Plant & Food Research
Rangahau Ahumāra Kai

RESEARCH BRIEF 12

Influence of soil type on poplar root development

1-3 year-old *Populus deltoides* × *nigra* grown from poles

Summary

Poplar (*Populus deltoides* × *nigra*) Trees were grown from 3 m-long poles on pastoral hill slopes in three different soil types, pumice, sandy loam and clay loam, differing in their bulk density. Over a three year period, above-ground growth parameters and root distribution (biomass, length and root diameter size class) of excavated root systems were measured relative to slope and soil depth. Soil bulk density near the ground surface was least in pumice (0.65 g cm3) and similar (1.05 and 1.1 g cm3) for clay loam and sandy loam, respectively. For all three soil types, bulk density increased with depth. In each of three consecutive years of the trial, root length (RL), root mass (RM) and root extension were greatest in the pumice soil and least for trees growing in the sandy loam soil. Root length and RM were greater in the clay loam soil than in the sandy loam soil but were closer in biomass to that in the sandy loam soil than in pumice. The percentage of poplar root mass found in the top 50 cm of soil was 90 - 100 % in the sandy loam , 87-93% in the clayloam and 56-87% in pumice. Poplar roots reached 1.3 m depth in the pumice soil but did not exceed 1.0 m depth in the other soils. Root mass in Year 3 in the pumice soil was ~ 13 x that in the sandy loam soil and 2.3 x that in the clay loam soil. The length of roots >1 mm diameter in Year 3 in the pumice soil was ~ 10 x that in the sandy loam soil and 2.3 x that in the clay loam soil. The mean volume of soil occupied by poplar roots in pumice, clay loam and sandy loam soils in year 1 was 3.5, 1.3 and 0.6 m3, respectively, and in year 3 was 20.5, 6.5 and 3.0 m3, respectively. Root development of poplar was negatively correlated with soil bulk density, with root length and mass increasing as bulk density decreased. We consider that the rate at which root systems of *Populus deltoides* × *nigra* will occupy a particular volume of soil and utilise its available water and nutrients will be greater in soils of lower bulk density, and that this will increase rates of survival during the early years of establishment, particularly in drought years.

Changes in soil bulk density for the three soil types are shown in Figure 1, and changes in the volume of soil occupied by roots in the three soil types in years 1, 2 and 3 of the experiment are shown in Figure 3.

Table 1 provides data on how growth parameters for the poplar trees varied between soil types and changed between year 1 and year 3.

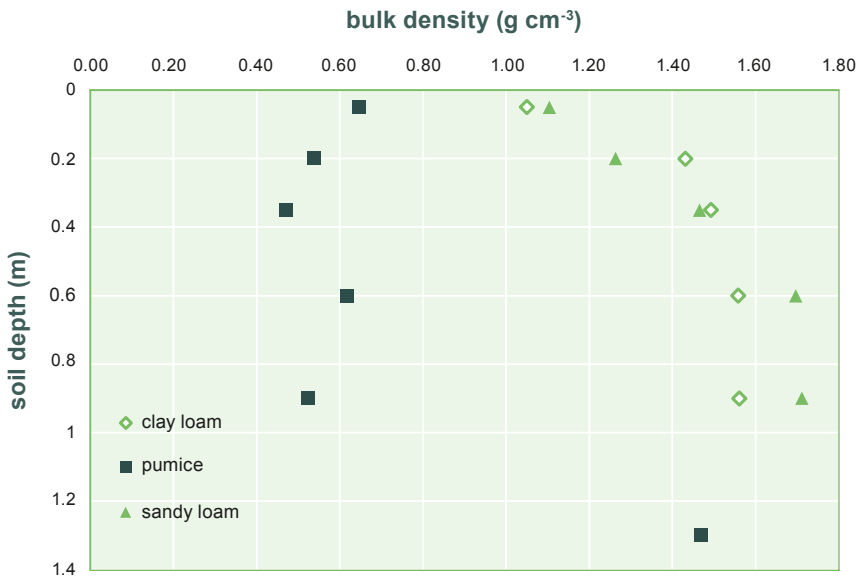

Figure 1. Soil bulk density changes with depth for the three soil types

Figure 2. The excavated pumice soil root system was hung from the woolshed beam and mapped

