SUNSHINE AGRICULTURE e-Newsletter

ISSN (E): 2583 – 0821

Sun. Agri.:e- Newsletter, (2025) *5*(8), 16-19

Article ID: 417

Direct-Seeded Rice (DSR) under Integrated Nutrient Management (INM)

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Available online at
www.sunshineagriculture.vitalbiotech.org

Article History
Received: 2.08.2025
Revised: 6.08.2025
Accepted: 11.08.2025

INTRODUCTION

Rice (*Oryza sativa* L.) is the food grain crop of over half of the world's population. Rice is traditionally cultivated under the transplanted puddled method (TPR), where nurseries are raised, fields are puddled, and seedlings are manually transplanted. The method proves to be labour-intensive, water-intensive, and energy-intensive. To find a solution to these problems, Direct-Seeded Rice (DSR) is seen as a sustainable substitute. DSR has direct sowing of seeds in the field without nursery rearing and transplanting. Although DSR conserves water, labor, and time, its success also rests to a great extent on effective nutrient management, especially the application of Integrated Nutrient Management (INM).

2. What is Direct-Seeded Rice (DSR)?

Direct-Seeded Rice (DSR) is a new rice culture technique where seeds are directly sown in the main field without nursery rearing and manual transplanting. In contrast to the labor- and water-intensive traditional puddled transplanted rice (TPR) system, DSR provides for a more efficient and resource-saving strategy. Seeds may be planted by broadcasting (manual or mechanical), seed-cum-fertilizer drill, or dibbling. Both irrigated and rainfed conditions can support DSR, and thus it can be supported in a broad spectrum of agro-ecological zones.

Types of DSR Methods:

Dry DSR: Seeds are planted in dry, well-puddled soil and irrigation is done after sowing. It is most suitable for places with ensured irrigation and excellent seedbed conditions.

Wet DSR: Seeds are planted in wet or slightly puddled land, which is widely followed in places having a high water table or where light puddling is feasible.

Water-seeded DSR: Seeds are broadcast over standing water, mainly followed in deep water rice fields to prevent transplanting.

Benefits of DSR:

- Tremendously cuts labor needs and drudgery, particularly during peak seasons.
- Saves 25–40% irrigation water, leading to water-use efficiency.
- Reduces methane emission, thus becoming more climate-friendly.
- Cuts the duration of the crop by 7–10 days, permitting sowing of the next crops in time.
- Permits mechanization, leading to large-scale operations and precision agriculture.

3. Problems in DSR Cultivation

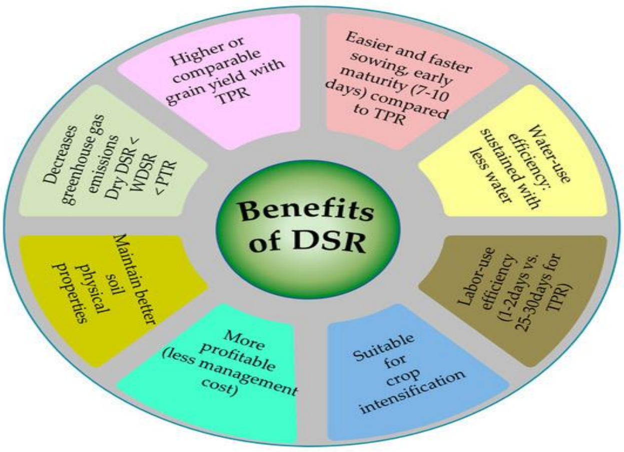
Although Direct-Seeded Rice (DSR) has many advantages compared to the conventional transplanted mode, its adoption is not free from challenging constraints. DSR's success is highly site-specific, dependent on timely operations, and good management practices. A number of agronomic and environmental limitations can constrain the productivity and sustainability of DSR if not properly managed.

Weed infestation is one of the primary challenges. Without constant standing water, which typically keeps weeds under check in traditional transplanted systems, weed development is more intense in DSR. This requires frequent application of herbicides or integrated weed management measures, raising the cost and complexity of production.

