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What lies beneath?

Linking litter and canopy food webs to protect ornamental crops

Muñoz Cárdenas, K.A.

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Muñoz Cárdenas, K. A. (2017). *What lies beneath? Linking litter and canopy food webs to protect ornamental crops*.

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menten zouden daarom kunnen achterhalen wat het effect is van het toevoegen van strooisel met rovers aan de voet van de planten, hetgeen zou kunnen resulteren in een sterkere verbinding tussen de beide voedselwebben. Bestrijding van andere plagen door de predators die in de strooisellaag leven verdient meer studie omdat ze goed zijn aangepast aan het gewas en omdat hun dichtheden kunnen worden verhoogd door toediening van alternatief voedsel (HOOFDSTUK 3). Het loslaten van de predators nadat tripsaantasting was opgetreden resulteerde in onvoldoende bestrijding, met veel schade aan de planten. Wanneer predators werden losgelaten en bijgevoerd met pollen voor de tripsaantasting, waren planten wél beschermd. Ik vond geen verschil in tripsdichtheden en schade wanneer pollen wekelijks werd toegevoegd en wanneer die toediening werd onderbroken. Er waren echter wel significant meer rovers aanwezig op de planten die continu pollen ontvingen. Concluderend, laat ik in HOOFDSTUK 4 zien dat bladbewonende rovers moeten worden losgelaten voordat trips invadeert om schade aan bloemen van siergewassen zoals roos te verminderen. Bovendien zou pollen wekelijks moeten worden toegevoegd. Ik geef aan dat meer studie nodig is naar de frequentie van toediening en de kwaliteit van alternatief voedsel. Ook de rol van predators in de strooisellaag bij de bestrijding van trips en andere plagen verdient meer onderzoek.

In dit proefschrift presenteer ik diverse methoden die kunnen worden gebruikt bij biologische bestrijding. Ik laat ook zien dat kasexperimenten kunnen helpen bij het testen van ecologische theorie: ik toon aan dat het toevoegen van alternatief voedsel voor generalistische predators voornamelijk resulteert in 'apparent competition'; 'apparent mutualism' werd af en toe waargenomen, en gedurende korte perioden, vooral wanneer de plaag aanwezig was voordat de predators werden losgelaten. Op basis van dit proefschrift, suggereer ik twee factoren die meer theoretische aandacht verdienen: (1) het effect van gemengde diëten op 'apparent competition' en (2) het effect van de frequentie van toediening van alternatief voedsel op de dynamica van predators en prooien. Ik laat ook zien dat de interacties tussen bovengrondse en ondergrondse voedselwebben effect hebben op plaagdichtheden. Met betrekking tot dit laatste onderwerp, beveel ik theoretische studies aan over het effect van meerdere soorten van generalistische predators en het toedienen van voedsel bovengronds en ondergronds op plaagbestrijding.

Samenvattend, concludeer ik dat voedselwebben in de strooisellaag en op de bovengrondse plantendelen kunnen worden verbonden en dat dit kan resulteren in betere biologische bestrijding in een siergewas. Kasexperimenten naar de dynamica van meerdere predatorsoorten met meerdere voedselbronnen zijn cruciaal voor het ontwikkelen van nieuwe bestrijdingsmethoden. Zulke experimenten vormen tegelijkertijd goede tests voor ecologische theorie.

Curriculum vitae

Karen was born in Bogotá, Colombia, surrounded by her beloved – and luckily a bit crazy and adventurous – relatives. She went to a catholic primary school in Soacha, a town near Bogotá. Karen and her family moved to Bogotá when she was 12 years old. There she attended a public technical high school. After graduating from high school, Karen travelled to the USA to work and to learn English. In 2002, Karen returned to Colombia to study a bachelor's degree in Applied Biology at the Nueva Granada Military University (UMNG). Karen was, is and will be a pacifist, so going to a military university may sound paradoxical. However, the UMNG was affordable, and their biology program focused on the important role biodiversity plays in agriculture.

Karen became especially interested in the subject of biological control: visiting and conducting experiments in ornamental and aromatic crops, Karen observed that in crops with low pesticide use, there was a higher diversity of beneficial insects and mites, and a better quality of life for the growers. This had a strong impact on Karen's life. That's why she decided to pursue a master's degree focused on plant protection and biological control at the UMNG. During her postgraduate studies, Karen continued working as a research assistant for the Colombian Association of Flower Growers (ASOCOLFLORES). Her master's thesis dealt with the integrated pest management in rose crops.

In 2008, Karen attended a workshop on agricultural acarology at Ohio State University. There she met Prof. Maurice Sabelis. He accepted Karen in his team. In 2010, she earned a scholarship from the Colombian Department of Science and Technology (COLCIENCIAS) to pursue a PhD program. In the year 2011, Karen did an internship in a biological control company, met her soul mate, and began her PhD research.

Karen now works as an Environmental Risk Evaluator at the Dutch Board for the Authorization of Plant Protection Products and Biocides (CTGB). In her new role, Karen wishes to continue highlighting the importance of biodiversity for sustainable agriculture.

