Special Review Decision SRD2022-02

Special Reviews: Potential environmental risk related to squash bee exposure to Clothianidin, Thiamethoxam and Imidacloprid used on cucurbits

Final Decision Document

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Special review decision

Pursuant to subsection 17(1) of the *Pest Control Products Act*, Health Canada's Pest Management Regulatory Agency (PMRA) initiated special reviews on pest control products containing clothianidin, thiamethoxam, and imidacloprid used on cucurbits such as pumpkin and squash. These special reviews were initiated based on a preliminary analysis of the information received under subsection 17(4) of the *Pest Control Products Act*. The aspect of concern for these reviews is to assess potential risk to squash bees, *Eucera pruinosa* (previously called *Peponapis pruinosa*), exposed to clothianidin, thiamethoxam or imidacloprid when products containing these active ingredients are used on cucurbits.

Health Canada evaluated the aspect of concern that prompted the special review in accordance with subsection 18(4) of the *Pest Control Products Act*. The proposed special review decision was published for consultation in Proposed Special Review Decision PSRD2021-02, *Special Reviews: Potential environmental risk related to squash bee (Peponapis pruinosa) exposure to Clothianidin, Thiamethoxam and Imidacloprid used on cucurbits*.[1] Since the publication of PSRD2021-02 on 29 June 2021, several comments were received during the consultation period.

This document presents the final regulatory decision[2] for the special reviews of clothianidin, thiamethoxam and imidacloprid used on cucurbits. All pest control products containing clothianidin, thiamethoxam or imidacloprid that are registered in Canada for use on cucurbits are subject to this special review decision (see Appendix I).

Comments were received and are summarized in the Additional Environmental Risk Assessment section along with the responses from Health Canada (list of commenters available in Appendix II). The comments were considered and prompted an additional environmental risk assessment to address potential risk to squash bees that could be exposed to persistent neonicotinoid residues from seed treatments. Additional consideration was given to squash bees that may be in cucurbit crops grown on fields that had a previous crop rotation of cucurbit, corn or soybean planted with treated seed. Ultimately, the additional assessment did not result in a change to the risk conclusions. Therefore, this decision is consistent with the proposed regulatory decision as described in PSRD2021-02.

Evaluation of available scientific information related to the aspect of concern indicated that the potential environmental risks to *Eucera pruinosa* (squash bee) through exposure to clothianidin, thiamethoxam and imidacloprid used on cucurbits are considered acceptable when used according to the current conditions of use.

1 "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act.*

2 "Decision statement" as required by subsection 28(5) of the *Pest Control Products Act.*

On this basis, Health Canada's Pest Management Regulatory Agency, pursuant to subsection 21(1) of the *Pest Control Products Act*, has determined that continued registration of clothianidin, thiamethoxam and imidacloprid products for sale and use on cucurbits in Canada is acceptable under the current conditions of use. No additional risk mitigation measures are required.

Next steps

Health Canada has completed the special reviews for clothianidin, thiamethoxam and imidacloprid used on cucurbits. Under the authority of the *Pest Control Products Act,* Health Canada has determined that the use of clothianidin, thiamethoxam and imidacloprid on cucurbits continues to be acceptable when used according to label directions. No additional data or mitigation measures are required at this time.

Other information

Please refer to PMRA Guidance Document: *Approach to Special Reviews of Pesticides*, for details on the special review approach.

Any person may file a notice of objection[3] regarding this decision on clothianidin, thiamethoxam and imidacloprid used on cucurbits within 60 days from the date of publication of this Special Review Decision. For more information regarding the basis for objecting (which must be based on scientific grounds), please refer to the Pesticides section of the Canada.ca website (Request a Reconsideration of Decision) or contact the PMRA's Pest Management Information Service.

The relevant confidential test data on which the decision is based (as referenced in PSRD2021-02) are available for public inspection, upon application, in the PMRA's Reading Room. For more information, please contact the PMRA's Pest Management Information Service.

