives. The Varroa mite is widespread in the United States and, since 1989, has been found along the U.S. border in New Brunswick, Ontario, Manitoba and British Columbia and farther north of the border in southwestern Ontario (several apiaries) and in Saskatchewan and Québec (single diagnoses).

Because the infestation of honey bees by Varroa mite is currently a reportable disease under the authority of the *Animal Health Protection Act*, Agriculture and Agri-Food Canada's policy has been to destroy infested apiaries. However, due to the increasing incidence of Varroa mite in Canada, it is evident that eradication programs are no longer technically or financially feasible.

2.2 Technical and End-Use Products

Fluvalinate-tau is a synthetic pyrethroid which is commonly referred to in the literature as fluvalinate, although technically it is a diastereoisomer of fluvalinate. According to the International Union of Pure and Applied Chemistry (IUPAC), the chemical name for this compound is (RS)- α -cyano-3-phenoxybenzyl N-(2-chloro-*a,a,a*-trifluoro-*p*-tolyl)-D-valinate. Zoecon Canada Inc. originally submitted the applications to register *Technical Fluvalinate-Tau* and the formulated products *Apistan*[®] *Anti-Varroa Mite Strips* (8±1 g plastic strip impregnated with 10% active ingredient), *Apistan*[®] *Queen Tabs* (0.25-0.50 g plastic tab impregnated with 1.0% active ingredient) and *Apistan*[®] *Package Bee Strips* (4.5±0.5 g plastic strip impregnated with 2.5% active ingredient) for the detection and/or control of Varroa mites on honey bees. Sandoz Agro Canada Inc. of Mississauga, Ontario is the current proprietor of these products.

Apistan[®] *Anti-Varroa Mite Strips* have been registered in the United States since 1990 where a tolerance for fluvalinate-tau in honey has been established at 0.05 ppm. *Apistan*[®] *Anti-Varroa Mite Strips* are also registered in several European, Asian, and African countries. *Apistan*[®] *Queen Tabs* (1.0% active ingredient) and *Apistan*[®] *Package Bee Strips* (2.5% active ingredient) have been registered in the United States since 1988 and 1990, respectively.

3.0 Proposed Use Pattern

Apistan[®] *Anti-Varroa Mite Strips* are to be used for both the detection and control of Varroa mites in honey bee hives. *Apistan*[®] strips are to be hung between the brood frames inside the bee hives so that the bees can come into contact with the strips. One strip is to be used for each 5 frames of bees in each brood chamber. To detect Varroa mites, sticky paper is to be placed below the frames and the honey supers are to be removed from the hives prior to the application of the *Apistan*[®] strips. At various intervals, the sticky paper is to be checked for the presence of Varroa mites. At the end of the survey period (within 7 days), the strips are to be removed from the hives and the honey supers replaced. For the control of Varroa mites, the honey supers are to be removed before the application of *Apistan*[®] and not replaced until the end of the treatment period. Hives are to be treated for a period of 42 days, either in the spring before the first honey flow or in the fall after the removal of the honey supers for the extraction of honey.

Apistan[®] *Queen Tabs* and *Apistan*[®] *Package Bee Strips* are to be used to treat packaged bees for possible Varroa mite infestation, before and during transport. *Apistan*[®] *Queen Tabs* are to be placed in queen shipping cages for a period of 3 to 7 days, while *Apistan*[®] *Package Bee Strips* are to be attached inside the bee packages for a period of 5 days.

4.0 Value of Fluvalinate-Tau to the Beekeeping Industry

4.1 Efficacy

4.1.1 *Apistan*[®] *Anti-Varroa Mite Strips*

The efficacy data submitted to date by Zoecon Canada Inc./Sandoz Agro Canada Inc. in support of *Apistan*[®] *Anti-Varroa Mite Strips* include reports from the United States, Europe and the Middle East which indicate that fluvalinate-tau likely has merit in controlling Varroa mites in Canada. In one of the studies conducted in France (published in part by Borneck and Merle 1990), Varroa mite-infested hives (2 groups of 10 hives) were each treated with two strips of *Apistan*[®] (10% active ingredient, 8 g strip) for a 42 day period during the summer. The effectiveness of the treatment (defined as the number of Varroa mites which died during the treatment period compared to the total number of mites) ranged from 97.6% to 100%. No information on untreated hives was reported. Treatment with *Apistan*[®] strips did not appear to have an adverse effect on bee behaviour or bee mortality. In an American study also submitted by the applicant, a 10% fluvalinate *Apistan*[®] strip formulation similar to that registered in Canada (i.e., same plasticizer in same concentration) was tested for a 6-week period at various sites. At one site, 100% control was achieved in both brood and forage bees in two out of three hives (the third colony died by 6 weeks post-treatment) when pre-treatment counts (taken just prior to treatment) were compared to post-treatment counts. Among the three control hives, Varroa mite counts could only be taken from one hive after the 6

