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Optimizing Greenhouse Rice Production: What Is the Best Root Medium?

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Purdue Methods: Optimizing Greenhouse Rice Production

What is the best root medium?

Short answer: A 3:1 mix, by volume, of Turface “MVP” coarse calcined clay (porous ceramic) and a general purpose peat-perlite mix such as Fafard #2 Mix.

Unlike other greenhouse crops, rice and other grasses grow poorly when planted in a peat-based soilless mix. In our initial study, severe chlorosis developed in this medium. Without corrective applications of micronutrient fertilizer, the chlorosis worsened, resulting in shorter plants with fewer tillers than other treatments.

Plants also failed to thrive in a clay loam mineral soil. This is a significant outcome, as many research greenhouses grow rice in field soil to avoid chlorosis. Of course, mineral soil varies by what can be dug locally, but there is no reason to believe that the soil in our study was not conducive to growth, being pH balanced to 6.2 and capable of growing other grass crops in our university greenhouses.

The greatest plant height and tiller number were achieved with Profile ‘Greens Grade’ or Turface ‘MVP’ calcined clay granules (porous ceramic). These granules are made for the golf course and athletic field industry to improve drainage and cation exchange capacity. The two products are the same clay, only milled to different size granules, the Profile being fine textured while the Turface is more coarse. After a few years of using Profile for rice production in our greenhouses, we found that the fine texture made it leak from the pots without taking extra steps, seed germination was reduced, and that fertilizer salts would accumulate to toxic levels if not managed properly. The fertilizer accumulation was not evident in the Turface, most likely because the larger granule reduced the total surface area for these salts to be bound. In the “paddy system” culture used for rice, it is difficult to leach excess fertilizer from the medium by clear water flush irrigation, so prevention of salts accumulation is crucial.

We also found that adding a general purpose soilless mix to the calcined clay resulted in improved plant survival during irrigation system failures, most likely due to improved water-holding capacity. If the amount of soilless mix was kept low enough, chlorosis did not develop. In a study conducted in 2015 comparing percentages of Turface and soilless mix, we observed

best root formation with 25% incorporation of soilless mix into the Turface (no data taken).

Where mixing root media is not practical, using coarse calcined clay granules alone is the best root medium for rice. For experiments with an absolute requirement for mineral soil, or for researchers reluctant to change methodology, we recommend augmenting mineral soils with Turface to improve aeration. The amount would be 25% Turface, by volume, if hand-watered, and up to 50% Turface if irrigation is automated.

Note that both Profile and Turface have a high cation exchange capacity: They are not inert like some soil mix components such as perlite.