Poor establishment is another limiting factor, especially on heavy clays or following erratic rainfall. Seeds are unable to germinate evenly because of soil crusting or at a deficiency of soil moisture at key stages. Crusting of the soil after rain or irrigation prevents seedlings from emerging, resulting in stand patches and yield loss.

Nutrient problems are also widespread. DSR fields tend to lose more nitrogen through volatilization and leaching because the soil remains in aerobic conditions. Micronutrient deficiencies, particularly of zinc (Zn) and iron (Fe), are also widespread in DSR because the oxidized soil environment limits nutrient availability.

Considering these limitations, a site-specific, integrated nutrient management (INM) strategy needs to be adopted. INM enhances nutrient efficiency, promotes early crop growth, and keeps the soil healthy, thus improving the success and sustainability of DSR systems.



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4. Integrated Nutrient Management (INM): Definition and Concept

INM refers to the coordinated use of chemical fertilizers, organic manures, green manures, crop residues, and biofertilizers for sustaining soil fertility and crop productivity in an eco-friendly way.

Aims of INM:

- Better soil health and structure.
- Better utilization of nutrients.
- Most economic and safe means of environmental protection.
- Minimum use of chemical fertilizers.
- Sustainable agriculture.

5. Nutrient Management Strategy in DSR under INM

Balanced and efficient nutrient management is essential to achieving the potential of Direct-Seeded Rice (DSR). In contrast to conventional puddled systems, DSR grows under aerobic soil conditions, which may influence nutrient availability and uptake. Therefore, an integrated INM approach utilizing chemical, organic, and biological sources is suggested to achieve sustainable productivity.

5.1 Chemical Fertilizers

Chemical fertilizers are important for the fulfillment of the crop's short-term nutrient needs:

Nitrogen (N): Since puddling is not practiced and there are higher leaching losses under aerobic conditions, DSR requires a higher initial application of nitrogen.

Recommended dose: 100–120 kg N/ha, divided into 3–4 split applications—at basal, early tillering, panicle initiation, and grain filling stages—to secure effective uptake and minimum loss.

Phosphorus (P): For early root development and filler formation.

Dose: 30–40 kg P_2O_5/ha, commonly applied as a basal dose.

Potassium (K): Facilitates water management, stress resistance, and grain quality.

Dose: 40–60 kg K_2O/ha, preferably in two splits—basal and panicle initiation.

Micronutrients: Zinc (Zn) deficiency is common in DSR due to aerobic soils.

Apply 25 kg $ZnSO_4$/ha as basal or use foliar sprays at critical stages.

5.2 Organic Sources

- Farmyard Manure (FYM): 5–10 tonnes/ha application enhances soil structure, water holding capacity, and microbial activity.
- Green Manuring: Sesbania aculeata and other crops contribute organic matter and biologically fixed N to the soil.
- Compost/Vermicompost: Increases CEC, water-holding capacity, and availability of macro- and micronutrients.

5.3 Biofertilizers

- Azospirillum and Azotobacter: Nitrogen-fixing bacteria that promote root growth and early vigor.
- Phosphate-Solubilizing Bacteria (PSB): Transform insoluble P into available forms.
- Mycorrhizae: Symbiotic fungi that increase nutrient (particularly P and micronutrient) and water uptake, especially under stress.

6. Benefits of INM in DSR Cultivation

S.No.	Benefit	Description
1	Balanced Nutrient Supply	Ensures proper combination of chemical, organic, and biological sources for macro- and micronutrient availability.
2	Improved Soil Health	Organic amendments enhance soil structure, microbial activity, and nutrient retention.
3	Enhanced Nutrient Use Efficiency	Minimizes nutrient losses and matches nutrient release with plant needs, crucial in DSR systems.
4	Reduced Dependency on Chemical Fertilizers	Promotes partial substitution with organics and bio-fertilizers, reducing input costs and environmental hazards.
5	Better Crop Growth and Yield	Supports uniform plant growth and increases productivity under direct seeding conditions.
6	Eco-friendly and Sustainable	Minimizes environmental impact and promotes long-term agricultural sustainability.
7	Resistance to Biotic and Abiotic Stresses	Enhances plant tolerance to pests, diseases, and drought or flooding, improving crop reliability in DSR.

