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A non-conventional method for establishing upland crops following lowland rice in saturated soils

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Abstract

A novel technique was tested for establishing upland crops in saturated paddy soils. It is based on the observation that deep planting in wet soil is feasible if the seed holes remain open to maintain an adequate gaseous exchange pathway to the soil surface. Three field experiments were conducted to compare the performance of this 'plunger planter' seeding method against five other methods to establish mungbean (*Vigna radiata* (L.) Wilzeck) following rainfed rice (*Oryza sativa* L.). The experiments were conducted on a silty clay Tropaquept during the 1990 and 1991 dry seasons (DS) at the International Rice Research Institute. Planting depths from 2 to 14 cm did not significantly affect seedling emergence (which varied from 88–97%) or grain yield. The apparent optimum depth was 6–8 cm. A needle-like point attachment to the end of the plunger increased mungbean stem diameter and facilitated vertical rooting, but had no significant effect on seedling emergence or yield. Plunger planting (PP) was successful at 50% soil moisture content (g/g). The other seeding methods could only be employed at a soil moisture content of 34% or less. Grain yields with PP in the 1990 DS (1.3–1.6 t/ha) were significantly greater than with all other methods (yield range of 0.4–0.8 t/ha). In the 1991 DS, yields with PP (2.2 t/ha) exceeded those with the other methods by 0.4–0.7 t/ha. Seedling emergence, plant density at harvest, and total dry matter were significantly ($P<0.01$) increased with PP in 1990, but not in 1991 (a season of less severe water stress). The PP method proved to have promising potential as a means of establishing mungbean in saturated soils, gaining time for germination and root growth before soil strength becomes prohibitive to root penetration, and enabling greater water use from deep soil layers. The plunger planter principle is adaptable to mechanical seeding.

Keywords: Mungbean; Rice; Seedling establishment; Upland crop

1. Introduction

There are vast areas of rice land in south and southeast Asia that remain fallow after rice harvest. Saturated soil conditions limit the immediate establishment of upland crops since conventional seeding methods can only be practiced on drained soils with adequate bearing capacity for tillage or seeding implements. Saturated soils also limit oxygen exchange and are chemically reduced, thus constraining seed germination and growth. However, when seeding is delayed sufficiently for the soil to dry to an optimum moisture content, the soil strength of puddled rice fields greatly increases. This limits vertical root growth that ultimately results in severe crop water deficits, since paddy soils typically retain residual moisture adequate to sus-

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