Laboratory experiments to determine the liquid formulation for a spraying application technique for *Trichogramma* parasitized eggs to control the codling moth *Cydia pomonella*

O. Zimmermann[1], B. Wührer[2]

Abstract

Egg parasitoids of the genus Trichogramma *can be one tool in a control strategy against the codling moth Cydia pomonella, e.g. to control late infestation where other control agents cannot be applied. A mechanical application method for parasitized eggs with a better distribution in a spraying cloud could possibly improve the efficacy of* Trichogramma *compared to a single spot release system with cardboard cards. Eggs of* Sitotroga cerealella *parasitized by* Trichogramma evanescens *were tested in a liquid formulation with a hydrocolloid. The optimum concentration has been assessed by determination of the viscosity of the formulation: 2-3 g/l with xanthan or guar bean flour. Different spraying treatments under semifield conditions resulted in a reduction of the emergence rate between* 37 and 69% *when the formulation had to pass the spraying tubes, nozzles and ventilation system. A low reduction between 4-12% could be reached by scattering loose parasitized eggs into the spraying cloud. In practice such an application system would require additional modification to the existing agricultural spraying technique.*

Keywords: *Cydia pomonella*, *Trichogramma*, hydrocolloid gel, liquid formulation, application method, release technique

Introduction

Trichogramma species have already been in the focus of research on control methods against the codling moth *Cydia pomonella* L. (CM), one of the most important pests in fruit orchards in Europe (Wetzel et al. 1995, Sakr 2002). The efficacy of *Trichogramma* treatments was not stable in practice and could only be adapted by home garden owners but not in orchard plantations. One reason lies in the single spot release of *Trichogramma* on cardboard cards which requires a better long distance searching behaviour compared to evenly distributed parasitized eggs, e.g. through spraying. The mechanical application of *Trichogramma* in biodegradable starch capsules (Wührer & Zimmermann 2002) was one step towards such an application method for egg parasitoids. Information on mechanical application systems as well as on additives and suspension agents (hydrocolloids) is rarely being published in scientific papers (Moser 1980). The aim of our study was to select a homogenous liquid dispersion that enables the spraying of parasitized eggs and has a sticky character as well to attach these eggs to the apple leaves. Both should not have a strong negative effect on the quality of the biocontrol agent. The presented trials give an example for systematic laboratory and semifield trials to improve the release techniques for beneficial organisms.

[1]Zimmermann, Olaf, Julius Kuehn-Institute (JKI), Institute for Biological Control, Heinrichstr. 243, D-84287 Darmstadt, ozimmermann@hotmail.com
[2]Wührer, Bernd, AMW Nützlinge GmbH, Außerhalb 54, D-64319 Pfungstadt[1]

Material and Methods

Different colloids were used in their standard quality for regular food production. They are listed with E-number codes (approved food additives in the European Union).

This was one requirement for a potential use in apple orchards. Pure starch and pectin failed in initial trials because they did not create a continuous viscose formulation and the parasitized eggs separated themselves from the dispersion. According to their viscosity and for economical reasons xanthan (E 415, bacterial fermentation from *Xanthomonas campestris*) and guar bean flour (E 412, from *Cyamopsis tetragonolobus*) where the most promising candidates for further studies. They were characterized by using a viscometer Ford flow cup (ISO 2431, 4 mm). The flow time of both colloids was tested at different concentrations compared to water control. The viscosity was checked at time intervals of 5-10 minutes and up to 150 minutes for consistency.

