

Management of N fertilizers in direct-seeded rice

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Puddled transplanted rice (PTR) is highly labour, energy intensive and requires more than 200 cm of water (mostly underground) and produces nearly 10% of global methane emissions. Therefore, direct seeded rice (DSR) is advocated as a sustainable alternative for reducing water, energy and fertilizer footprints which improve soil health, and declining land and water productivities. To realize DSR yield levels, farmers use nitrogenous (N) fertilizers indiscriminately which enhance nitrous oxide emissions. To reduce different input footprints, viz. water, N fertilizers etc and improve soil health and mitigate global warming consequences in DSR, farmers advocated to go for soil testing. However, farmers overuse particularly N fertilizers to improve their yield potentials which on one hand increased costs of cultivation while on other added to global warming. Hence, farmers needed to replace the deficit nitrogen requirement using need-based in-season fertilizer topdressings or following site-specific nutrient management. Current article discusses 'PAU-Leaf Colour Chart (PAU-LCC) for sustainable N management in DSR as it is simple, inexpensive, and a farmer-friendly device to enhance crop yields and manage N in a sustainable way.

Keywords: DSR, N footprints, PAU-Leaf Colour Chart, Site-specific nutrient management

NITROGEN (N) is the essential nutrient that affects the growth and quality of direct seeded rice (DSR). It is required more consistently than other nutrients. Its moderate additions help improve the crop yield and quality, but its excessive application results in severe problems in the ecosystem due to soil, atmospheric, and water enrichment with reactive N of agricultural origin. Its excessive applications, which are not synchronized with crop demand, pollute the environment and groundwater resources. Moreover, current N management doses used for puddled transplanted rice (PTR) are not optimal for direct seeded rice (DSR) because of different development processes and crop management practices. Therefore, appropriate N application in DSR is needed which fulfil crop requirements to maximize DSR yield and reduces N losses in ecosystem. Unfortunately, N

management in DSR has received very little attention and mostly Puddled transplanted rice (PTR) N management is adopted. Therefore, optimizing N scheduling for the DSR system is inevitable to obtain maximum grain yield and enhance

nitrogen use efficiency (NUE).

For sustainable fertilizer management, particularly of N, LCC is being standardized to guide the farmers for optimal use of N fertilizers. In Punjab, nearly 6 lakh ha area is under DSR cultivation. It



Leaf colour chart for N management in direct seeded rice

Source: https://agritech.tnau.ac.in/agriculture/agri_nutrientmgt_rice.html

is becoming more popular since it saves water, labour, and improves soil structure. It should preferably be cultivated on medium to heavy textured soils to improve the efficiency of applied N fertilizers and to overcome iron deficiency. PR 126 is the best-suited short-term rice variety for direct sowing and should be planted in the first fortnight of June.

After water, nitrogen is the most critical input for rice and is generally handled inefficiently. Farmers are enticed to apply urea over crop requirements by the lush growth and dark green colour of the crops that follow urea application. Farmers rarely consider the cost of purchasing urea because it is readily available and heavily subsidized. However, we must educate farmers about the importance of avoiding excessive urea treatment to avoid nutritional imbalances, insect pest control, lower production costs, and most importantly, environmental problems associated with DSR. Excessive nitrogen fertilizer leaks from soil-plant systems into water bodies and the atmosphere, causing pollution issues. The release of N into the atmosphere as nitrogen oxides causes the ozone layer to dissolve, posing a health risk. Nitrogen leached into sub-surface water bodies as nitrate could make the water unsafe to consume. In addition, dark green-coloured crop cultivated with high nitrogen fertilizer increases insect-pest incidence, diminishes yield, and its quality and provides less economic advantage to farmers. Further, more urea may cause crop biomass to accumulate at the ripening stage, resulting in more significant yield loss.

The only way to avoid excessive N fertilizer applications is to fully explore soils' intrinsic nitrogen-providing potential and replace the deficit nitrogen requirement using need-based in-season fertilizer top dressings. Punjab Agricultural University, Ludhiana, Punjab has created a simple, inexpensive, and farmer-friendly device dubbed the 'PAU-Leaf Colour Chart (PAU-LCC)' to coordinate crop nitrogen

needs with soil availability in many other crops, viz. PTR, DSR, wheat, maize, and Bt cotton. The beauty of this technology is that the same PAU-LCC can be used for all the crops, and farmers need not to purchase it separately for different crops.

Management of nitrogen using 'PAU-Leaf Colour Chart'

The physical, chemical, and biological features of soil, the dynamics of nitrogen release from crop residues and organic manures, climate, the nitrogen concentration in irrigation water, management techniques, and other factors interact to determine a crop's nitrogen fertilizer requirement. The PAU-LCC considers all of these aspects and gives a need-based nitrogen application choice to ensure maximum output with the least amount of nitrogen fertilizer. It helps to reduce the N fertilizer inputs after coordinating plant nitrogen needs with soil inherent N supply and thereby enhances system productivity.