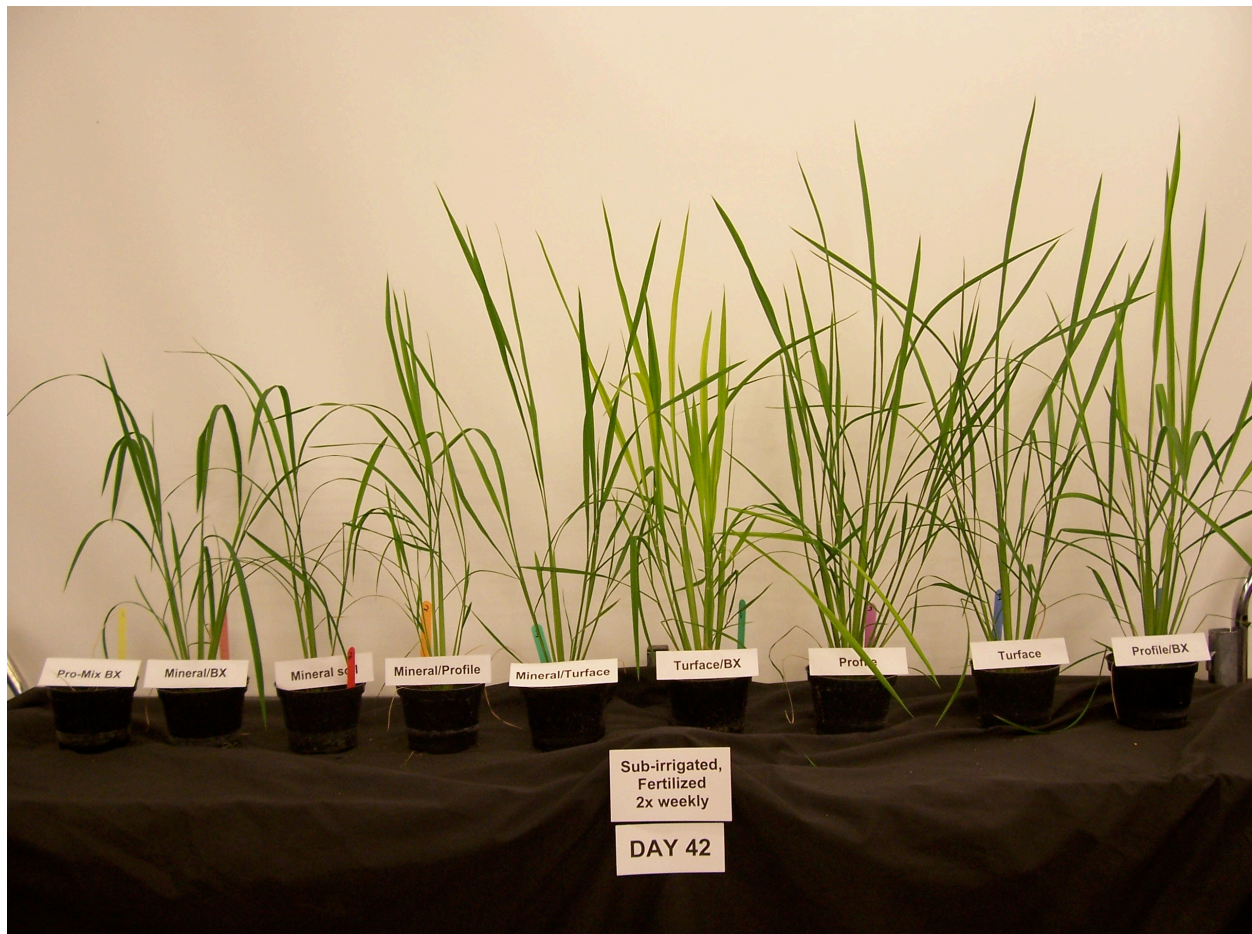


Figure 1. From left to right: Rice plants grown in Pro-Mix 'BX' (barely visible); Mineral soil/ 'BX'; Mineral soil; Mineral soil/ Profile; Mineral soil / Turface; Turface/ 'BX'; Profile; Turface; Profile/ 'BX'. All mixtures are at 1:1 by volume. Pro-Mix 'BX' is a general purpose peat-based soilless mix.



Figure 2. Turface ‘MVP’ and Profile ‘Greens Grade’ calcined clay granules.