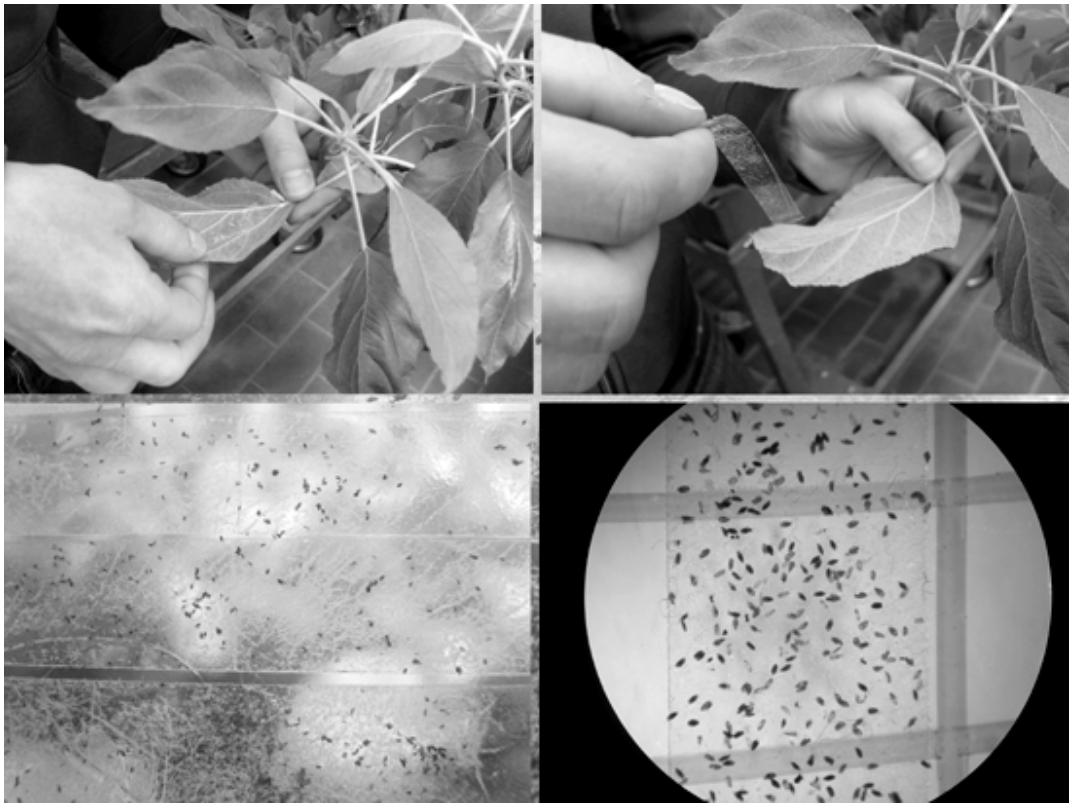

Figure 1: Microscopic analysis of the emergence rate of *Trichogramma* parasitoids after spraying parasitized eggs on apple leaves under semifield conditions using a transfer method with sticky tapes

Starting with single droplets testing of drying the study was extended to using standard garden hand sprayers to determine the time of drying and the reduction of emergence of the adult *Trichogramma* parasitoids. Different treatments were a) spraying the liquid formulation with submerged parasitized eggs and b) scattering loose dry eggs into the spraying cloud. The assessment included apple leaves up and downside. For a microscopic analysis the sprayed eggs were collected from the leaves by using a sticky film transfer method (fig. 1). Both hydrocolloids were tested at a concentration of 2 g/l.

Results

The observation of the viscosity of guar bean flour (fig. 2) at a concentration of 6,7 g/l showed an increasing large viscosity even after 150 minutes with a flow time between 60-105 seconds. At 3,3 g/l the flow time was constantly 21 seconds and at 1,7 g/l it resulted in 15 seconds compared to water control with a flow time of 12 seconds.

