Rooting pattern distribution and spatial variability of Italian ryegrass (Lolium multiflorum Lam) in a Mediterranean region

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Introduction It is estimated that less than 10% of the studies on pastures and forages have evaluated the subterranean biomass production. The objective of this study was to evaluate for a Mediterranean region the rooting characteristics and spatial variability of Italian ryegrass *(Lolium multiflorum Lam)* under two different soil water status conditions.

Materials and methods The study was carried out in two experimental plots with irrigated and rainfed ryegrass in a vertic Luvissol soil in a Mediterranean climate. Root length density (RLD) and root dry mass (RDM) in relation to depth were determined from auger root samples (500 cm^3). Also three minirhizotron tubes (5 cm i.d.) were installed per plot at an angle of 30º to the vertical and to a depth 0.5m for phenological studies. During the growing season digital images (1.8 x 1.35 cm) were recorded using a BTC system (Bartz Technology, Santa Barbara, CA), recorded at 1.34 cm depth intervals. Images were analyzed using RooTracker v2.0 software (Duke University) for morphological parameters quantification (Root length, number, diameter, and color).

Results The pattern of root distribution and spatial variability shows in general that more than 80% of RLD and 75% of RDM is concentrated in the first 10cm layer and maximum rooting depth was 60 cm (Table 1). The response was similar for the other sampling dates. The relationship is closely described by a negative exponential equation (van Noordwijk, 1993) for both root parameters. In terms of specific root length the data show a decrease (207.8 m/g at 10cm depth to 143.2 m/g at 20 cm depth) probably as a result of high soil bulk density. For both parameters the coefficient of variation increased with depth but the variability observed for the top layers was lower than that from other grassland studies. Minirhizotron data obtained throughout the growing season show that for all situations a significant amount of fine roots (∅<0.5 mm) and root branching occurred in the top 10cm of the soil profile. In rainfed ryegrass, after the second harvest (May) there was a strong decrease in fine root production and root mortality increased which contributed to cessation in shoot regrowth. Meanwhile irrigated ryegrass gave two more cuts although new root production rate declined by 30 – 40 %.

Table 1 Ryegrass root distribution and spatial variability (data from the first sampling date)

Depth (x) (cm)	Root Length Density (y) (m/500 cm^3)	CV (%)	Roots (%)	Root Dry Mass (y) (g/ 500 cm^3)	CV (%)	Roots (%)
0 -10	157.4 ± 48.64	31	80.1	0.76 ± 0.16	21	75.25
10 -20	25.3 ±16.32	65	12.88	0.18 ± 0.10	58	17.82
20 – 30	8.5 ± 7.43	87	4.33	0.04 ± 0.02	55	3.96
30 – 40	3.3 ± 3.69	112	1.68	0.02 ± 0.02	97	1.98
40 – 50	1.8 ± 2.10	120	0.92	0.01 ± 0.01	99	0.99
50 - 60	0.3 ± 0.82	245	0.15	0.00	245	0
Equation	$y(RLD) = 191.29\, e^{-11.355x}$	$R^2 = 0.98$		$y(RDM) = 6.8347 e^{-5.8873\,x}$		$R^2 = 0.95$

Conclusions The ryegrass rooting pattern followed an exponential decrease with depth with a strong concentration, about 75-80%, of root density on the top 10cm, mostly fine roots. This is a disadvantage for ryegrass production in Mediterranean conditions caused by soil water conditions in those top layers.

References

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