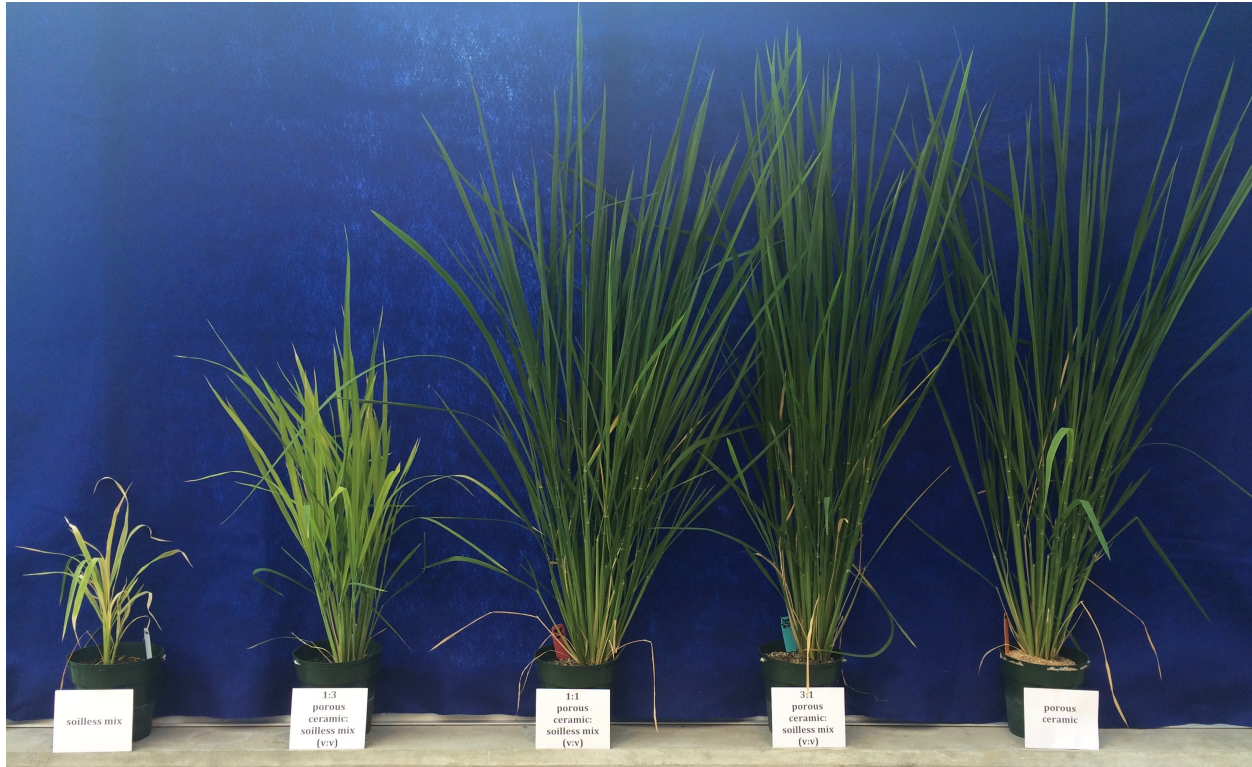


Figure 3. From left to right, increasing rates of Turface in root medium: soilless mix only; 1:3 Turface and soilless mix; 1:1 Turface and soilless mix; 3:1 Turface and soilless mix; Turface only.



Figure 4. From left to right, increasing rates of Turface in root medium: 1:3 Turface and soilless mix; 1:1 Turface and soilless mix; 3:1 Turface and soilless mix; Turface only.

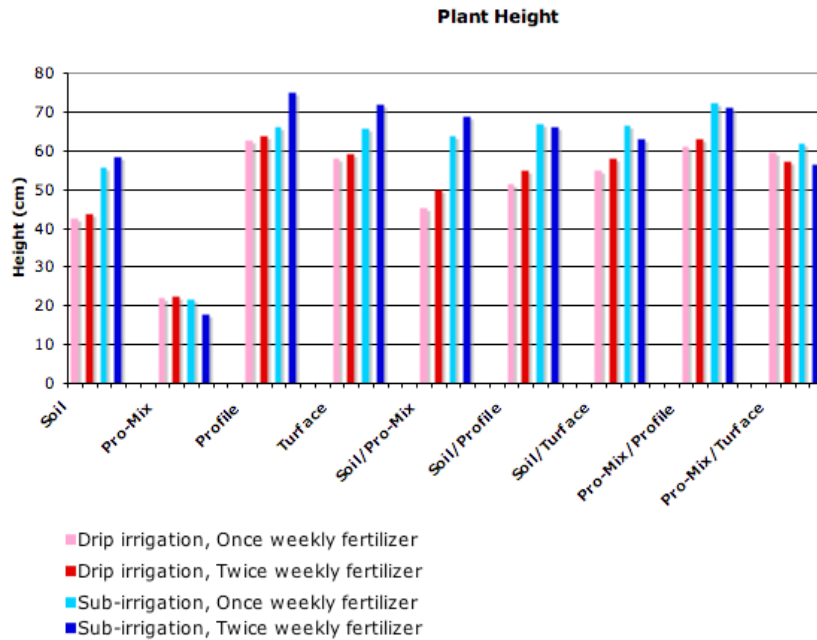


Figure 5. Rice plant height at day 78 in differing media and under differing fertilization schedules.