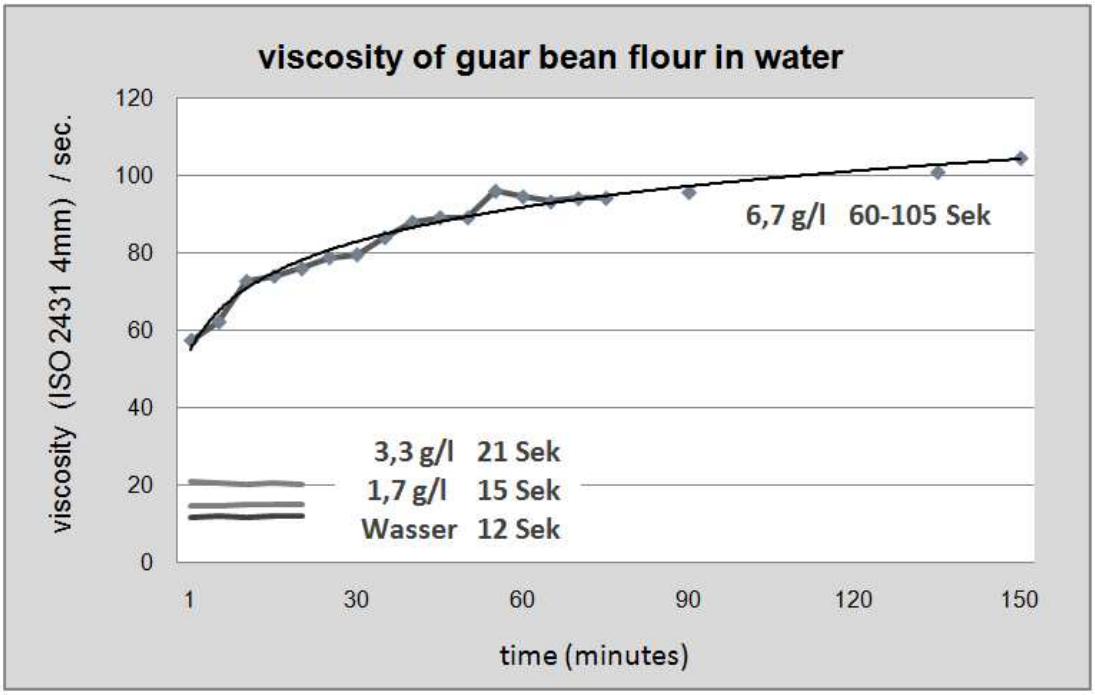

Figure 2: Viscosity (ISO 2431 4 mm) of guar-bean flour at different concentrations

For xanthan at a concentration of 2,5 g/l the flow time increased up to 26-29 seconds. With 5,0 g/l the viscosity increased continuously even after three hours observation time. A higher concentration could not be fully tested for viscosity because the flow had stopped.

In these laboratory experiments the emergence rate of adult *Trichogramma* parasitoids has been reduced by both hydrocolloids by 37-52% (guar) and 43-69% (xanthan) when a hand sprayer was used for application. The nozzles and the tube system might have affected the parasitized eggs and the jelly formulation might also increase the mortality of the *Trichogramma* pupae because of the deprivation of oxygen. In the spraying treatment with scattered parasitized eggs in the spraying cloud resulted in a higher emergence rate of the parasitoids with less negative effects (fig.3). The reduction of emergence was low between 4-12% and did not significantly differ between xanthan and guar bean flour. The emergence rate in the control was 88 % which is a standard high quality measure in the mass rearing.

These results show that a hydrocolloid liquid formulation of parasitized eggs with *Trichogramma* will reduce the emergence rate at quite variable levels according to which application method has been used. The effect of the formulation passing the spraying tubes and nozzles will also be tested with regular agricultural machinery. It will be a decision between efficacy and economy to decide how to proceed with these laboratory results.