[3] As per subsection 35(1) of the *Pest Control Products Act*.

Science evaluation update

1.0 Additional environmental risk assessment

A risk assessment and proposed special review decision for squash bees exposed to clothianidin, thiamethoxam and imidacloprid used on cucurbits was published for consultation in the document: Proposed Special Review Decision PSRD2021-02, *Special Reviews: Potential environmental risk related to squash bee (Peponapis pruinosa) exposure to Clothianidin, Thiamethoxam and Imidacloprid used on cucurbits*.

Several comments were received during the consultation period but no new data was submitted. The comments related to PSRD2021-02 acknowledge that removing soil uses as a mitigation measure is a positive action. Comments also include the recommendation to remove seed treatment uses and that further research should be undertaken.

Based on the information and opinions submitted, information in the pollinator risk assessment was reconsidered, and an additional risk assessment was conducted to determine potential risk to nesting squash bees from exposure to soil residues of neonicotinoids resulting from seed treatment uses. As a result of this assessment, there were no changes to the pollinator risk conclusions or mitigation measures presented in PSRD2021-02. The overall risk conclusions based on consideration of all information received during the consultation process remain consistent with those presented in PSRD2021-02.

Comments:

Friends of the Earth, the Wilderness Committee and University of Guelph:

These organizations agree with the removal of soil applications of neonicotinoids but want the neonicotinoid seed treatments removed as well. They call for future work and funding to focus on impacts of neonicotinoids on ground nesting wild bees and to find alternatives to pesticides. Additionally, they suggest the Health Canada review included incorrect assumptions regarding the lack of bioavailability of neonicotinoids in the soil. They point out that neonicotinoids accumulate in soil from seed treatment applications and from dust resulting from neonicotinoid seed treatments. They suggest that squash bees migrating into cucurbit crops grown on fields that had a previous crop rotation of corn or soybean could be exposed to persistent neonicotinoid residues from seed treatments. No new data was submitted with the comments.

Health Canada response:

Given the comments received regarding the potential accumulation of neonicotinoids in soil as a result of seed treatments, Health Canada re-analyzed the information considered for PSRD2021-02 to assess the potential risk to squash bees in cucurbit fields from seed treatment uses. Additional consideration was given to squash bees that may be in cucurbit crops grown on fields that had a previous crop rotation of cucurbit, corn or soybean planted with treated seed.

The following sections summarize the data that was previou9sly considered in PSRD2021-02 and show the assessment of this data in relation to the comments received, including consideration of soil residue carry-over in corn and soybean growing regions where cucurbits may be planted.

Summary of data previously considered from pollinator re-evaluations [PRVD2017-23 and RVD2019-05 (clothianidin); PRVD2017-24 and RVD2019-04 (thiamethoxam); PRVD2018-12 and RVD2019-06 (imidacloprid)]

A significant amount of data on the fate and pollinator toxicity of clothianidin, thiamethoxam and imidacloprid considered in the squash bee special reviews came from the recent Health Canada pollinator re-evaluations.

The pollinator re-evaluations considered all bees, including squash bees, and potential risk from uses on cucurbit crops. The pollinator re-evaluations were based on a large volume of open literature and registrant data. This included:

- Pollinator toxicity information
    - Acute and chronic toxicity endpoints for adults and larvae;
    - Higher tiered studies on *Apis* and non-*Apis* bees.
- Extensive field residue data
    - From pollen and nectar;
    - From seed, soil and foliar treatments;
    - On a wide variety of crops, including cucurbits.

The pollen and nectar residue levels from targeted on-field crops and non-targeted off-field plants were compared to different effects seen in bees:

- Tier I laboratory effects seen in individual bees;
- Tier II field effects seen on bumble and honeybee colonies, and in colony feeding studies with *Apis* and non-*Apis* bees.