week post-treatment period because one colony had died while the other was queenless with no brood. The number of Varroa mites in the remaining control hive decreased by 77% among the brood bees and remained the same among the forage bees. At a second site, 100% control of Varroa mites among brood and forage bees was achieved in four treated hives after a period of 6 weeks, when pre-treatment counts (taken 9 weeks before treatment) were compared to post-treatment counts. Among the control hives, there was an overall increase in the number of Varroa mites among both brood and forage bees. At two other sites where no control hives were monitored, over 99% control (as determined by brood examination) was reported after a 6-week treatment period with *Apistan*[®] strips when pre-treatment counts (taken just prior to treatment) were compared to post-treatment counts. In one of the trials, over half of the colonies had died by the end of the treatment period.

Results from other studies submitted by the applicant also indicate that treatment of infested hives with 10% fluvalinate strips can result in a high degree of Varroa mite control. However, due to various inadequacies identified in these and the above-mentioned study reports (e.g., lack of controls, ambiguous protocol), confirmatory efficacy data demonstrating the effectiveness of *Apistan*[®] *Anti-Varroa Mite Strips* in controlling Varroa mites under Canadian conditions have been requested from Sandoz Agro Canada Inc. These studies are currently being generated by Manitoba Agriculture.

4.1.2 *Apistan*[®] *Package Bee Strips*

A study to demonstrate the effectiveness of *Apistan*[®] *Package Bee Strips* in controlling Varroa mites in packaged bees has been submitted by Sandoz Agro Canada Inc. and is also available in the published literature (Witherell and Herbert 1988). In this study simulated commercial packages of Varroa mite-infested bees were treated with various concentrations of fluvalinate, including a 2.5% fluvalinate *Apistan*[®] strip formulation. All Varroa mites exposed to the various fluvalinate treatments were killed within 5 days. However, bee mortality was only maintained at an acceptable level among those bees exposed to the lower concentrations of fluvaliate, such as the 2.5% concentration. Other studies in the published literature also indicate that *Apistan*[®] *Package Bee Strips* are effective in significantly reducing the number of Varroa mites in bee packages. Herbert et al. (1988a) tested the effectiveness of fluvalinate for the control of Varroa mites in commercial shipping cages by placing either one or two strips of 2.5% fluvalinate into each unit of bees for a period of 6 days. Of the ten bee packages treated with fluvalinate, over 99% control was attained in nine of the packages. The majority of mites were killed within the first 24 hours, with the percentage of mites recovered (with the exception of one treatment) ranging from 97.0% to 99.7%. Among the two untreated packages, less than 7% of the Varroa mites had died by the end of the 6 day period, with only 3.7% and <1.0% of mites being recovered during the first 24-hour period. In another study by Herbert et al. (1989), the treatment of 2 groups of packaged bees in

cages (10 packages per group) with *Apistan*[®] *Package Bee Strips* (2.5% fluvalinate, 5 day exposure) resulted in over 90% of the mites dying on the first day. A few Varroa mites, however, were able to survive treatment and were discovered in colonies 27 days after establishment. Because of the variability of the above-mentioned results, Sandoz Agro Canada Inc. has been asked to supply data confirming efficacy under Canadian use conditions.

4.1.3 *Apistan*[®] *Queen Tabs*

Data to demonstrate the effectiveness of *Apistan*[®] *Queen Tabs* in controlling Varroa mites on queen bees in queen cages have yet to be submitted by Sandoz Agro Canada Inc., and information on the efficacy of *Apistan*[®] *Queen Tabs* for the control of Varroa mites on queen bees is not available in the published literature. However, a study submitted by Sandoz Agro Canada Inc., also available in the published literature (Herbert et al. 1988b), demonstrated that when a small piece (12mm x 12mm) of 1% fluvalinate-impregnated plastic strip was placed on the floor of queen mailing cages containing 6 worker bees (with at least one bee being infested with Varroa mite), all of the mites were killed within 72 hours (with little adult bee mortality), whereas most of the mites in the control cages survived and remained attached to the bees.

4.2 Economic Benefits

The beekeeping industry in Canada is comprised of approximately 13,000 beekeepers and 500,000 hives. The Canadian honey bee industry annually generates approximately \$50 million worth of products, with Canadian honey exports (mostly to the United States) valued at about \$16 million. In addition to honey production, pollination by honey bees adds an estimated \$0.5 billion per year to the value of horticultural crops produced in Canada.

