Evaluating efficacy of earthworms after exposure to broadcast contact insecticides

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Abundance and activity of decomposers in the soil food web can be used as indicators of ecosystem health, since they are responsible for over 80% of total soil metabolism (Brady and Weil 2004; Coleman et al.1992). Earthworms are examples of these decomposers, with some soils containing up to four hundred within one cubic meter of soil. Since the earthworms ingest soil when burrowing, they are regarded as living indicators of good soil quality. They also have important roles in nutrient cycling and increasing the overall biological activity of the soil (Parmelee et al. 1998).

A concern of some homeowners and Master Gardeners in Collin and Dallas counties is the effect that broadcast contact insecticides have on earthworm populations. Since these insecticides bind to the soil, many people are fearful that they will kill their existing earthworm population within the landscape. For this trial, I evaluated three different chemicals, bifenthrin, imidacloprid and fipronil that are commonly used by homeowners as broadcast contact insecticides to determine effects on red wiggler earthworms, *Eisenia foetida,* in a laboratory setting.

Methods and Materials

This trial was initiated on October 9, 2007 at 12:00 pm at the Dallas Research and Extension Center. Sixteen Rubbermaid™ containers measuring 20.5cm by 30.8cm with a volume of 128 oz were used for the trial (Figure 1). Each container was filled with 1000g of Black Velvet Premium Top Soil™ purchased from local garden store. The soil was chosen due to the high manure content. Red wiggler earthworms were purchased from a local composter in Grapevine, Texas. Ten red wiggler earthworms were placed into each container at 12:00pm and allowed to tunnel into the soil for six hours before treatments were applied.

The treatments used for this trial were Ortho® Season Long Control (0.115% bifenthrin), TopChoice® (0.0143% fipronil), Merit® 2G (0.2% imidacloprid), and water (control). Each treatment was replicated four times. Chemical application rates were calculated to account for small area being covered. The label rate of Ortho® Season Long control is 4 lbs/1000 ft^2, so 0.052 oz was used per container, the label rate of TopChoice® is 2 lbs/1000 ft^2, so 0.026 oz was used per container, and the label rate of Merit® 2G is 1.8 lbs/1000 ft^2, so 0.023oz was used per container in this experiment. Each chemical treatment was weighed and then sprinkled evenly over the entire container. Eight ounces of water was applied using a hand-held spray pump to each container so the chemicals could distribute into the soil.

Evaluations were conducted at 3, 7, 14, 21, 28 and 60 days post treatment. For each evaluation, the soil was lightly disturbed using a Scoopula® spatula to remove all 10 of the earthworms to assess mortality (Figure 2). Dead earthworms were disposed of and live earthworms were placed back into their original container. Following each evaluation, containers were moistened with one ounce of water using a hand-held spray pump.

Data were analyzed using Analysis of Variance (ANOVA) test with means separated using Duncan's Multiple Range Test at $P \leq 0.05$ (SPSS for Windows, Lead Technologies, Version 14.0).

Discussion and Conclusions

At 3, 7, 14, 21, 28 and 60 days post treatment, imidacloprid had significantly less live earthworms compared to the bifenthrin, fipronil and water (control) treatments (Table 1). After 3 days, it was noticed that imidacloprid negatively affected the epidermal layer of the earthworms. This caused the earthworms in the imidacloprid treated containers to become gummy and thin. The fipronil and bifenthrin treatments were not significantly different than the water controls, so these chemicals did not seem to affect the earthworms.

I plan to continue with evaluations of additional broadcast contact insecticides that are commonly used within the landscape to determine effects on earthworm populations.

Figure 1. The sixteen containers used for the earthworm trial, each containing 10 earthworms and 1000g of soil.

Figure 2. One replicate depicting the live earthworms and Scoopla® spatula used for each evaluation.

Table 1. Mean number of live earthworms found within each of the treated containers.

Treatment	3 Days	1 Week	2 Weeks	3 Weeks	4 Weeks	6 Weeks	8 Weeks
Bifenthrin	9.50b	9.50b	9.25b	9.00b	8.25b	8.25b	8.00b
Imidacloprid	6.50**a**	4.25**a**	3.00**a**	1.50**a**	0.25**a**	0.25**a**	0.00**a**
Fipronil	9.75b	9.50b	9.50b	9.00b	8.25b	8.00b	7.75b
Water Control	9.75b	9.75b	9.75b	9.75b	9.50b	9.25b	9.25b

[a]Means followed by the same letter within the same column were not significantly different using Analysis of Variance (ANOVA) and means separated using Duncan's Multiple Range Test at $p \leq 0.05$ (SPSS, Windows 11.5).

Literature Cited

Coleman D. C. et al. 1992. Soil biology, soil ecology and global change. Biol. Fert. Soils 14:104-111.

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