

Short Communication

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Observations on rooting patterns of *Colophospermum mopane* in agroforestry systems of hot arid Rajasthan

N. D. Yadava*, M. L. Soni, N. S. Nathawat, Birbal, V. S. Rathore, V. Subbulakshmi, K. R. Sheetal and P. S. Renjith

ICAR-Central Arid Zone Research Institute, Regional Research Station, Bikaner-334004, India

*Corresponding author e-mail: narendra_yadava@yahoo.co.in

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Abstract

Root architecture of 12-years old *Mopane* (*Colophospermum mopane*) along a soil depth gradient of up to 2.5 m was studied with a focus to record the belowground development and biomass production. In the study, the rooting pattern of *C. mopane* indicated that > 70% roots were confined to upper 60 cm soil layer. The root spread was 2.48 fold higher than the crown spread. The angles of primary roots were more than 66°. The total root biomass varied from 5.13 kg to 13.80 kg and average root: shoot ratio was 0.20. The inferences of the results have been discussed in the context of the ecological niche of the species, and its usefulness in agroforestry systems.

Keywords: Arid region, Mopane, Root angle, Root spread, Rooting pattern

Tree plays an important role in ensuring livelihood security of arid region. The absence of adequate information on belowground rooting pattern, leads to problems in the designing and managing of agroforestry systems. Competition between trees and intercrops exist belowground for soil moisture and nutrients, apart from aboveground competitions for light (Ong and Huxley, 1996). Though deficiency of the soil nutrients also has a major impact on the crop yields of the system, competition for soil resources particularly soil water, generated by roots is said to be the main factor affecting crop yields followed by light (Gao *et al.*, 2013). An understanding of the rooting pattern is very important especially in arid zones, in order to forecast vegetation dynamics.

Root architecture determines many of the vital functions of a tree such as, competition for resource uptake, stability through anchorage, etc. Root distribution can be extensive but many factors including the type of soil, tree species, health, age, environmental stresses, planting density and silvicultural management influence the ultimate root structure. Shoot- root ratio determines the

yield of tree, and intercrops as well. Role of roots in the biological and ecological competitions in the agroforestry systems are pertinent, which in turn is expressed by the vigour and growth of trees. Intensity of competition is regulated by rooting depth/ root spread and appears to be the major constraint that affects stability and function of the agroforestry systems. Eis (1974) observed that tap roots in *Tsuga heterophylla*, *Thuja plicata* and *Pseudotsuga menziesii*, grew to about 50% of its final depth in 3-5 years, and to 90% in 8 years. In 20-year-old trees of *Picea sitchensis*, more than 80% of total cross sectional area is comprised of 3-10 prominent lateral roots (Coutts, 1983). In the eastern United States, the ratio of root spread to crown radius was measured after excavation of lateral roots in several species by Gilman (1990), who recorded that average root spread exceeded crown radius by a factor of 1.7 in green ash (*Fraxinus pennsylvanica*) and in poplar (*Populus* sp.) and in the case of red maple (*Acer rubrum*), it is >3. In most of the species maximum root biomass was allocated in the top 30 cm of the soil layer, which also provides enough absorptive surfaces to exploit water and nutrients from the top soil, does not offer much physical support to the shoot system (Shukla and Ramakrishnan, 1984). Chauhan *et al.* (2009) excavated root system of thirteen tree species and recorded that 83 to 100 per cent root system is distributed in the top one meter.

Mopane (*Colophospermum mopane* (Kirk ex Benth) J. Leonard) is a multipurpose tree belonging to the family Leguminosae introduced to India from southern Africa (Subbulakshmi *et al.*, 2017). Being a drought hardy species, *C. mopane* can withstand harsh climatic conditions of arid regions. It was planted in arid Rajasthan to stabilize sand dunes and to provide fuel wood, fodder, shade, shelter to the local communities. Under agroforestry systems, *C. mopane* was observed to have better height and collar diameter growth than sole tree plantations (Patidar *et al.*, 2008; Singh and Singh, 2015), which at later stages, affect the growth and yield of inter-