The Effect of Microwave Soil Treatment on Key Soil Biota

Graham Brodie* ⁽¹⁾, Michelle Grixti⁽¹⁾, Eloise Hollins⁽¹⁾ and Mary Cole⁽²⁾
(1) The University of Melbourne, Nalinga Rd., Dookie, 3647, Victoria, Australia
(2) Agpath Pty Ltd, 105 Gunn Rd., Vervale, 3814, Victoria, Australia

No-till agricultural practices, which maintain good soil structure and greatly reduce the potential for soil erosion compared with older tillage practices, are heavily dependent on herbicides to manage weed infestations. Unfortunately, herbicide resistance in many weed species is becoming wide spread and multiple herbicide resistances in several economically important weed species have also been widely reported. Some studies have demonstrated that competition from weeds can reduce the expected yield of some crops by between 35% and 55%.

Microwave treatment of some pests, weed plants and weed seeds is effective, with broadleaf plants and exposed snails being much more susceptible than grass plants (Figure 1); however the effect of microwave soil treatment on soil biota needs further study. Fluorescence microscopy is a rapidly expanding technique, both in the medical and biological sciences. Fluorescence can be induced in cells by addition of various chemicals: fluorescein diacetate for living cells and fluorescein isothiocyanate for non-living cells. This technique was used to determine the portions of active and total specimens of bacteria, fungi, and flagellates, ciliates, and amoeba (protozoa) extracted from soil samples that have been treated with differing levels of microwave energy. Secondary assessments of the same biota groups were made on the same soils 35 days after treatment to assess species recovery. Soil biota data were analysed using a multifactor analysis of variance with the factors being microwave energy applied to the soil surface, soil depth and recovery time after treatment.

Analysis revealed that no significant effect on fungi, flagellates, ciliates, and amoeba could be attributed directly to microwave treatment energy. Initially, microwave treatment reduced bacterial numbers; however bacterial numbers significantly increased after one month (Table 1). In conclusion, microwave soil treatment has minimal effect on most soil biota tested for in this study. It reduces the number of active bacteria in the soil, but does not sterilize the soil. Bacterial numbers recover with time after microwave treatment.



Figure 1: Response of annual ryegrass (Lolium rigidum), wild radish (Raphanus raphanistrum), and Italian White Snails (Theba pisana) to applied microwave energy.

Soil	Recovery	Estimated Microwave Treatment			
Depth	time after	Energy (J cm ⁻²)			
(cm)	Microwave	0	132	264	528
	Treatment				
	(Days)				
0	1	6.20 ^a	5.57 ^a	4.73 ^a	1.78 ^a
	35	18.90 ^b	38.48 ^d	38.25 ^d	19.67 ^b
5	1	3.78 ^ª	4.71 ^a	4.23 ^a	1.18 ^a
	35	18.73 ^b	24.28 ^{bc}	29.95 ^c	28.22 ^c
10	1	4.06 ^a	2.93 ^a	3.87 ^a	1.74 ^a
	35	16.93 ^b	26.13 ^c	28.90 ^c	18.00 ^b
LSD (P = 0.05)					7.30

Table 1: Effect of microwave treatment on active bacteria as a function of applied microwave energy and soil depth and recover time after treatment