Higher tier studies were also included in the exposure and effects analysis, considering soil, foliar and seed treatment applications. The semi-field and field studies on seed treatment uses included examining residues and effects in pollen and nectar of crops grown from treated seed as well as from the carry-over of residues into pollen and nectar of rotational crops. They also included exposure in pollen and nectar of plants adjacent to treated fields. These included residues resulting from dust generated from planting treated seed during the current year’s application, and residues in water/puddles and plant guttation water in treated fields from the current year's application.

Squash bees were given special consideration because of their specialized relationship with cucurbit plants throughout their life cycle. The squash bee feeds on pollen only from cucurbit crops and on nectar from cucurbits as well as other sources, if available. Although the pollinator re-evaluations did not have data specific to squash bees, exposure from soil, seed and foliar treatments were qualitatively included in the risk assessment.

The residues in pollen and nectar of cucurbit plants following soil applications were higher than the levels where effects were seen in honeybees and non-*Apis* bees including bumble bees and the red mason bee (*Osmia*). As a result, soil applications of thiamethoxam and imidacloprid were cancelled for cucurbits. Foliar applications of clothianidin were also reduced for cucurbits in order to reduce pollen and nectar residues to acceptable levels. Soil residues resulting from foliar applications are expected to be much lower than from soil applications based on available information from pollen, nectar and soil residues. Soil residues from seed treatment applications (when following dust reduction mitigation) are also expected to be lower than soil applications. Seed treatments had very low pollen and nectar residues as well as very low soil residues, which were determined to be acceptable.

Dust reduction mitigation for neonicotinoid treated corn and soybean seed has been in place since 2014, when Health Canada implemented measures to protect pollinators as a result of reported bee mortality incidents. The 2019 pollinator re-evaluation decisions added measures for dust reduction during planting of neonicotinoid treated cereal and legume seeds. The use of a dust reducing fluency agent is mandatory for planting corn and soybean, and best management practices for protection of pollinators are mandatory for all cereals and legumes, including corn and soybean.

Additional data from public literature considered in the special review for squash bees (PSRD2021-02)

Data from Chan and Raine 2021, and Chan et al. 2019, were considered in addition to the information from the pollinator re-evaluations.

Chan and Raine 2021

The Chan and Raine 2021 hoop house tunnel study concluded potential risk to squash bees from soil application of imidacloprid. This conclusion is consistent with the overall risk conclusion from the pollinator re-evaluations, whereby Health Canada removed soil applications to cucurbits. The Chan and Raine 2021 study also concluded that there were no effects on squash bees in fields with cucurbit seeds treated with thiamethoxam. This is also consistent with the conclusion of acceptable risk from treated seed in the pollinator re-evaluation.

Soil residue information from hoop house fields was available in Chan and Raine 2021 for applications of thiamethoxam seed treatment or imidacloprid soil applications to a cucurbit crop, as well as in the untreated control. The range of soil residues as well as the mean soil residues in hoop-house treatment group sites are reported (there are three hoop-house sites per treatment group, and two separate years).

