

Root Morphology of Alfalfa Plant Introductions
and North American Cultivars

D.K. Barnes, N.R. Degenhart, D.M. Smith, and R.N. Sahi
USDA-ARS and University of Minnesota, St. Paul, MN 55108

A USDA alfalfa germplasm evaluation project was initiated at St. Paul, Minnesota in 1986. Plant Introductions (P.I.'s) are evaluated in a two-stage program for fall dormancy, seedling vigor, plant size during the seeding year, summer growth habit, recovery after cutting, crown types, stand survival and yield potential. The first stage consists of growing single row plots of each P.I. and recording general growth rates, measuring fall growth (dormancy) and winter survival. The second stage consists of growing P.I.'s in replicated plots where the P.I.'s are blocked according to plant size and fall growth.

In 1986, 555 P.I.'s were evaluated for root morphology in the first stage of the program. An additional 200 P.I.'s were evaluated in 1987. Part of each row was undercut to a depth of 25 cm during late October. Approximately 6-10 plants were dug, placed in plastic bags, washed, and photographed. All root scores were made from the photographs. Traits evaluated were determinate tap roots, tap root diameter, number of secondary roots, position of secondary roots, size of secondary roots, and amount of tertiary or fibrous roots. Significant variability was observed for all root traits.

A set of 23 P.I.'s were selected from the 1986 test as representing the diversity of available root types. This set of P.I.'s was evaluated during 1987 in 3 replicates to determine the repeatability of root traits between years and among replications. In addition, 185 North American alfalfa cultivars were evaluated for root traits.

Root traits differed in their stability over years and replications. Plant density in the row and sample size appeared to be factors that influenced the evaluation of some traits. More research needs to be done before the factors affecting root morphology are identified. Nevertheless some general observations can be made. Traits most influenced by the environment appear to be percentage of plants with determinate tap roots, tap root diameter, and size of secondary roots. Traits least influenced by the environment were position of determinate roots, amount of secondary roots, position of secondary roots, and numbers of tertiary roots.

Cultivars differed markedly for root morphology. Root type generally appeared to be associated with dormancy and winterhardiness. These general observations are summarized below. (Note: exceptions can be found to all descriptions).

<u>General Description</u>					
<u>Cultivar</u>	<u>Determinate</u>	<u>Tap</u>	<u>Lateral</u>	<u>Lateral</u>	<u>Tertiary</u>
<u>Winterhardiness</u>	<u>tap root</u>	<u>root</u>	<u>roots</u>	<u>roots</u>	<u>roots</u>
<u>Classification</u>	<u>(Frequency)</u>	<u>(Size)</u>	<u>(Amount)</u>	<u>(Size)</u>	<u>(Amount)</u>
Very Winterhardy	many	large	many	large	some
Winterhardy	some	large	many	large	moderate
Moderately Winterhardy	few	moderate	moderate	moderate	many
Non-Winterhardy	few	small	few	small	few

The newer cultivars tended to be tap rooted, with fewer determinate tap roots, more and smaller lateral roots, and more tertiary roots than older cultivars having similar winterhardiness traits. This may indicate an evolution towards a more efficient alfalfa root system.