Soil Thermal Properties of Peat Based Media Amended with Fertilizers and Grown to Three Vegetables

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ABSTRACT

We investigated the effects of growing media amendment with organic fertilizers and vegetable species on soil temperature (T), thermal conductivity (K), thermal resistivity (R), thermal diffusivity (D) and volumetric heat capacity (C). The study was conducted from June to September 2011in a greenhouse at Lincoln University. Results showed that organic fertilizers did not directly affect soil thermal properties, but vegetable species did. In addition, soil K, R and C were either positively or negatively correlated with vegetables growth parameters

OBJECTIVES

- Evaluate the effects of growing media amendment with organic fertilizers and vegetables growth on soil temperature (T), thermal conductivity (K), thermal resistivity (R), thermal diffusivity (D) and volumetric heat capacity (C).
- Assess the relationship between soil thermal properties and vegetables growth

MATERIALS AND METHODS

The study was conducted from June to September 2011in a greenhouse at Lincoln University. One hundred and twenty pots were filled with Fafard organic soil and amended with three organic fertilizers: Cottonseed meal (6-2-1), Dried Blood (12-0-0), Garden Food (4-3-2) and NPK(13-13-13). A control treatment made of non-amended Fafard organic soil was also included in the study. The experimental design was a completely randomized block with 5 fertilizers treatments and 3 vegetables replicated 8 times. T, K, R, D and C were monitored throughout the four months of this study using a KD2-Pro Thermal Meter. Soil moisture and soil water potential were also measured

RESULTS

Fig. 1. Soil thermal properties in August 2011

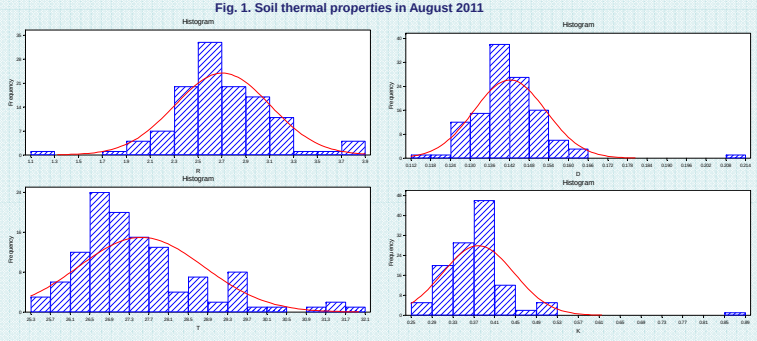


Table 1. Effect of organic fertilizers and vegetables growth on soil thermal properties, August 2011

Fertilizers (F)		T (°C)	K (W/m°K)	R (m°K/W)	D (mm^2/S)	C (J/kg°K)
Control		27.32	0.38	2.67	0.14	2.64
Cottonseed meal		27.52	0.36	2.86	0.14	2.54
Dried Blood		27.45	0.38	2.70	0.14	2.69
Zoom garden food		27.68	0.38	2.71	0.14	2.64
Mineral		27.76	0.41	2.58	0.14	2.80
Vegetables (V)						
Sweet pepper		27.60	0.38	2.67	0.14	2.69
Green lettuce		27.29	0.36	2.91	0.14	2.51
Swiss chard		27.75	0.40	2.54	0.14	2.79
Analysis of variance						
Sources of variation	df					
Fertilizers (F)	4	ns	ns	ns	ns	ns
Vegetables (V)	2	ns	**	****	ns	**
Interaction						
F x V	8	ns	ns	ns	ns	ns

Table 2. Correlation matrix (r values) between soil thermal properties and vegetables growth parameters

	T	K	R	D	C
Height	-0.02^{ns}	-0.27**	0.26**	-0.04^{ns}	-0.23**
Leaf Area	-0.07^{ns}	-0.39****	0.38****	-0.12^{ns}	-0.29***
Leaves #	0.06^{ns}	-0.26**	0.24**	-0.17^{ns}	-0.17^{ns}
Plant dry weight	-0.02^{ns}	-0.31**	0.30**	-0.16^{ns}	-0.22*
Root dry weight	-0.09^{ns}	-0.25**	0.23**	-0.10^{ns}	-0.18*

*, **, ***, **** significantly different at 0.05, 0.01, 0.001 and at 0.0001 probability level

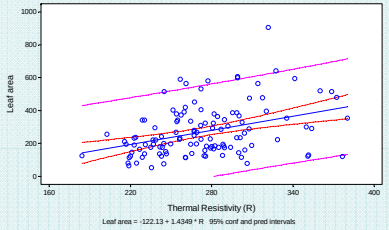
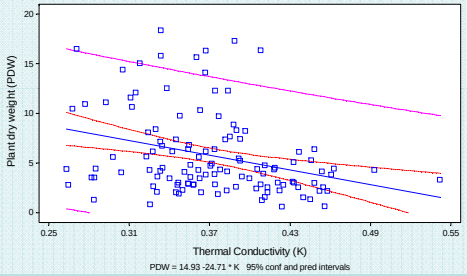


Fig. 2. Relationship between vegetables leaf area and soil thermal resistivity(R)

Fig. 3. Relationship between vegetable dry weight and soil thermal conductivity(K)



RESULTS

Results showed that soil thermal properties were: 29.81°C, 0.34 W/m°K, 3.56 m°K/W-1, 0.16 mm/s and 2.09 MJ/m^3°K for T, K, R, D, C respectively at the beginning of this study in June 2011 and slightly increased (T, K, C) and decrease (R, D) after four months of study in September 2011. Fertilizers did not significantly affect soil thermal properties. However, vegetable type significantly affected R (p=0.002) during the second month, and also K (p=0.022), R (p = 0.0001) and C (p=0.004) during the fourth month of this greenhouse study. Soil thermal properties were also significantly correlated with plant growth parameters. K was significantly correlated with all growth parameters with coefficients of correlation (r) ranging from 0.25 to 0.40. Similarly, C and R also correlated with all vegetables growth parameters. However, the correlations between K and C and plant growth was negative while that between R and plant growth was positive. No significant correlation was found between T, D, and vegetables growth parameters.

SUMMARY

These preliminary (first year) results suggest that vegetables growth can affect the thermal properties of the growing media. In addition, soil thermal properties can act as controlling factors for vegetables growth when soil temperature does not. More studies are needed for a better understanding of the effects soil amendment and plant growth on soil properties of the growing media.

ACKNOWLEDGEMENT

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