SOIL REPLACEMENT: LONG-TERM RESULTS

by Gary W. Watson

Abstract. Soil replacement treatments in a radial trench pattern around white *oak (Quercus alba)* trees, filled with compost or a compost–topsoil mix, were sampled 14 years after treatment. Root development in the replacement soils was greater than in the unmodified control soils. Root development was not increased in soils adjacent to the trenches over time as was originally anticipated.

Key Words. Root development; soil replacement; vertical mulching.

An earlier report of soil replacement (Watson et al 1996) demonstrated the value of an alternative to traditional vertical mulching (a grid of small drilled holes) that enabled replacement of a larger volume of soil in the root zone. In this study, root development increased in the highly organic replacement soil in the spokelike trenches over a four-year period. Root density in some soils adjacent to the trenches showed slight improvement in the second and fourth years after the treatments were installed, but the differences were not significant. It was thought that this improvement might be the beginning of long-term root increases in soils adjacent to the trenches resulting from higher levels of aeration and biological activity in the trench soils. The objective of this study was to determine if the trenches resulted in measurable changes in root development in adjacent soils over a longer period of time.

MATERIALS AND METHODS

In 1987, a backhoe was used to dig trenches in a spokelike pattern around three large [31-in. (79-cm)] dbh white oak *(Quercus alba)* trees. They were filled with either 100% compost or a 50–50 mixture of compost and topsoil from the trenches (Watson et al. 1996). In December 2000, 2.7-in. (7-cm) diameter, 16-in. (40-cm) deep core samples were taken in the center of the trench and in the undisturbed soil 4 in. (10 cm) and 11 in. (27 cm) from the edge of the trench, just as they were in the earlier study. Roots were washed from the soil and measured with a WinRhizo system (Regent Instruments, Quebec). Treatments were compared with a one-way ANOVA ($P = 0.05$). Separation of means was accomplished with the Student-Newman-Keuls test ($P = 0.05$).

RESULTS AND DISCUSSION

Fourteen years after replacement soil installation, overall root density in both the compost–soil mix and the 100% compost replacement soils were significantly greater than in unmodified control soils (Figure 1). The long-lasting effect of the treatments is encouraging. Root development in adjacent soils was still only slightly higher than in the control, just as it was 4 years after treatment, and there was still no significant difference. After 14 years, it must be concluded that compost-filled trenches do not result in improvements in root growth outside of the trench itself.

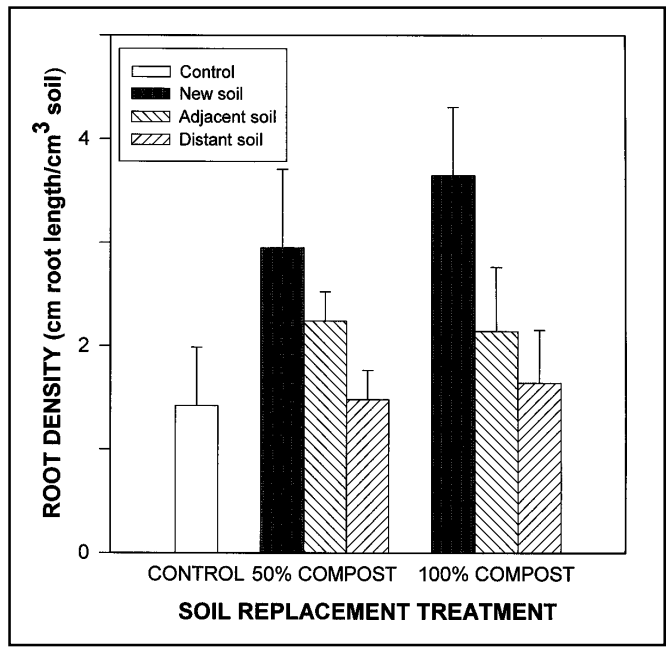

Figure 1. Root density 14 years after soil replacement treatment. Control locations were at least 6 ft (2 m) from the trenches. Adjacent and distant soil samples were centered 4 in. (10 cm) and 11 in. (27 cm) from the trenches, respectively.

One of the most common reasons given for vertical mulching (used here in the simple sense of creating holes in the soil) is to aerate nearby soils and improve

root growth. The holes are sometimes filled with compost, sand, or other materials thought to provide channels for good air movement. The data from this study cast doubt on the effectiveness of this practice. As judged by root development, aeration was apparently good throughout the 100% compost-filled trenches. From 15 to 40 cm (6 to 15.7 in.) deep in the trenches, root density was significantly higher in the compost than in the heavy clay subsoil of the controls at similar depths (Table 1). Average root density from 15 to 40 cm was triple that of the controls. Root densities in soils adjacent to the trenches at this same depth were not increased over the controls. In the top 15 cm of soil, where aeration was likely to be adequate in all soils, there was no difference in root development. A similar pattern of root development was observed in the 50% compost replacement soil, but there were no significant differences (data not shown). Either the improved aeration in the trenches did not spread to adjacent soils from the trenches, or improved aeration could not overcome other limitations to root growth in the heavy clay subsoils, such as penetration resistance. A similar lack of root stimulation in nearby soils was reported when holes were filled with Perlite (Kalisz et al.1994). In a situation where only the surface soils are compacted (e.g., as a result of foot traffic), vertical mulching may be more effective as a channel for air through the compacted layer to soils that are otherwise suitable for extensive root growth.

Table 1. Root density 14 years after 100% compost soil replacement treatment. Control locations were at least 6 ft (2 m) from the trenches. Adjacent soil cores were centered 2 in. (5 cm) from the edge of the trench.

	Root density (cm root length/cm^3 soil)		
Soil depth (cm)	Control	New soil	Adjacent soil
5	1.38	2.06	1.02
10	2.44	2.03	2.30
15	1.58	2.81	1.85
20	1.04	3.44*	1.85
25	1.35	3.98*	2.22
30	1.28	4.48*	2.99
35	1.08	5.16*	2.26
40	1.26	4.97*	2.60

*Significantly different (P = 0.05) from control at the same soil depth

LITERATURE CITED

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Résumé. Des traitements de remplacement du sol dans des patrons de tranchées radiales autour de chênes blancs *(Quercus alba)* ont été évalués 14 ans après leur implantation. Les tranchées ont été remplies de compost ou d'un mélange compost et terreau. Le développement racinaire dans les sols de remplacement s'est avéré plus important que dans le sol contrôle non modifié. Le développement des racines n'était pas plus abondant dans le sol naturel adjacent aux tranchées, et ce contrairement à ce qui avait été anticipé.

Zusammenfassung. 14 Jahre nach einer Bodenaustauschmaßnahme in einem radialen Grabenmuster um Weißeichen *(Quercus alba)*, die mit Kompost oder einem Kompost/Oberbodengemisch gefüllt wurden, wurden erneut Proben entnommen. Die Wurzelentwicklung in den Austauschböden war immer noch größer als in den unveränderten Kontrollböden. Die Wurzelentwicklung in den angrenzenden Bodenpartien hat sich über die Zeit nicht gesteigert, obwohl dies ursprünglich vermutet wurde.

Resumen. Se hizo un muestreo, después de 14 años, de los tratamientos de reemplazo del suelo con zanjas en patrones radiales alrededor de árboles de encino blanco *(Quercus alba)*, rellenados con composta o con mezcla de composta/suelo superficial. El desarrollo de las raíces en los suelos reemplazados fue aún mayor que en los suelos no modificados de control. El desarrollo de las raíces no aumentó en los suelos adyacentes a las zanjas, como fue originalmente anticipado.