- Clothianidin (a transformation product of thiamethoxam); clothianidin was not applied at any site but was measured at all sites, including the thiamethoxam seed treatment sites:
    - Range measured in the thiamethoxam seed treatment sites: 0 to 6.2 ppb for clothianidin.
    - Mean site residues of clothianidin at the thiamethoxam seed treatment sites were: 2017: 1.2, 3.1, 2.6 ppb; 2018: 1.2, 3.6, 1.6 ppb.
    - It is noted that clothianidin was measured in soils at low levels at all sites and may have been there from previous use in the area. Across all sites, measurements of clothianidin ranged from 0 to 7.5 ppb. Across all sites, clothianidin site means ranged from: 2017: 0.1 to 5.7 ppb (detected at all sites); 2018: non-detectable to 3.6 ppb (detected at half of the sites).
    - Overall, clothianidin residues were lower in the second year of the study in sites where thiamethoxam was not applied, suggesting it degraded over time. In thiamethoxam seed treatment sites, clothianidin was detected in both years of the study, possibly because it was formed as a transformation product of thiamethoxam.
    - No effects on squash bees were found at the thiamethoxam seed treatment sites, and no effects on squash bees were linked with clothianidin exposure at any of the other treatment or control sites.
- Thiamethoxam, measured in the thiamethoxam seed treatment sites:
    - Range: 0 to 54 ppb for thiamethoxam.
    - Site means: 2017: 0.1 ppb, non-detectable and non-detectable; 2018: 1.9, 16.6 and 1.1 ppb.
    - Overall, there is a slight increase in residues in the second year of seed treatment application.
    - It is noted that one of the three thiamethoxam sites in 2017 had measured levels of imidacloprid as well, with a site mean of imidacloprid of 31.5 ppb.
    - No effects on squash bees were found at thiamethoxam seed treatment sites.
- Imidacloprid, measured in the imidacloprid soil treatment sites:
    - Range: 0 to 230 ppb for imidacloprid.
    - Site means: 2017: 25.6, 11.3 and 48 ppb; 2018: 142.6, 44.6 and 88.8 ppb.
    - Overall, there is an increase in residues in the second year of soil application.
    - Effects were observed on squash bees at all imidacloprid soil treatment sites.
- Untreated control sites had some detections of clothianidin and thiamethoxam, but no imidacloprid detections.
    - Clothianidin range 0 to 4.05 ppb; Thiamethoxam range 0 to 3.6 ppb.
    - Clothianidin site means: 2017: 0.2, 3.6 and 3.6 ppb; 2018 non-detectable, non-detectable, and 2.2 ppb.

    - Thiamethoxam site means: 2017: non-detectable, 9.1 ppb, and non-detectable; 2018: non-detectable in all three sites.
    - Overall, the residues were low in control sites, and there is a decrease in residues in the second year, suggesting degradation.
- Overall, residues from seed treatments resulted in much lower concentrations of residues in soil compared to soil applications.

Chan et al. 2019

The Chan et al. 2019 study concluded potential risk to squash bees based on a probabilistic risk assessment using honeybee laboratory effect endpoints adjusted by an uncertainty factor of 10 as a surrogate for squash bees. These adjusted endpoints were compared to estimated soil exposures, incorporating theoretical estimates regarding bioavailability of soil residues and the amount of soil handled during nest building. The study considered soil residues from cucurbit crops in Ontario, and soil residues from agricultural fields in corn and soybean growing regions from a 2015-2018 Ministry of Environment, Conservation and Parks (MOECP) monitoring study.

The mean soil residues collected from 18 different cucurbit fields (0-15 cm depth) in the Chan et al 2019 study were:

- 1.95 ppb clothianidin;
- not detectable for thiamethoxam;
- 2.99 ppb imidacloprid.

These soil residues represent residues in cucurbit crops, which squash bees may be exposed to.

The range of soil residues collected from major corn and soybean growing regions in the 2015-2018 MOECP monitoring study were:

- 0.01 to 39 ppb for clothianidin (mean of 1.35 ppb from 2015 to 2018);
- 0.05 to 6.9 ppb for thiamethoxam (mean of 0.67 ppb from 2015 to 2018);
- 0.05 to 20 ppb for imidacloprid (mean of 0.68 ppb from 2015 to 2018).

These soil residue values could represent residues from seed treatment applications from the current year, or from carry-over of previous years. Carry-over refers to the residues that may be present in soils after a crop is harvested. These residues can be taken up into the next crop planted, including cucurbit plants that might be rotated into these fields. The very low means compared to the maximum values indicate that there were many non-detectable residues in the sampling.

In contrast to the risk conclusion of Chan et al. 2019, the Health Canada pollinator re-evaluations concluded a low risk to bees (honey, bumble and red mason bees) from seed treatment use. Health Canada's conclusion considered seed treatment exposure from the following sources:

- Pollen and nectar from the current year's applications;
- Dust;
- Residues in puddles/water;
- Carry-over to pollen and nectar the following year.

