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Direct Seeded Rice: Nutrient Deficiencies and Its Management

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Introduction

Rice is commonly cultivated in Asia by transplanting one-month-old seedlings into puddles of constantly saturated soil. Because frequent puddling damages soil aggregates, lowers permeability in subsurface layers, and generates hard-pans at shallow depths, the succeeding non-rice upland crop in the cycle may suffer. Excess conveying of water for puddling during the warmest months of summer causes a drop in the water table and bad quality water for agriculture in the North West Indo-gangetic Plain (IGP). While in the eastern IGP, rice transplanting is mainly reliant on monsoon rainfall and is one to three weeks postponed due to the conventional practise of puddling with ponded water.. Farmers are therefore altering either their rice cultivation techniques (transplant to directly sowing in puddle soil) [Wet-DSR]) or tillage practices or both (puddle transferring to unpuddled soil dry direct seeding).

Three common procedures puddling, which compacts soil to decrease water seepage, transplanting, and standing water are avoided by direct sowing. In the world, South Asia, and India, respectively, direct seeding accounts for 23%, 26%, and 28% of rice production (Rao et al., 2007). Direct seeded rice (DSR) can be accomplished using one of three main techniques: dry seeding (dry soil where dry seeds are sown), wet seeding (sowing pre-germinated seeds in where soils are in puddle conditions), or water seeding (sowing seeds into standing water conditions). Wet-DSR is largely used to handle the manpower shortage, but if water constraints get worse, there is more reasons to develop and establish dry-DSR. Though dry-DSR production hardly ever used in irrigated areas. In Asia, wet seeding is still widely used in submerged conditions whereas dry seeding are often used in lowland, upland, and flood-prone area that get rain.

Nutrient Deficiency Management

The primary factors regulating the dynamic of nutrients in DSR are water management and land preparation. Direct seeding typically results in altered nutrient dynamics since it comes after aerobic paddy cultivation because the prepared land in DSR remains dry and aerobic throughout the season. The availability of various nutrients, including N, S and P; Zn and Fe are some micronutrients, is to be a constraint when using direct seeding. Additionally, Dry-DSR is anticipated to lose more nitrogen (N) than traditional tilled-transplanted paddy due to nitrification, denitrification, volatilization, and leaching. Micronutrient deficits are a problem in DSR, and imbalance of these nutrients are caused by improperly applied and unbalanced N fertiliser.

DSR has significant deficits in iron and zinc. For better nutrient management in DSR, 0.5 kg of Librel Zinc (12%) and 0.5 kg of Librel Fe (7%) are drilled at the sowing time, while the other fertilisers are broadcast. This aids in addressing the iron and zinc deficiency Zn shortage in paddy fields is caused by factors like redox potential was low, carbonate content and pH are high. In aerobic soils, Fe oxidation by root-released oxygen reduces the pH of the the root zone and limits the release of Zn from highly insoluble fractions for rice plant usage. Zinc is best applied at the soil's base, and using 25–50 kg of zinc sulphate per hectare is advised to prevent zinc deficiency. However, if a basal treatment is missed, a top dressing up to 45 days later can make up the difference. For foliar treatment, spray 0.5% zinc sulphate two to three times between seven to fifteen days after the manifestation of deficiency symptoms.. Zn application time and source may have an impact on DSR Zn absorption.. Due to the soil's oxidation the availability of ferrous (fe) form into unattainable ferric (fe) form under aerobic conditions, there is an increased risk of Fe shortage. Foliar application of 3% FeSO4.7H2O solution at a rate of 9 kg iron ha^{-1} in three splits (40, 60, and 75 DAS) has noticed to be efficient (Pal et al., 2008).

The benefit of a "one-shot dose" of nitrogen is provided by slow-release (SRF) or controlled-release (CRF) fertilisers, and because of their prolonged release pattern, they may better match crop N requirement to cut down on losses and labour costs.. In country like Japanese, farmers successfully employ CRF with polymercoated urea in ZT-dry-DSR because it increases N use efficiency and yield as compared to untreated urea. However, farmers' usage of CRF is constrained due to its four to eight times higher cost than conventional fertilisers (Shaviv and Mikkelsen 1993).

To meet nutrient demand and to avoid nutritional deficiencies, fertilization schedule as mentioned below has been followed (Pepsico International 2011):

Days After Sowing	Fertilizer (in kg acre-1)				
	Urea	**DAP**	**MOP**	**Librel Zn**	**Librel Fe**
At sowing	15	25	20	0.5	0.5
20	15-20	0	0	0	0
35	10-15	0	0	0	0

However, a slightly greater N dosage (22.5-30 kg ha-1) is recommended in DSR to compensate for the higher losses and reduced availability of N from soil mineralization at the early stage, as well as the longer life of the crop in the main field in Dry-DSR. In general, NPK fertiliser requirements are comparable to those in puddled transplanted rice. It is common practise to apply a full dosage of P, K, and one-third of N as a basal at the time of sowing. Split N treatments are necessary to increase N absorption, minimise N losses, and optimise grain output. At the active tillering and panicle start stages, the remaining two-thirds of the N dosage should be separated and top dressed in equal proportions. A leaf colour chart (LCC) can also be used to manage N. There are two options for using an LCC to apply fertiliser N. For the fixed-time option, N is applied at a predetermined period for active tillering and panicle initiation, and the dose can be changed depending on the colour of the leaves. For the real-time option, rice leaves are regularly checked beginning at early tillering (20 DAS), and N is applied if the colour falls below a key threshold value. N application for high-yielding inbreds and hybrids should be based on a critical LCC value of 4, whereas for basmati types, a critical value of 3 should be used.

For basal application, it is preferable to utilise granular complex NPK combinations other than nitrogen for P and K. The majority of planters have difficulties placing powdery materials like MOP and when urea is combined with DAP in fertiliser boxes, it absorbs moisture and causes problems with dropping, leading to uneven fertiliser distribution. Therefore urea should be broadcasted separately. Water-soluble P fertilisers should only be used carefully. Band or localised placement of these fertilisers is more effective than broadcast application of the same in powder form. Application of 25 kg ha-1 DAP at the time of planting is very efficient for improving crop development. In medium textured soil, split K treatment has also been recommended for direct sowing. K can be split in these soils, with 50% at the base and 50% at the beginning of the panicle.

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