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Overcoming Weeds in Direct Seeded Rice (DSR)

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Abstract
Direct-seeded rice (DSR) is a water-saving method with reduced labour requirements, but weed control is a challenge. Weeds compete for resources, leading to yield losses. Effective weed management requires an integrated approach, including preventive measures, mechanical and chemical control, cultural practices, and accurate weed identification. This approach minimizes weed pressure and ensures sustainability in DSR rice production systems.

Introduction
Rice (*Oryza sativa* L.) is one of the leading cereals of the world and two-third of the Asian people receives their daily calories from rice Rice provides 30–75% of the total calories to more than 3 billion Asians. Rice is mostly grown by manual transplanting of seedlings into puddled soil which creates a hard pan below the plough layer and reduces soil permeability and deteriorates soil structure and soil quality for the subsequent upland crops. Puddling and transplanting operations consume a significant quantity of water; in some cases, up to 30 per cent of the total rice water requirement. This triggers the farmers to shift from manual transplanting to direct seeded rice systems. The advantages offered by direct seeded rice are early maturity, easy mechanization, less labour and water requirement. But, weeds are the number one biological constraint and major threat to the production and adoption of direct seeded rice systems and can cause rice yield losses of up to 50 to 91 per cent. In direct seeded rice, weeds could be managed by hand weeding (manual means). However, chemical weed management is replacing manual weeding due to meagre labour availability, escalating labour costs and drudgery involved. Sole use of herbicides may lead to the development of resistance in weeds, changes in the weed density and composition. Moreover, a single weed control approach may be unable to keep weeds below the economic threshold level. Therefore, adoption of integrated approach is essential for weed management in direct seeded rice to get targeted yield.

Direct-seeded rice (DSR) is a rapidly growing cultivation method due to its water-saving benefits and reduced labour requirements. However, weed control in DSR poses a significant challenge compared to transplanted rice (TPR). Weeds compete with rice for vital resources like light, water, and nutrients, leading to substantial yield losses.

Effective weed management in DSR requires an integrated approach, combining various strategies:
1. Preventive Measures: Clean Certified Seeds: Using weed-free certified seeds prevents the introduction of new weed species into the field and reduces the weed seed bank in the soil.

Stale Seedbed Technique: This involves multiple irrigations and harrowing before sowing to stimulate weed seed germination and deplete the seed bank. Research by the Indian Agricultural Research Institute (ICAR) found that stale seedbed techniques reduced weed density by 44-85% compared to control plots.

Land Preparation: Thorough land preparation through deep ploughing, harrowing, and levelling creates a weed-free seedbed, minimizing weed competition during the initial crop stages.

Competitive Rice Varieties: Selecting rice cultivars with vigorous early growth and allelopathic properties (suppressing weed growth) can provide a competitive advantage against weeds.

2. Mechanical Weed Control

- ✓ **Hand Weeding:** This remains a crucial method, particularly for controlling emerged weeds that escape other control measures. However, labor availability can be a constraint.
- ✓ **Mechanical Weeder:** Rotary weeders and hoes can be effective in managing weeds between crop rows, especially in early crop stages.

3. Chemical Weed Control:

- ✓ **Herbicides:** Judicious use of herbicides plays a vital role in DSR weed management. Common herbicides include:
- ✓ **Pre-emergence (PRE) herbicides:** Applied before weed seed germination, such as pendimethalin, oxadiazon, and pretilachlor.
- ✓ **Post-emergence (POST) herbicides:** Applied after weed emergence, targeting specific weed species like bispyribac-sodium, penoxsulam, and 2,4-D.
- ✓ **Herbicide Mixtures:** Combining herbicides with different modes of action can broaden the weed control spectrum and delay the emergence of herbicide resistance.
- ✓ **Herbicide-Resistant Rice:** Herbicide-resistant rice varieties are being developed for specific herbicides, offering targeted weed control. However, their widespread adoption requires careful consideration of potential ecological implications to prevent herbicide resistance buildup in weed populations.

4. Cultural Practices:

- ✓ **Crop Rotation:** Rotating rice with other crops like legumes or oilseeds disrupts weed life cycles and helps manage weed populations.
- ✓ **Residue Management**: Retaining crop residues after harvest can suppress weed emergence by creating a physical barrier and altering soil conditions. Research indicates that brown manuring with Sesbania species can reduce weed populations by up to 50%
- ✓ **Critical Weed-Free Period:** Research has shown that the critical weed-free period for DSR is typically within the first 30-45 days after crop emergence. This period is crucial for ensuring maximum crop yield potential. Timely weed control interventions during this window are essential.
- ✓ **Integrated Weed Management:** The most effective weed management strategy in DSR involves integrating various methods mentioned above. This approach helps create a sustainable system that minimizes weed pressure while reducing reliance on any single control method, thus delaying herbicide resistance development.
- ✓ **Additional Considerations:** Weed Identification: Accurate weed identification is crucial for selecting appropriate control measures.
- ✓ **Herbicide Safety:** Always adhere to herbicide label instructions regarding application rates, timing, and safety precautions.
- ✓ **Environmental Factors:** Consider soil type, weather conditions, and potential environmental impacts when choosing weed control methods. By implementing these comprehensive weed management strategies, DSR farmers can significantly reduce yield losses and ensure the sustainability of their rice production systems.

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