Consideration of the additional data from public literature in PSRD2021-02

In Health Canada's squash bee risk assessment proposed special review decision, the results from the more realistic hoop house study by Chan and Raine 2021 were relied upon over the theoretical risk estimates from the Chan et al 2019 study. The real-world, multi-year study of squash bees in cucurbits by Chan and Raine 2021, demonstrated effects on squash bees from soil applied imidacloprid, and a lack of effects on squash bees in cucurbits grown from thiamethoxam treated seed. It also demonstrated much lower residues in soils from seed treatments as compared to soil applied pesticides. These results were consistent with the risk assessments and conclusions of the pollinator re-evaluations.

Consideration of squash bee biology in relation to soil exposure

Comments received during the consultation on PSRD2021-02 discuss how squash bees may be exposed to soil residues when they nest in treated fields. Squash bee nests can be found in fields; however, large, stable squash bee populations are typically found where they are able to establish undisturbed nesting sites in addition to access to cucurbit crops. Consequently, commercial cucurbit fields may not be suitable habitats for squash bees or other ground-dwelling insects due to disturbances associated with normal agricultural practices. For example, in Canada (and Ontario, the primary growing region of cucurbits), commercial fields of summer squash are cultivated numerous times and are typically grown on raised beds with plastic mulch early in the growing season (in other words, prior to the plants developing runners). The majority of growers in Ontario are using some form of tillage in winter squash and pumpkin production, either in the spring prior to planting, or in the fall to prepare the seedbed for cover crops.

Tilling, plowing and other soil disturbances, which occur in crop fields, are expected to affect the success of squash bees nesting directly in cucurbit fields or in other crop fields. Therefore, the choice of a successful squash bee nesting location and survival of nests has been linked to areas that have little soil disturbance and lower clay content. These environments are typically found in field margins of cucurbit crops or other areas outside of crop fields.

The Chan and Raine 2021 hoop house tunnel study confined mated female squash bees to areas that were planted with treated cucurbit crops. This study represents an in-field exposure pathway. In-field exposure for squash bees is expected to be higher than off-field exposure, which is where squash bees typically nest. Even with squash bees nesting in the seed-treated cucurbit crop fields in the Chan and Raine 2021 study, there were no effects on the squash bees.

Further consideration of data and additional risk assessments in relation to comments received for PSRD2021-02

The comments received on PSRD2021-02 discuss residues in soil that could occur from the current year's applications to cucurbit crops. The comments also discuss residues in soil that could result from the previous season's use (carry-over) primarily from treated corn and soybean seeds where cucurbit crops may be rotated/planted the following year. Health Canada cancelled the soil uses on cucurbits in 2019 as a result of the pollinator re-evaluations; however, all seed treatment uses were found to be acceptable. The risk assessment for the seed treatment uses in the pollinator re-evaluations considered exposure to *Apis* and non-*Apis* bees in pollen and nectar from current year use, dust off to adjacent plants (pollen and nectar), dust residues on bees, residues in water/puddles in treated fields, and guttation water from plants. In response to the comments on PSRD2021-02, further consideration of data related to seed treatment uses was undertaken, considering available data related to both cucurbit seed treatments and seed treatment use in corn and soybean agricultural areas where cucurbits could be rotated.

The following additional risk assessments were conducted to further consider the points raised by commenters about residues in soil from seed treatment uses that could be present in cucurbit crops:

1. Imidacloprid: Squash bee effects from the Chan and Raine 2021 study were compared with:
    - Imidacloprid soil residues that were measured in the cucurbit hoop houses (Chan and Raine 2021) (these soil residue levels resulted in effects in squash bees);
    - Imidacloprid soil residues that were measured in cucurbit fields (Chan et al. 2019);
    - Imidacloprid soil residues that were measured in major corn and soybean growing areas of Ontario following mitigation for dust reduction of treated corn and soybean (Chan et al. 2019 from the 2015-2018 monitoring study by MOECP);
    - Imidacloprid pollen and nectar residues from rotational crops planted in fields where seed treatments were used the previous season. (pollinator re-evaluations);
    - Levels of thiamethoxam soil residues which did not cause effects in squash bees (from Chan and Raine 2021 study).

