

Honey Bees as an Aid in Improving Labour Conditions in Sweet Bell Pepper Greenhouses: Reduction of Pollen Allergy

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Keywords: *Capsicum annuum*, exposure, human health, occupational allergy, skin prick test

Abstract

Sweet bell pepper is the most important greenhouse vegetable crop in the Netherlands. It is grown on an area of 10,000 hectares, and about 8000 people are working in these greenhouses. One third of these workers sooner or later develop an occupational allergy to the sweet bell pepper pollen. The symptoms range from itching, blocking of the nose as well as a sniffling nose, to asthma. The pollen falls down from the flowers when the plants are shaken, which occurs when people are cutting fruits or when they prune or twine the plants. In a pilot study, a number of greenhouses in which honey-bee colonies were introduced were compared with greenhouses without honey-bees. In the greenhouses with honey-bees, hardly any pollen was present on the anthers of the flowers, since it was collected by the honey-bees as a food for their larvae. In flowers of plants in greenhouses without honey-bees, pollen was present most of the time. The symptoms of allergic workers in the greenhouses were significantly reduced by the presence of honey-bees, as was deduced from questionnaires in which the workers were asked to mark the intensity of the symptoms during the past two weeks on a Visual Analogue Scale. The possible beneficial impact of the application of honey-bees on a larger scale needs further research, as well as answering the question of a possible prevention of this occupational allergy in sweet bell pepper horticulturists by honey-bees. The required or optimal number of bee colonies per area greenhouse needs also to be studied.

INTRODUCTION

Pollen allergy is an important occupational disease in the cultivation of sweet bell peppers in greenhouses. One third of the 8000 people working in the sweet bell pepper greenhouses in the Netherlands sooner or later suffer from it. Symptoms include itching, nose problems, sneezing and breathing problems (asthma). It has been shown that the allergy is associated with the pollen (Groenewoud et al., 2002).

Honeybees as well as bumblebees can be used to pollinate sweet bell pepper flowers (Delaplane and Mayer, 2000), however this application is not common practice, since sweet bell pepper is under normal conditions a good self-pollinator. There are no obvious recommendations for the number of hives per surface area. Honeybees can discard the pollen from the flowers, and might be helpful to reduce the pollen load in the greenhouse air, leading to a reduction of the allergy symptoms.

MATERIALS AND METHODS

A pilot study was carried out from July through mid September 2001 on three greenhouses with, and three greenhouses without honeybees. Sixteen nurseries were invited by telephone to join the research project. These were selected from those that were involved in the earlier research of 1999 (Groenewoud et al., 2002). Only nurseries with at least three allergic people were admitted. Of the sixteen nurseries contacted, ten did not join for various reasons: they were using bumblebees already (2); the employees with

allergies had left (2); the nursery had replaced sweet bell pepper with another crop (2); or they were not interested (4).

Bee Colonies

All colonies originated from the experimental bee stand of Applied Plant Research, Unit Bee Research. These were normal colonies of *Apis mellifera mellifera*, no particular selection or line. The colonies were healthy, and had not been used previously for experiments that might influence their development. During the experiments all colonies were fed with Apifonda sugar and with a pollen replacement food composed of Soybeans, beer yeast, milk proteins, sucrose and water. One colony per 3000-4000 m² greenhouse area was used. Before each hive was introduced, different coloured orientation marks were made to help the bees to find their hives.

Visits

Each nursery was visited twice: on June 11 and 20 before placement of the bee colonies and on September 10 and 17, after three months of bee intervention. During the first visit information was given about the research to the labourers, and also information was given about how to handle a bee sting. The participants were asked to sign an informed consent. During the first visit a questionnaire was filled out consisting of the items: name, date of birth, sex, smoker/non-smoker, drug use, labour history with sweet bell pepper growing, and work linked symptoms concerning skin, nose, eyes and lungs. During the second visit the participants were asked to fill out a VAS score (visual analogue scale) that asks the participant to put a point on a linear scale that represents the severity of symptoms experienced during the past two weeks. A mark at the far left means no symptoms were present, while a mark at the far right indicated constant unbearable symptoms. The symptom list consisted of five items: itching, sneezing, sniffing nose, blocked nose and total nose symptoms. During the second visit the participants were asked to give an estimation of the percentage decrease of the symptoms.

Skin Prick Test

Patients who did not join an investigation beforehand were asked to participate in a skin prick test. The test consisted of a positive control (histamine), a negative control (buffer) and one with a sweet bell pepper pollen extract.