Soil type	Year	Pole DM (kg)	Shoot DM (g)	Root DM (g)	Root length (m)	Collar diameter (mm)	Diameter at top of sleeve (mm)	Shoot: Root ratio
Clay loam	1	2.22	50	17.7	7.9	61	43	3.34
	2	3.53	196	74.1	14.8	63	49	2.57
	3	3.09	763	420.5	63.9	62	51	0.94
Sandy loam	1	3.08	65	9.8	6.1	59	51	4.76
	2	2.77	178	45.8	12.6	62	53	3.95
	3	2.55	373	74.6	15.6	60	53	12.89
Pumice	1	2.41	89	57.8	18.8	52	43	1.53
	2	2.83	645	760.7	69.8	58	43	1.07
	3	4.71	4262	947.7	144.2	63	61	4.39

Table 1. Mean growth parameters for excavated *'Populus deltoides × nigra* poplar trees aged 1-3 years growing in the three soil types.

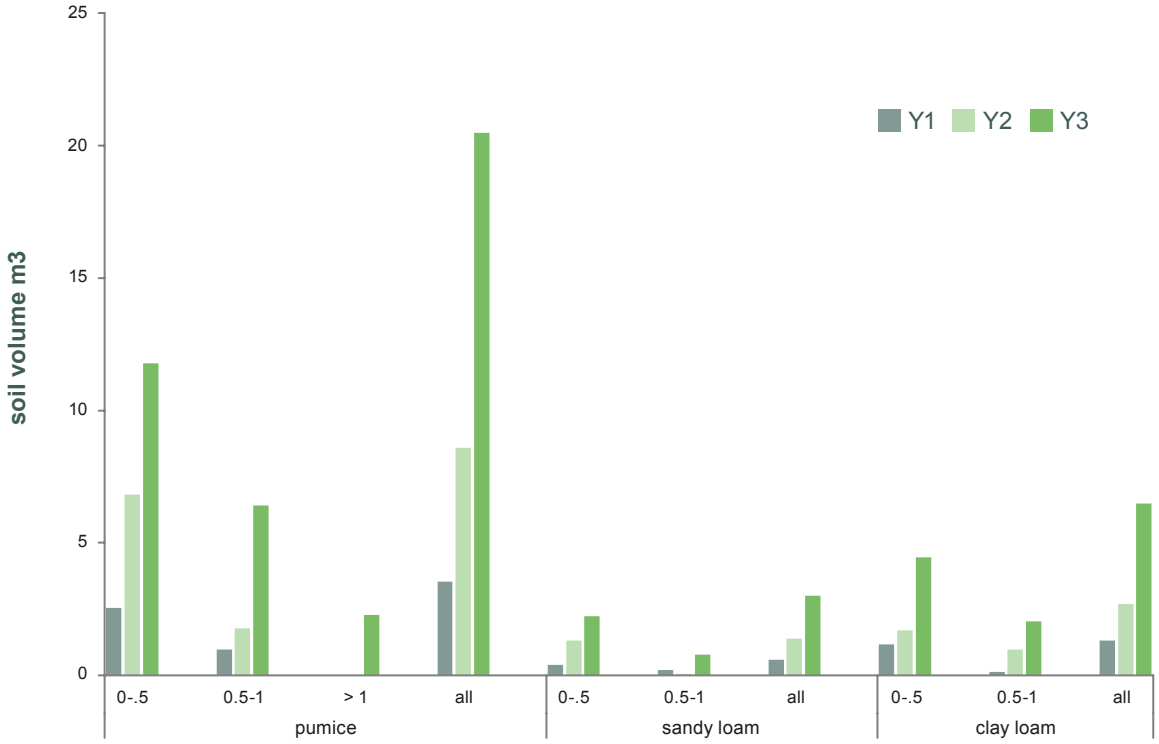

Figure 3. Mean soil volume (m^3) occupied by poplar roots, by soil type, 0.5 m depth intervals, all depths combined, and by tree age (Years 1-3).

For more information

This is one in a series of research briefs about Poplars and Willows that can be found at poplarandwillow.org.nz

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