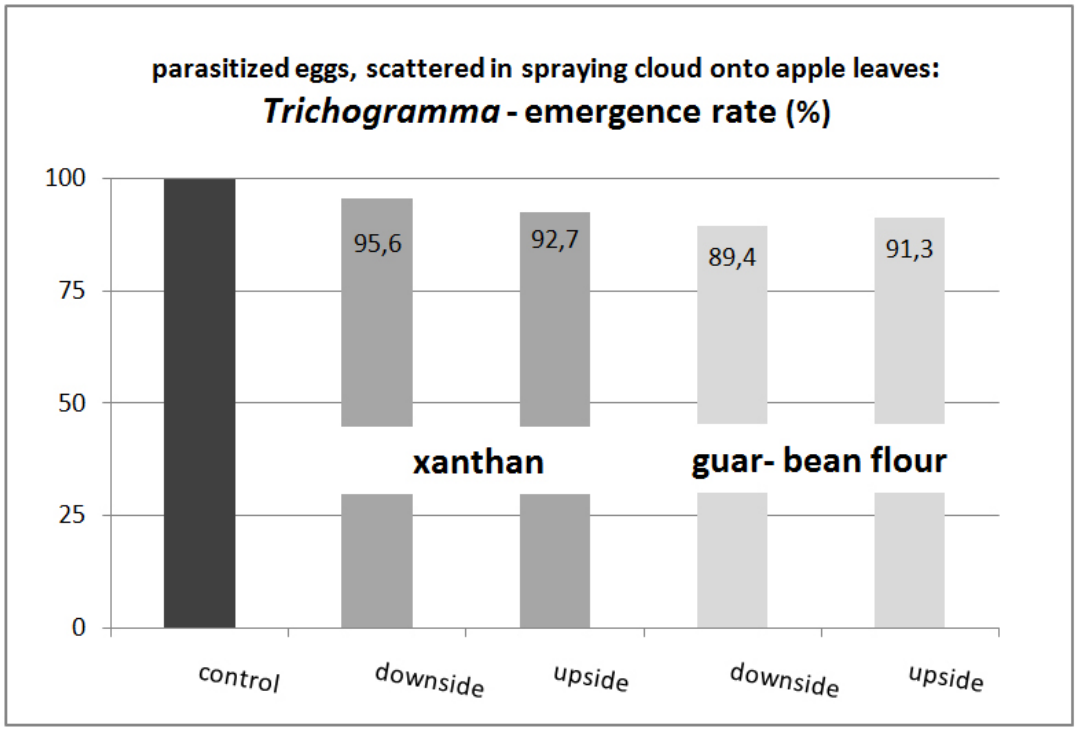

Figure 3: The emergence rate of *Trichogramma* after scattering loose eggs in a spraying cloud of a liquid formulation with xanthan or guar bean flour

In practice an application system with dry parasitized eggs in a spraying cloud would be desirable from a scientific point of view, but it will require additional modifications to the existing agricultural spraying technique.

Acknowledgements

We thank the Bundesamt für Landwirtschaft und Ernährung (BLE) for financial support of the project (Az 28-1-42.021/022/023-06).

References

Moser, E. (1980): Untersuchungen zur Ausbringung von *Trichogramma* im Spritzverfahren zur biologischen Schädlingsbekämpfung. *Agrartechnische Berichte des Instituts Agrartechnik der Universität Hohenheim. Heft* **11**.

Sakr, H.E.A. (2002): Use of egg parasitoids of the genus Trichogramma to control the codling moth Cydia pomonella (Lepidoptera: Tortricidae); selection of effective parasitoid species. Dissertation, Universität Stuttgart-Hohenheim, 126 S. .

Wetzel, C., Dickler, E., Hassan, S.A. & Wrzeciono, S. (1995): Untersuchungen zum Einsatz von *Trichogramma dendrolimi* Matsumura (Hym., Trichogrammatidae) zur Bekämpfung von Tortriciden im Apfelanbau. *Mitt. Biolog. Bundesanst. Land- Forstwirtsch.* **313**: 88 S.

Wührer, B., Zimmermann, O. (2002): First results of the mechanical and aerial release of *Trichogramma* with biodegradable capsule release units TichoKugel for the commercial use in Germany. In: Zimmermann, O., Herz, A., Hassan, S.A. (eds.) (2002): Egg Parasitoid News No. 14. IOBC, *Biol. Bundesanst. Land- Forstwirtsch.* **14**, 39.