4.2.1 *Apistan*[®] *Anti-Varroa Mite Strips*

The value of *Apistan*[®] *Anti-Varroa Mite Strips* to the beekeeping industry, would, in many cases, be the survival of each individual enterprise. Lack of treatment would likely result in a three year decline in production, followed by a complete loss of bees. If no treatment were available, beekeepers would have to either discontinue honey production, or destroy infested bees annually and replace them each spring with imported bee packages. The United States is the only source of bee stock available at prices which would be competitive to the cost of treating and overwintering bees in Canada. However, an import ban on the shipping of bee stock from the United States has been in place since 1987 as a means of mitigating the spread of Varroa mites in Canada. Without an available treatment, it is estimated that approximately one-half of the Canadian honey bee population would have to be imported each year, if the Varroa mite became widespread in Canada. The cost of importing replacement bees from the United

States would be approximately \$30-40 per hive (\$6-8 million potential cost to the industry), assuming that the import ban on American bees was lifted.

Treating hives with fluvalinate-tau would cost approximately \$4.00 per hive (i.e., 2 strips per hive at approximately \$2.00 per strip). This would result in a maximum annual cost to the industry of \$2 million to treat all hives. It is unlikely that treatment would be required nation-wide in the short term (i.e., within the next 5 years). However, the spread of Varroa mite would require increased treatment with each succeeding year. It should be noted that imported honey coming into Canada is currently permitted to have residues of up to 0.1 parts per million of fluvalinate-tau under the authority of Section B.15.002(1) of the *Food and Drugs Regulations* administered by Health Canada.

4.2.2 *Apistan*[®] *Queen Tabs* and *Apistan*[®] *Package Bee Strips*

Apistan[®] *Queen Tabs* and *Apistan*[®] *Package Bee Strips* are to be used in packages of queens and honey bees respectively, while they are in transit. The rationale behind using these products is that any mites infesting the bees would be killed by the time the bees arrived at their destination. However, there is no evidence to indicate that treating infested bees with either *Apistan*[®] *Queen Tabs* or *Apistan*[®] *Package Bee Strips* would kill all of the mites.

In Canada, 52,000 queens and 14,000 packages are produced annually. Because almost half of the domestic bee production originates in southern British Columbia where limited mite infestations exist, the availability of a treatment for bee packages would reduce the risk of mites being introduced into uninfested areas, such as Alberta and northern British Columbia, where most of these bees are destined.

There is a possibility that the import ban on bee stock from the United States will be lifted at some time because the Varroa mite is now present in Canada. In 1987, the year prior to the import ban, about 190,000 bee packages were imported into Canada. Removal of the import ban could return imports to that level, and the use of *Apistan*[®] *Queen Tabs* and *Apistan*[®] *Package Bee Strips* could reduce the likelihood that mites would be introduced. In 1992, an amendment of the import ban was made to allow queen bees to be imported from Hawaii under permit, provided that the queen bees had been treated with fluvalinate-tau. It is expected that 30,000 queens will be imported from Hawaii annually.

4.3 Alternative Control Products

There are other products besides fluvalinate-tau which are reputed to be effective Varroa mite control agents, namely: flumethrin (*Bayvarol*[®]), amitraz (*Miticur*[®] *Bee Mite Strips*), coumaphos (*Perizin*[®]), and formic acid. No application has yet been submitted to Agriculture and Agri-Food Canada for the registration of flumethrin or coumaphos. An application to register *Miticur*[®] *Bee Mite Strips* was received in 1992 and is under evaluation. Because formic acid is naturally found in honey and is used in other applications such as food flavourings, the use of formic acid by beekeepers will be exempt from registration and will soon be regulated under the authority of Schedule II of the *Pest Control Products Regulations*. Although Agriculture and Agri-Food Canada has not received definitive data to assess the efficacy of formic acid for Varroa mite control, the beekeeping industry is prepared to accept the level of efficacy indicated by preliminary data.

Because of the status of flumethrin, amitraz, coumaphos and formic acid in Canada, fluvalinate-tau remains the best candidate for registration under the *Pest Control Products Act* for the control of Varroa mites. The registration of a chemical control agent such as fluvalinate-tau would permit beekeepers to treat their infested hives and would allow Agriculture and Agri-Food Canada to modify their existing disease control policy of destroying infested hives.