2. Thiamethoxam: Squash bee effects from the Chan and Raine 2021 study were compared with:
    - Thiamethoxam soil residues that were measured in the cucurbit hoop houses (Chan and Raine 2021) (these soil residue levels did not result in effects in squash bees);
    - Thiamethoxam soil residues that were measured in cucurbit fields (Chan et al. 2019);

- Thiamethoxam soil residues that were measured in major corn and soybean growing areas of Ontario following mitigation for dust reduction of treated corn and soybean (Chan et al. 2019 from the 2015-2018 monitoring study by MOECP);
- Thiamethoxam pollen and nectar residues from rotational crops planted in fields where seed treatments were used the previous season. (pollinator re-evaluations)

3. Clothianidin: Squash bee effects from the Chan and Raine 2021 study were compared with:
    - Clothianidin and thiamethoxam soil residues that were measured in the cucurbit hoop houses (Chan and Raine 2021) (these soil residue levels did not result in effects in squash bees);
    - Clothianidin soil residues that were measured in cucurbit fields (Chan et al. 2019);
    - Clothianidin soil residues that were measured in major corn and soybean growing areas of Ontario following mitigation for dust reduction of treated corn and soybean (Chan et al. 2019 from the 2015-2018 monitoring study by MOECP);
    - Clothianidin pollen and nectar residues were not available from rotational crops planted in fields where seed treatments were previously used. (pollinator re-evaluations)

Additional Risk Assessment Conclusions

1. **Imidacloprid:** In the Chan and Raine 2021 study, effects were observed in squash bees in all fields with imidacloprid soil treatments. In these imidacloprid soil treated fields, maximum soil residues of imidacloprid reached 230 ppb, and site means were: 2017: 25.6, 11.3 and 48 ppb; 2018: 142.6, 44.6 and 88.8 ppb imidacloprid.
   The following imidacloprid residue data were available for comparison with the effects seen on squash bees in the Chan and Raine 2021 study:

    - **3.9 ppb.** Chan et al. 2019 reported mean soil residues of 3.9 ppb collected from 18 cucurbit fields in Ontario.
    - **0.05 to 20 ppb (mean of 0.68 ppb).** The 2015-2018 MOECP monitoring study reported soil residues of 0.05 to 20 ppb from corn and soybean growing regions in Ontario.
    - **Less than 1 ppb.** From the pollinator re-evaluation, field residue studies with seed treatment application to various crops resulted in pollen and nectar residues of <1 ppb in rotational crops (corn followed by phacelia and oilseed rape) (no soil residues were reported).

Overall, imidacloprid residues detected in corn and soybean growing regions (maximum 20 ppb, mean 0.68 ppb) and cucurbit fields (mean 3.9 ppb), under realistic use applications, were lower than soil residues detected at sites with squash bee effects in the Chan and Raine 2021 study (maximum 230 ppb, site means 11.3 - 142.6 ppb imidacloprid). As a ‘no observed effect’ soil

residue level for imidacloprid is not available for comparison from this study, the similar mode of action and toxicity between thiamethoxam and imidacloprid allows effects data on thiamethoxam to also be considered in this analysis. No effects on squash bees were seen at sites with maximum soil residue levels of up to 54 ppb, and maximum site means up to 16.6 ppb, of thiamethoxam, and this is considered in lieu of a no effect residue level for imidacloprid. The cucurbit field means (3.9 ppb) and corn and soybean region means (0.68 ppb) are below the 16.6 ppb maximum site mean where there were no observed effects. The corn and soybean region maximum value (20 ppb) is below the 54 ppb maximum value where there were no observed effects. Additionally, residues in pollen and nectar were low in rotational crops planted where seed treatments were used in the previous year; this further supports low soil residues carrying over from seed treatment use. **Therefore, overall, no additional risk is identified for squash bees in cucurbit fields that may be exposed to imidacloprid residues resulting from seed treatment uses (including carry-over in corn and soybean growing regions).**