Additional Data Observations Recorded

- Abundance of pollen in the flowers: pollen counts
- Counts of the number of flowers with and without pollen falling from the anthers after a touch of the plant stem
- Counts of the number of bees returning to their hives with sweet bell pepper pollen loads
- Development of the bee colonies: number of frames occupied with bees and the number with brood.

The bee colonies were checked every fortnight. Bee colonies were replaced if the size of a colony dropped below five frames with bees, or if the colony became broodless.

RESULTS AND DISCUSSION

Bees and Flowers

The bee colonies were placed in the greenhouses on July 3, 2001, and removed on September 19, 2001. During the first two weeks of placement in the greenhouses colony strength (number of bees) generally decreased, probably because the bees get lost in the greenhouse or outside it (open vents). Also the brood area decreased during the first weeks, but then remained constant. After two months the number of bees decreased significantly due to the lowered brood production. After two months, colonies generally had to be replaced. In all colonies sweet bell pepper pollen was found in the cells. The

reduction of the percentage of flowers with pollen was generally more than 90%. Pollen collecting behaviour of the bees was generally higher during the morning than during the afternoon. As a mean result: the percentage of flowers with pollen was 42 ± 7 (SE; range 10-83) % with bees, and 88 ± 4 (SE; range 61-99) % without bees. A density of one hive per 3000-4000 m² proved to be appropriate to catch most of the pollen. An interference of crop protection measures with bee activity was observed. After an application of Admire the bees remained inactive for at least a week. During applications of crop protection substances the closed bee colonies were placed in a cool place outside the greenhouse. After re-entering the greenhouse, bee activity only slowly re-established.

Allergy Symptoms

There were 45 workers involved, 18 of them with allergic symptoms (IgE mediated allergy; confirmed with positive skin test). These 18 were the target of our research. As a mean they were 29.7 years of age (20-62 years), 17 male and 1 female. Eight were using drugs against allergies and six of them were smokers. They had been working in sweet bell pepper cultivation for an average of 15 years (1-45 years). All of these 18 individuals had nose problems, 61% had eye problems, 61% had skin problems, and 56% had breathing problems. 83% of participants found that the symptoms disappeared partly or fully during weekends and holidays.

V.A.S. score (Table 1): The mean V.A.S. score was calculated in greenhouses with and without bees (Wilcoxon Signed Ranks test). In the group with bees there was a significant ($p < 0.05$) reduction of V.A.S. score for the following items: sneezing, sniffing nose, and total nose problems. In the control group there was no significant decrease in symptoms observed between the first and second visit.

Percentage improvement: Eleven of the twelve people in the group with honeybees were able to give an answer to the question of how much their symptoms had decreased (or their health condition improved): 21.5% as a mean. However, they considered this question very difficult to answer, because they also suffered from other allergies, e.g. house dust mite. Hence the range of percentage of improvement was large: 0-75% improvement.

Pollen Counts

Statistical analyses (Wilcoxon Signed Ranks test) showed a significant difference (2-tailed, $p < 0.001$) in the median number of pollen grains per 10 flowers between samples collected before and after the introduction of honeybees. In the treatments without bees there was no significant difference between the June and September values (2-tailed, $p = 0.1464$).

CONCLUSIONS

Despite the small group of participants, a significant reduction of allergy symptoms was demonstrated. The percentage of symptoms observed were representative of sweet bell pepper cultivation, since the percentage of allergic workers are comparable to those in earlier studies. The workers were not hampered by the presence of the bees and only a few individuals were stung, without alarming reactions.

There was a significant decrease in the amount of pollen in flowers, and the number of flowers with pollen, through the use of honeybees in sweet bell pepper greenhouses. One hive per 3000-4000 m² was sufficient. With that density of bees the colonies remained strong enough to be effective for two months. Applications of crop protection substances can strongly reduce the pollen collecting activity of the bees, either by specific effects of the substance or by the temporal absence of the bees in the greenhouse.

To develop a clear picture of whether the application of honeybees on a large scale in the cultivation of sweet bell pepper will result in a reduction of symptoms, more research will be necessary. Whether it can also prevent the development of (new) allergy cases cannot be determined yet and should also warrant research. Further research has to

be done on a larger scale throughout a whole season to determine the optimal number of hives per surface area.

ACKNOWLEDGEMENTS

This research was supported financially by the Dutch Product Board for Horticulture (PT).

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Tables

Table 1. V.A.S. score before and after introduction of bees (12 of the 18 allergic people), and in control greenhouses (6 of the 18 allergic people).

	Visit	Sniffling	Sneezing	Nose (total)
With bees	1 (before)	4.8	5.0	5.9
	2 (after)	1.8	2.5	3.0
Without bees	1	5.0	5.5	6.2
	2	3.3	4.5	4.3