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Effect of pest controlling neem and mata-raton leaf extracts on greenhouse gas emissions from urea-amended soil cultivated with beans: A greenhouse experiment

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ABSTRACT

In a previous laboratory experiment, extracts of neem (*Azadirachta indica* A. Juss.) and *Gliricidia sepium* Jacquin, locally known as mata-raton, used to control pests on crops, inhibited emissions of CO_2 from a urea-amended soil, but not nitrification and N_2O emissions. We investigated if these extracts when applied to beans (*Phaseolus vulgaris* L.) affected their development, soil characteristics and emissions of carbon dioxide (CO_2) and nitrous oxide (N_2O) in a greenhouse environment. Untreated beans and beans planted with lambda-cyhalothrin, a commercial insecticide, served as controls. After 117 days, shoots of plants cultivated in soil amended with urea or treated with lambda-cyhalothrin, or extracts of neem or *G. sepium* were significantly higher than when cultivated in the unamended soil, while the roots were significantly longer when plants were amended with urea or treated with leaf extracts of neem or *G. sepium* than when treated with lambda-cyhalothrin. The number of pods, fresh and dry pod weight and seed yield was significantly higher when bean plants were treated with leaf extracts of neem or *G. sepium* treatments than when left untreated and unfertilized. The number of seeds was similar for the different treatments. The number of nodules was lower in plants fertilized with urea, treated with leaf extracts of neem or *G. sepium*, or with lambda-cyhalothrin compared to the unfertilized plants. The concentrations of NH_4^+, NO_2^- and NO_3^- decreased significantly over time with the lowest concentrations generally found at harvest. Treatment had no significant effect on the concentrations of NH_4^+ and NO_2^-, but the concentration of NO_3^- was significantly lower in the unfertilized soil compared to the other treatments. It was found that applying extracts of neem or *G. sepium* leaves to beans favored their development when compared to untreated plants, but had no significant effect on nitrification in soil.

1. Introduction

Extracts of neem (*Azadirachta indica* A. Juss.) are strong repellents for insects mainly due to azadirachtin, a complex limonoid, mostly found in the neem seeds (Schaaf et al., 2000), and also due to other limonoid and sulphur-containing compounds found in the leaves, flowers, bark and roots (Mordue and Nisbet, 2000). Extracts of neem leaves or seeds have been used to control pests (Schmutterer, 1985; Akhtar and Mahmood, 1997; Amadioha, 2000; Michereff et al., 2008; Montes-Molina et al., 2008a). In a previous field experiment, it was found that leaf extracts *A. indica* reduced damage to newly formed leaves and increased yields of maize (*Zea mays* L.) compared to untreated plants (Montes-Molina et al., 2008b). Abo-Elyousr et al. (2009) reported that neem extracts achieved a 65% mortality of the root-knot nematode *Meloidogyne incognita in vitro*. However, neem originates from India and might replace natural vegetation thus affecting local ecosystems. *Gliricidia sepium* (Jacquin), also known as mata-raton, originating from Central America and Mexico, was therefore used as an alternative to control pests on maize (Montes-Molina et al., 2008a). *Gliricidia* is used in Chiapas as an insecticide although little is known about the components bioactive towards pests. However, its leaves do contain triterpene saponins (Rastrelli et al., 1999; Rojas et al., 2006).

Extracts of the neem plant are known to affect soil processes and some compounds found in neem seed kernels are known to affect soil bacteria (Mohanty et al., 2008). Extracts of mata-raton have antimicrobial activity, so they might also affect soil processes (Rojas et al., 2006). Gougoulias et al. (2010)reported that crushed neem pellets decreased C mineralization, but increased the concentrations of NO_3^-, organic P, bioavailable P, K and Mn. Gopal et al. (2007) investigated the effect of granules containing 10% azadirachtin, i.e. alcoholic extract of neem seed

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