2. **Thiamethoxam**: In the Chan and Raine 2021 study, no effects were observed in squash bees in fields planted with thiamethoxam treated cucurbit seeds. In these fields soil residues were measured at 0 - 54 ppb, and site means were: 2017: 0.1 ppb, non-detectable and non-detectable; 2018: 1.9, 16.6 and 1.1 ppb. Therefore, it is considered that the no effect level for thiamethoxam soil residues are the maximum 54 ppb and the maximum site mean 16.6 ppb. The following thiamethoxam residue data were available for comparison with the lack of effects seen in the Chan and Raine 2021 study:

    - **No detects.** Chan et al. 2019 study did not find detectable levels of thiamethoxam in soil collected from 18 cucurbit farms in Ontario.
    - **0.05 to 6.9 ppb (mean of 0.67 ppb from 2015 to 2018).** The 2015-2018 MOECP monitoring study reported soil residues of 0.05 to 6.9 ppb for thiamethoxam from corn and soybean growing regions in Ontario.
    - **Less than 6 ppb.** From the pollinator re-evaluation, field residue studies with seed treatment application to various crops resulted in pollen and nectar residues of <6 ppb in rotational crops (corn or barley followed by sunflower, barley or rape). No soil residues were reported for comparison.

Overall, the thiamethoxam soil residues measured in fields under realistic use applications were lower than the no effect soil residue levels from the Chan and Raine 2021 study (no effect levels: maximum 54 ppb; maximum site mean 16.6 ppb). The cucurbit field means (non-detectable) and corn and soybean region means (0.67 ppb) are below the 16.6 ppb maximum site mean where there were no observed effects. The corn and soybean region maximum value (6.9 ppb) is below the 54 ppb maximum value where there were no observed effects. Additionally, residues in pollen and nectar were low in rotational crops planted where seed treatments were used in the previous year; this further supports low soil residues carrying over from seed treatment use. **Therefore, overall, no additional risk is identified for squash bees in cucurbit fields that may be exposed to residues resulting from seed treatment uses (including carry-over in corn and soybean growing regions).**

3. **Clothianidin**: In the Chan and Raine 2021 study, clothianidin was not linked to any effects on squash bees. Clothianidin was not applied as an experimental treatment for this study; however, clothianidin was detected at all sites in the first study year, and at some sites in the second year, including sites with the thiamethoxam seed treatment. Clothianidin is registered for use on seed treatments (including corn), and is also a transformation product of thiamethoxam, and therefore was considered in this analysis. Across all sites, clothianidin soil residues were detected up to 7.5 ppb, with site means up to 5.7 ppb. In the thiamethoxam seed treatment sites, where no effects were observed, both thiamethoxam residues (maximum 54 ppb; maximum site mean 16.6 ppb) and clothianidin residues (maximum 6.2 ppb; maximum site mean 3.6 ppb) were measured.
   The following clothianidin residue data were available for comparison with the lack of effects seen in the Chan and Raine 2021 study:

   - **1.95 ppb.** Chan et al. 2019 reported mean soil residues of 1.95 ppb collected from 18 cucurbit fields in Ontario.
   - **0.05 to 39 ppb (mean of 1.35 ppb from 2015 to 2018).** The 2015-2018 MOECP monitoring study reported soil residues of 0.05 to 39 ppb from corn and soybean growing regions in Ontario.
   - **pollen and nectar.** Pollen and nectar analysis were not available for rotational crops planted in fields previously planted with clothianidin seed treatments.