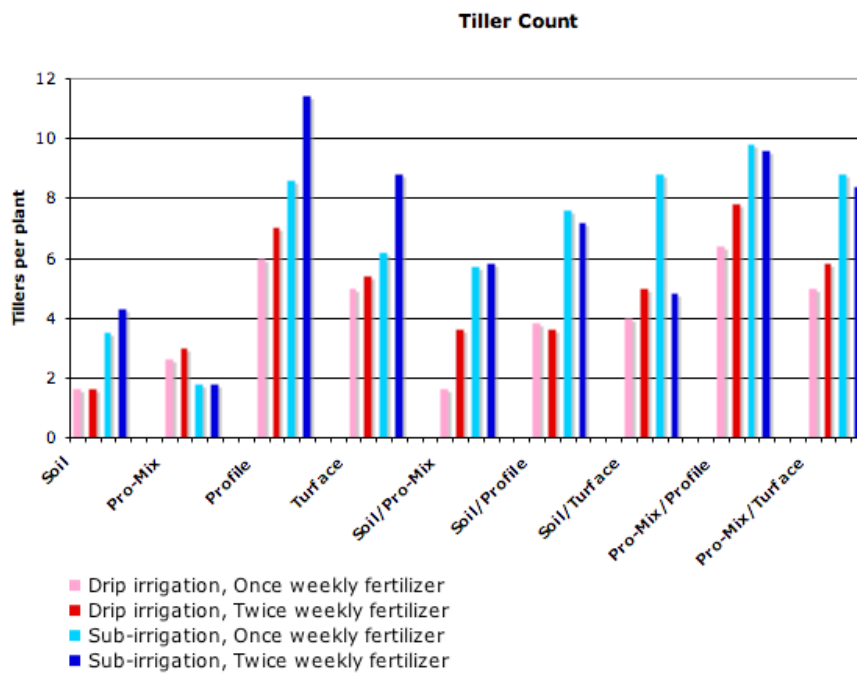


Figure 6. Rice plant tiller count at day 78 in differing media and under differing fertilization schedules.

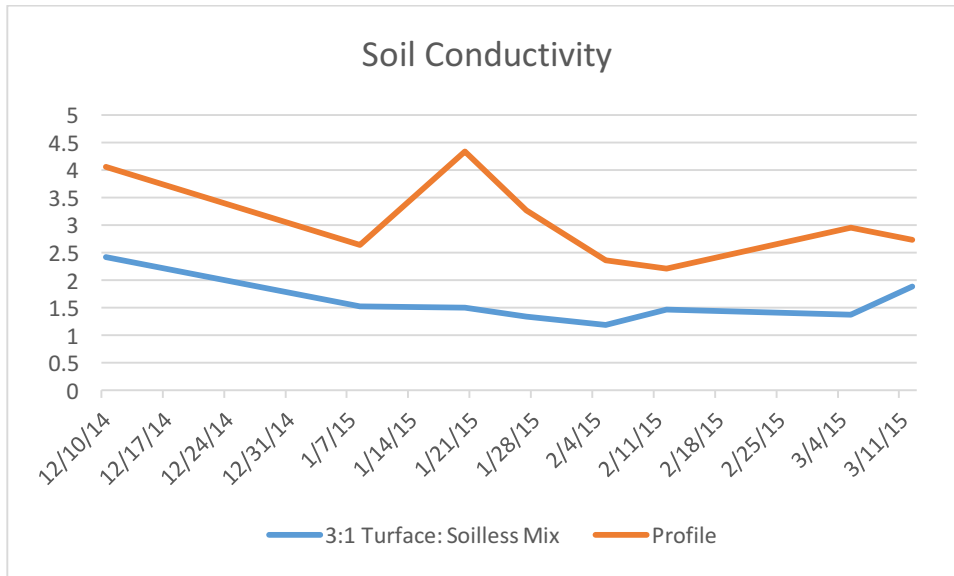


Figure 7. Soil conductivity (dS/cm) of 3:1 Turface: soilless mix and Profile over a three month period, indicating fertilizer being bound by Profile, with potential to accumulate to toxic levels.