Environmental Impact:

- DSR under INM decreases methane emissions due to aerobic soil conditions.
- Decreases nitrate leaching and eutrophication.

7. Best Practices for Implementing INM in DSR

In order to effectively implement Integrated Nutrient Management (INM) in Direct-Seeded Rice (DSR), there are a number of best practices that must be followed. Soil analysis should be the initial step to determine nutrient levels and dictate fertilizer application. Split nitrogen application, particularly in 3–4 installments, reduces loss and uptake. Employing slow-release nitrogen sources such as neem-coated urea increases nitrogen use efficiency. Adding crop residues increases soil organic carbon and microbial activity. Rotation and cover crops ensure soil fertility and pest suppression. Lastly, embracing Site-Specific Nutrient Management (SSNM) techniques guarantees accuracy and sustainability in the use of nutrients.

8. New Research Findings

A number of trials and experiments conducted in India (Punjab, Haryana, Eastern U.P., Bihar) have established:

- INM in DSR can be equal to or even surpass TPR yields.
- Mixing 50% RDF + 5t FYM + PSB + Azospirillum provides greater grain yield and B:C ratio.
- DSR-INM plots register improved soil microbial activity and greater organic matter content over a period of time.

9. Constraints in Adopting INM for DSR

In spite of the established advantages of Integrated Nutrient Management (INM) in raising the productivity and sustainability of Direct-Seeded Rice (DSR), there exist some constraints to its extensive practice by the farmers. One of the main issues is the non-availability of technical skills and information regarding INM technology, especially for small and marginal farmers. Non-availability of good quality organic inputs, i.e., well-decomposed farmyard manure, compost, and biofertilizers, also restricts effective implementation.

Another major hindrance is the restricted availability of suitable mechanization equipment, such as seed drills and residue management equipment, required for effective DSR and INM integration. In addition, inadequate policy support coupled with the lack of organic and biological input subsidies dissuade farmers from practicing INM-based systems. Finally, successful adoption of DSR with INM necessitates efficient management of weeds and water, which poses a challenge to many farmers to manage without training and support, particularly in rainfed or resource-poor situations.

10. CONCLUSION AND WAY FORWARD

Direct-seeded rice (DSR) is an attractive option for water, labor, and energy saving as an alternative to traditional transplanting. Its long-term sustainability, however, rests with balanced and sustainable nutrient management through Integrated Nutrient Management (INM).INM increases soil fertility, enhances the use of nutrients efficiently, promotes environmental sustainability, and guarantees stable yields. In the future, capacity building, input availability, and policy support are essential to upscale INM practices in DSR.

REFERENCES

Chaudhary, A., Mishra, A. K., Venkatramanan, V., & Sharma, S. (2025). Enhancing yield and GHG mitigation through site-specific nutrient management for transplanted and direct-seeded rice in Odisha, India. *Frontiers in Sustainable Food Systems*, *9*, 1571263.

Choudhary, A. K., & Suri, V. K. (2014). Integrated nutrient-management technology for direct-seeded upland rice (Oryza sativa) in Northwestern Himalayas. *Communications in Soil Science and Plant Analysis*, *45*(6), 777-784.

Joshi, E., Kumar, D., Lal, B., Nepalia, V., Gautam, P., & Vyas, A. K. (2013). Management of direct seeded rice for enhanced resource-use efficiency. *Plant Knowledge Journal*, *2*(3), 119-134.

KUMAR, S., SINGH, I., & MEHLA, O. (2025). Growth and yield performance of direct-seeded rice (Oryza sativa L.) hybrids under integrated nutrient management. *Research on Crops*, *26*(2), 223-228.

Sadhukhan, R., Kumar, D., Sen, S., Sepat, S., Ghosh, A., Shivay, Y. S., ... & Hossain, A. (2023). Precision nutrient management in zero-till direct-seeded rice influences the productivity, profitability, nutrient, and water use efficiency as well as the environmental footprint in the indo gangetic plain of India. *Agriculture*, *13*(4), 784.

Shivay, Y. S., Pooniya, V., & Anand, A. Nutrient management in Direct Seeded Rice (Oryza sativa L+ Zero Till.