Mean clothianidin soil residues in cucurbit fields (1.95 ppb as reported in the study by Chan et al. 2019) and mean soil residues from corn and soybean growing regions (1.35 ppb) are both lower than the maximum site means of clothianidin in the study (3.6 ppb in thiamethoxam seed treatment fields; 5.7 ppb across all sites), none of which were linked to effects in squash bees in the Chan and Raine 2021 study. However, the maximum in the range of clothianidin soil residues collected in corn and soybean growing regions under realistic use applications (39 ppb) was higher than the clothianidin maximum soil residues measured in Chan and Raine 2021 where no effects were detected (6.2 ppb in thiamethoxam seed treatment fields; 7.5 ppb across all sites). In order to further examine the potential risk from clothianidin, thiamethoxam residues were also considered. Both thiamethoxam and clothianidin have a similar mode of action and toxicity, clothianidin is a transformation product of thiamethoxam, and both were present in the cucurbit fields planted with thiamethoxam treated seed. Therefore, the clothianidin levels in soils are also compared to residue levels of thiamethoxam resulting in no effects on squash bees. There were no effects on squash bees reported in Chan and Raine 2021 in fields containing up to 54 ppb (and up to site mean 16.6 ppb) thiamethoxam. The maximum in the range of clothianidin levels in soils from corn and soybean growing regions (39 ppb), were below the 54 ppb level of thiamethoxam where no effects were observed on squash bees in the Chan and Raine 2021 study. **Therefore, overall, no additional risk is identified for squash bees in cucurbit fields that may be exposed to residues resulting from seed treatment uses (including carry-over in corn and soybean growing regions).**

Overall risk conclusion

The comments received prompted an additional risk assessment to further consider the risk to squash bees that could be exposed to persistent neonicotinoid residues from seed treatments. This additional assessment included consideration of exposure in cucurbit crops grown on fields that had a previous crop rotation of cucurbit, corn or soybean planted with treated seed. Information was reconsidered from the pollinator re-evaluations, the recent publications by Chan et al. 2019, and Chan and Raine 2021, and squash bee biology. An additional assessment was also conducted combining all data. As a result of reconsidering the data and the additional assessment, no additional risk was identified for nesting squash bees from exposure to soil residues of imidacloprid, thiamethoxam or clothianidin resulting from seed treatment uses.

The overall risk conclusions based on consideration of all information received during the consultation process remain consistent with those presented in PSRD2021-02.

List of abbreviations

cm	centimetre(s)
MOECP	Ministry of Environment, Conservation and Parks
PMRA	Pest Management Regulatory Agency
ppb	parts per billion

Appendix I Registered products containing Clothianidin, Thiamethoxam or Imidacloprid for cucurbit use in Canada subject to special review

Table 1 Registered commercial class products containing clothianidin, imidacloprid and thiamethoxam in Canada[1]

Registration number	Registrant	Product name	Formulation type	Active ingredient
29382	Valent Canada Incorporated	Clutch 50 WDG Insecticide	Water Disperable Granules	50% Clothianidin
29384	Valent Canada Incorporated	Clothianidin Insecticide	Water Disperable Granules	50% Clothianidin
30972	Bayer CropScience Incorporated	Sepresto 75 WS	Wettable Powder	56.25% Clothianidin; 18.75% Imidacloprid
25636	Bayer CropScience Incorporated	Merit 60 WP Greenhouse And Nursery Insecticide	Wettable Powder	60% Imidacloprid
27357	Bayer CropScience Incorporated	Intercept 60 WP Greenhouse Insecticide	Wettable Powder	60% Imidacloprid
27045	Syngenta Canada Incorporated	Cruiser 5FS Seed Treatment	Suspension	47.6% Thiamethoxam

[1] as of 29 December 2021, excluding discontinued products or products with a submission for discontinuation. Reg. No. 24094 is not included as the soil use on cucurbit vegetables was cancelled in the Re-evaluation Decision RVD2019-06, *Imidacloprid and Its Associated End-Use Products: Pollinator Re-evaluation*.

Appendix II List of commenters to PSRD2021-02

List of commenters' affiliations for comments submitted in response to PSRD2021-02.

Category	Commenter
Academia	University of Guelph
Non-governmental	Friends of the Earth
Non-governmental	Wilderness Committee