Publications

- Muñoz K**, Fuentes L, Cantor F, Rodríguez D, Cure J (2009) Preferencia alimenticia del ácaro depredador *Balaustium* sp. en condiciones controladas. *Agronomía Colombiana* 27: 95-103
- Buitrago I, **Muñoz K**, Bustos A, Cantor F (2010) Evaluación de plantas hospederas para la producción del trips *Frankliniella occidentalis* (Thysanoptera: thripidae) como suministro de presas para sus controladores. *Revista de la Facultad de Ciencias de la Universidad Militar Nueva Granada* 6:12-23
- Muñoz-Cárdenas K**, Fuentes L, Cantor F, Rodríguez D, Janssen A, Sabelis MW (2014) Generalist red velvet mite predator (*Balaustium* sp.) performs better on a mixed diet. *Experimental and Applied acarology* 62:19-32

Fuentes Quintero LS, Muñoz-Cárdenas K, Combita O, Jimeno E, Getiva de la Hoz JC, Cantor F, Rodríguez D, Makol J (2014) A re-description of *Balaustium leanderi* Comb. Nov. (Actinotrichida, Erythraeidae) with first report on characteristics of all active instars and taxonomic notes on the genus. The Florida Entomologist 97:937-951

Muñoz-Cárdenas K, Fuentes L, Rueda-Ramirez D, Rodríguez D, Cantor F (2015) The Erythraeoidea (Trombidiformes: Prostigmata) as biological control agents, with special reference to the genus *Balaustium*. In: Prospects for biological control of plant feeding mites and other harmful organisms, edited by D Carrillo, GJ de Moraes, JE Peña, Chapter 8, Springer

Muñoz-Cárdenas K, Ersin F, Pijnakker J, Van Houten Y, Hoogerbrugge H, Leman A, Pappas M, Duarte M, Messelink G, Sabelis MW, Janssen A (2017) Supplying high-quality alternative prey in the litter increases control of an above-ground plant pest by a generalist predator. Biological Control 105:19-26

Acknowledgements

People say that a community is needed to raise a child and I think that a community is also needed to make a happy doctor in philosophy. I am deeply grateful with my family, friends and colleagues from all over the world that supported me during the challenging years of my PhD.

I have no words to thank my supervisor Maurice Sabelis (Maus), sadly he is not here to celebrate the end of this stage. He gave me the opportunity to join his team in The Netherlands. I feel very fortunate to have listened to his talks and to have had very exciting discussions about biological control and ecology. To my co-supervisor Arne, I am also deeply grateful, I learnt a lot from him and I really appreciate that he supported me always in all my academic adventures. Special thanks also go to Peter de Ruiter for accepting the role of supervisor and for contributing during the writing period of my thesis.

Juliette, Ada, Firdevs, Maria, Gerben and Marcus, it was so cool to work with you and get to learn from your experience in laboratory and field experiments. Thanks for engaging conversations, meetings and presentations to my colleagues from IBED or that passed by IBED, Iza, Martijn, Farid, Isabel, Michiel, Anieke, Paulien, Andre, Tom, Nienke, Zepeng, Dan Li, Yukie, George, Nicky, Sabina, Masoumeh, Seye, Merijn and his team, Juan Ma, Bart, Alessandra, Carlos, Rachid, Jie and Josefina. I am grateful for all help and support from Mary, Maria, Tanya, Ludek and Harold. Paul, many thanks, I highly admire your work and I feel fortunate to have received your advices regarding experiments which were always super useful. Louise, Bram and Floor, it was fun to work together in the Ph(D) council. Thanks to Yvonne, Markus, Hans and Karel for your support during the internship before starting my PhD. To Tom and his research team in Koppert, thanks for your support with materials and discussions also during my PhD. To Jan vA, your work with images and photos is excellent and it made me very happy. Jan B, thanks for editing the thesis before printing. Hecticor, gracias por ayudarme tanto con la escritura de mi tesis. To all amazing friends that I met in The Netherlands, Laura, Patricia, Saioa, Nina, Heike, Kirsten, Monika, Hector, Dim, Rocío, Marian, Sofi, Daniela, Fernando, Joris, Livia, Felipe, Catalina, Thomas, Alexandra, Josinaldo, Oziel, Hidde, Leena, Ana, Paola, Aija and Olivier and other friends that I might forget to name, thanks for caring and for all the moments we spent together.

A mis amigos y colegas acarólogos, Luz Stella, Orlando, Elisa y Diana, siempre es muy divertido trabajar juntos, espero que lo sigamos haciendo. Abuelita, tía Abelina, tía Ana, tío Jairo, Claudia, Danny, Betty, Isabella, Nana y Manu, Andrés, Will, Yheimy,

ACKNOWLEDGEMENTS

Jessica, Catalina, Alejita, Angie, Alex, Dieguito, Elizabeth y Maria Claudia, tía Rosa, tía Elizabeth y los Muñoz, doña María y los Gutiérrez, gracias por su amor y apoyo incondicionales. Tineke, Erkal en Emre dank jullie wel dat jullie mijn familie in Nederland zijn. Mamá, Padre y Marquito, gracias por la fortaleza emocional que siempre me transmiten, por ser fuertes y aventureros, y por enseñarme que todo en la vida se puede lograr. And finally, last but by no means least, mi amor, gracias por hacerme tan feliz.