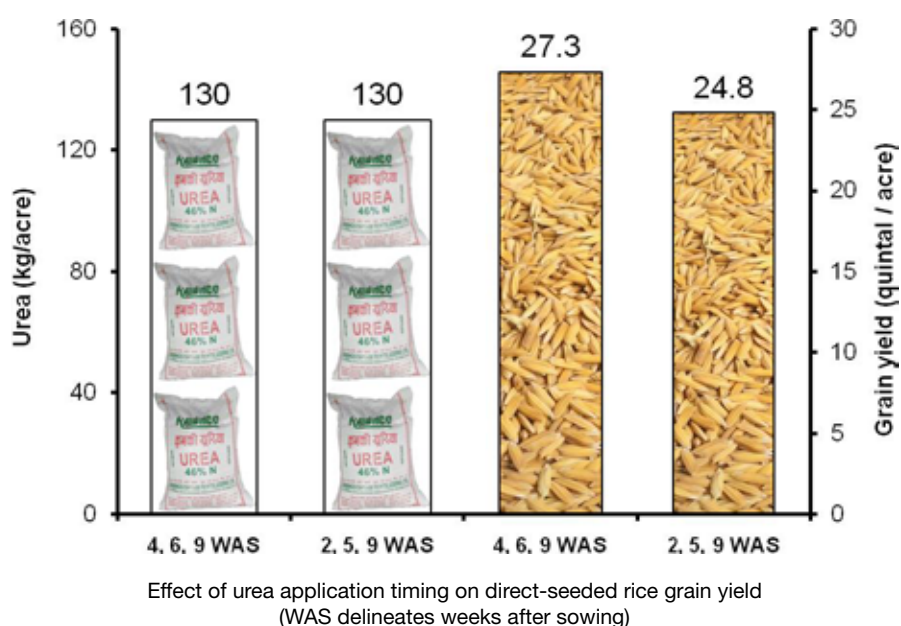
In no case, PAU-LCC is advocated as N fertilizer reducing gadget rather it may guide to use more N based on the soil inherent N supply to have sustainable yields. The PAU-LCC is a top-notch plastic strip with six shades of green color marked as 3.0, 3.5, 4.0, 4.5, 5.0, and 6.0.

The following is the protocol for

using PAU-LCC recommended in the DSR:

- At the time of seeding, no urea should be used.
- Apply 25 kg N fertilizer, viz. urea per acre 4 weeks after the sowing.
- After 6 weeks of sowing, at a 7 day interval, start matching the colour of the topmost fully exposed intact leaf of 10 randomly disease free rice plants with PAU-LCC under the shadow of your body.
- Apply 30 kg N fertilizer, viz. urea per acre whenever the greenness of 6 or more out of 10 leaves is lighter than LCC shade 4.
- If the colour of the leaves is equal to or darker than LCC shade 4, no urea should be used.
- After the flowering onset, LCC should be ceased, and no more urea should be used as afterwards it leads to plant lodging which further reduces both quality and quantity of the produce.

Precautions: The crop should not be subjected to water stress, and nutrients other than N should be provided following recommendations, with the leaves chosen to be free of insect or disease infestation. Without the PAU-Leaf Color Chart, nitrogen management is difficult. However, in the absence of PAU-LCC, under



blanket recommendation, farmers can use 130 kg urea per acre (in medium fertility soils) to DSR in 3 equal splits, viz. at 4, 6, and 9 weeks. In DSR, N fertilizer management research indicated that delivering the first dose of urea 4 weeks after sowing rather than 2 weeks after sowing generated more grains. For managing N fertilizers in DSR, farmers should use PAU-LCC as it is more cost-effective than following blanket recommendations. As a result, the PAU-LCC is a win-win technology that increases potential yield, improves grain quality by reducing insecticide/pesticide use, decreases air and underground

pollution. The use of PAU-LCC can also help in saving 25 kg of urea per acre on average which could be used in other crops. PAU-LCC can be obtained through the Punjab Agriculture University's Department of Soil Science and Farmers Service Centres/Krishi Vigyan Kendras of the state established in the different districts of the state.

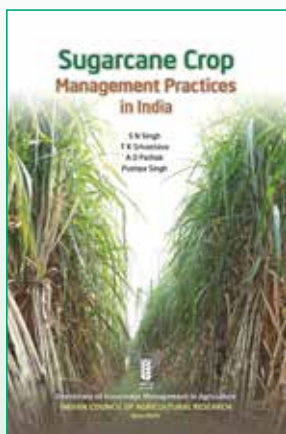
SUMMARY

Sustainable N management in DSR helps in reducing methane emissions, global warming potential, and minimum disturbance to soil structure. Soil test based N fertilizer

management is also advocated in the region where PAU-LCC was recommended for sustainable and need based N management in DSR as it results in higher N use efficiency, lowered nitrous oxide emissions. Therefore, sustainable and need based N fertilizer application in DSR with PAU-LCC will reduce N fertilizer footprints, N losses in ecosystem, viz. in air and water bodies and maximize grain yields along with livelihoods of the DSR farmers.

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TECHNICAL SPECIFICATIONS

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