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Effects of Different Sources of N on Pearl Millet Growth and Yield in P-limited Environments of West Africa

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Abstract

Pearl millet (*Pennisetum glaucum* L.) is the major food crop in West African Sahel and largely contributes to food security of 50 millions farmers. Its adaptation to soil phosphorus (P) deficiency at early seedling stages is crucial for its final yield. Plant-based strategies, such as long roots, and efficient P fertiliser application are fundamental, being P resources limited. Evidence from pot trials in 2011 indicated that the addition of NH_4^+ to P can stimulate early root growth more than other N sources.

To test this hypothesis in field-like conditions, an innovative experiment was set in Niger, ICRISAT research station, in 2012. Twenty-four lysimeters were cut, rearranged with a longitudinal plexiglass surface and filled with P-deficient soil (Bray P1<5). Millet plants from a genotype known as tolerant to low soil P were grown until yield. Three treatments were applied at sowing: +P, +P + NH_4^+ and +P + NO_3, with 8 repetitions. We measured: root length at 2, 3, 4 and 5 weeks after sowing (WAS), plant growth, final yield, transpiration (twice a week). Roots were hand marked on a plastic removable surface on the plexiglass, scanned and analysed through WinRhizo.

Root length correlated with root biomass (r=0.7).The addition of NH_4^+ decreased the flowering time and increased grain yield, while NO_3 increased the vegetative biomass. At early stage, roots in the upper 40 cm soil of treatment 2 were longer than roots in treatment 3 and 1 (at 4 WAS: 129.3 cm, 83.6 cm and 54.3 cm, respectively). Throughout the season, the root system developed more in treatment 3 than in treatment 2 and 1 (40.87 g, 26.4 g and 13.8 g, respectively), mainly due to higher solubility of NO_3. At a given root length at 5 WAS, plants in treatment 2 produced the highest total yield. They transpired more water than plants in treatment 3, despite being smaller, probably because of the higher cost of grain production versus overall biomass. Our results suggest that the choice of N source to add to P can be critical to differential development of reproductive/vegetative organs, probably due to a mechanism during early root growth.

Keywords: Nitrogen, pearl millet, phosphorus, root length

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