

Nodule development, root traits and productivity of lentil genotypes

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Lentil is a significant pulse throughout the Mediterranean basin that lately has gained significant interest as a component of Mediterranean diet. Symbiosis between lentil plants and nitrogen-fixing soil bacteria (*Rhizobium leguminosarum*) is considered a significant factor for the development and productivity of lentils [1].

The aim of the research was to study the development of nodules in lentil, to investigate the existence of genetic variation in the number of nodules and other characteristics of the root and their correlation with productivity.

The genetic material used was three Greek varieties (Thessalia, Dimitra, Samos), four French (Rosana, Anicia, Santa, Flora) and two Swiss landraces (Kleine Schwarze, Spaths Albinise klein) which were planted in pots. No fertilization or plant protection procedures were applied during the experimentation. Five samplings of the root system were taken in the following stages: 1st, 4th, 8th composite leaf, beginning of inflorescence and full bloom. Number of nodules, length of the root system (on first three growth stages), volume and dry weight of the roots (full bloom) were measured. Seed yield, above ground biomass, nitrogen of above ground biomass and the harvest index (HI) were measured at the stage of full seed maturity. Nitrogen fixation was also calculated. The measurements of the above-mentioned characteristics in every growth stage were taken from 16-20 individual plants per variety. A technique for preparing roots for electronic scanning and measurement of root traits was optimized using the programs Matlab and Image J.

Significant variability was observed between varieties in terms of number of nodules and their growth rate. The number of nodules (full bloom stage) ranged from 136 to 281, while the varieties Anicia and Rosana ranked in the top. Greek varieties showed a rapid increase in the number of nodules, occupying the three first places up to the stage of the 8th composite leaf, without nevertheless continuing at the same pace. The average nodule growth rate between vegetative stages was 51% (1st to 4th composite leaf), 56% (4th to 8th composite leaf), 355% (8th composite leaf to emergence of inflorescence) and 30% (emergence of inflorescence to full bloom). All varieties followed the above pattern of nodule growth except for Dimitra, which showed a 361% nodule increase between 4th and 8th composite leaf stage. Significant differences were observed among varieties regarding the length of root system and its growth

rate. At the 8th composite leaf stage, root length ranged from 29,3 to 245,1 cm with Dimitra variety occupying the first place. The average root growth rate between vegetative stages was 23% (1st to 4th composite leaf) and 90% (4th to 8th composite leaf). High correlation was recorded between the length of the root system and number of nodules ($R=0.963^*$).

Varieties differed for seed yield. Samos had the highest seed yield, followed by Dimitra. A positive correlation between the number of nodules and seed yield was observed at all vegetative stages. The correlation coefficient at the full bloom stage was $R=0,3$.

Variety Samos exhibited the highest nitrogen fixation value, but there was no significant difference with the other varieties. A significant correlation between N derived from nitrogen fixation with the above ground N ($R=0.808^*$) and the seed N ($R=0.838^*$) was recorded.

In conclusion, remarkable genotypic variability was observed for the number and growth rate of nodules along with the extend and root growth rate, highlighting two main types of varieties in relation to the above characteristics. The positive correlation observed between the number of nodules and seed yield should be further studied as a potential breeding target for the modern lentil breeding programs.

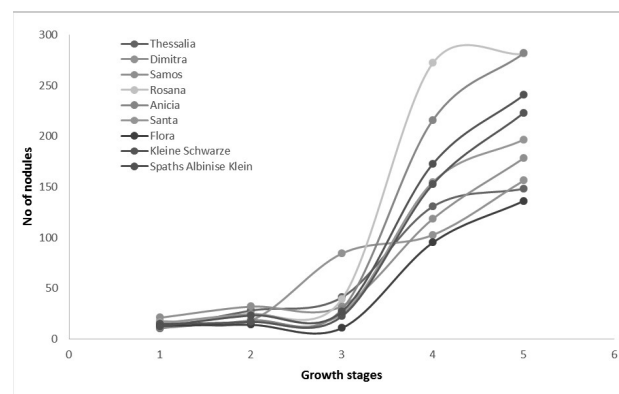


Figure 1. No of nodules/variety/growth stage

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[1] Drevon JJ et al., *Grain Legumes* (de Ron.A., New York 2015)