5.0 Human Risk Assessment

5.1 Dietary Exposure

Officials at the Food Directorate, Health Canada have concluded that they would have no objection to the granting of a temporary registration to fluvalinate-tau products. This is due to the fact that a review of the available residue data demonstrates that the levels of fluvalinate-tau in honey are <0.01 parts per million when *Apistan*[®] *Anti-Varroa Mite Strips* are used as proposed (i.e. when the honey supers are off the hives). The outstanding toxicology data required to support full registration have recently been submitted by the applicant and are under evaluation by the Food Directorate. The possibility of using fluvalinate-tau during honey flow periods is also under review.

5.2 Occupational Exposure

Officials at the Workplace Substances and Pesticides Division, Health Protection Branch, Health Canada have reviewed the submitted data from an occupational/bystander viewpoint and have concluded that they have no objection to the temporary registration of fluvalinate-tau products provided the precautions outlined on the product label, including the use of chemically-resistant gloves when handling *Apistan*[®] products, are followed.

6.0 Environmental Hazard Assessment

According to officials at Environment Canada who have reviewed the environmental data submitted to date, the amount of fluvalinate-tau remaining in *Apistan*[®] *Anti-Varroa Mite Strips* after the treatment period is reported to not be significantly reduced from the amount initially present. Laboratory studies indicate that fluvalinate-tau strongly adsorbs to sandy loam soil and has a low potential for leaching in sandy loam, silt loam, and clay soils. Under aerobic and anaerobic conditions in laboratory studies, it undergoes rapid biotransformation in soil. The two major transformation products from the acid portion of the molecule are haloaniline and anilino acid. The former is volatile and the latter has intermediate mobility in some soils. Because the studies of biotransformation in soil employed a test material that was radio-labelled in the acid portion of the molecule only, data on the major transformation products from the alcohol portion of the molecule were not provided. Data on leaching and persistence of all major transformation products, and data on the rate(s) of release of fluvalinate-tau from *Apistan*[®] *Anti-Varroa Mite* products into soil, are still outstanding. Data gaps concerning the physicochemical properties (solubility, octanol/water partitioning coefficient, and vapour pressure) and environmental chemistry and fate (hydrolysis, photo-transformation, and desorption from soil) have also been identified. Fluvalinate-tau has also been found to be extremely toxic to fish and non-target aquatic invertebrates.

Based on the proposed use pattern of *Apistan*[®] products (i.e., within honey bee colonies or in packages of bees), it is anticipated that exposure of the environment to fluvalinate-tau and its major transformation products during the period of application will be limited. However, the fate of these compounds following the disposal of used *Apistan*[®] products cannot be determined until the outstanding data are submitted by Sandoz Agro Canada Inc. and assessed by Environment Canada.

In the interim, Environment Canada is prepared to support the temporary registration of *Apistan*[®] products provided that the product labels carry disposal statements which specify that the used strips, tabs or empty packages are not to be re-used, that the empty packages must be made unsuitable for future use, that the open-burning of *Apistan*[®] *Anti-Varroa Mite* products be prohibited (because toxic chemicals may be produced during low temperature combustion of the end-use product), and that the empty packages, used strips or tabs, and unused/unwanted product be disposed of in accordance with provincial requirements.

7.0 Regulatory Decision

In light of the foregoing hazard and value assessments, Agriculture and Agri-Food Canada, in consultation with Health Canada and Environment Canada, has decided to grant temporary registration to *Technical Fluvalinate-Tau* (Pest Control Product Registration Number 23022), *Apistan*[®] *Anti-Varroa Mite Strips* (PCP Registration Number 23023), *Apistan*[®] *Queen Tab* (PCP Registration Number 22896) and *Apistan*[®] *Package Bee Strip* (PCP Registration Number 22897). This decision was made in consideration of:

- the value of fluvalinate-tau to the beekeeping industry in Canada.
- the unavailability of other products for the control of Varroa mites in Canada at the time this decision was made.
- a review of the available efficacy data, which indicates that *Apistan*[®] products will likely be effective in controlling Varroa mites under Canadian conditions.
- the fact that exposure of the honey crop to fluvalinate-tau is likely to be negligible because *Apistan*[®] *Anti-Varroa Mite Strips* are to be used during the non-honey flow period when the honey supers are off the hives.
- the fact that exposure of applicators to fluvalinate-tau can be mitigated by wearing chemically-resistant gloves while handling *Apistan*[®] products.
- the fact that the exposure of the environment to fluvalinate-tau and its major transformation products during the period of application will be limited, based on the proposed use pattern of *Apistan*[®] products (i.e., within honey bee colonies or in packages of bees).

Full registration will be considered once the remaining efficacy, toxicology and environmental fate and degradation data gaps have been addressed.

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