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SMART PACKAGE AND PRACTICES FOR DIRECT SEEDED RICE (DSR)

General Article

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ABSTRACT

Increasing scarcity of labour, water, and energy and rising cost of production, along with climate variability, are major challenges for the sustainability of rice–wheat system in the northwesten Indo- Gangetic Plains (IGP). Direct-seeded rice (DSR) with best management practices provided equivalent or higher yield and 30–50% lower irrigation water use than those of farmer-managed puddled transplanted rice (CT-TPR). DSR showed overall net benefit of up to 4000-5000 ha^{-1} as compared to puddled transplanted rice.

Introduction

Rice (*Oryza Sativa*) is one of the most important staple food crops in India. In North-West Indo-Gangetic Plains (IGPs) of India, the production of rice and wheat is critical for food security of India. Here, depletion of ground water level is a major threat to the productivity of the traditional puddled transplanted rice (PTR) system (Humphreys *et al.,* 2010). Ground water has played a key role in success of green revolution. Data from irrigation census 2011 shows that the three states (Punjab, Haryana and UP) account for 55 percent of the tube wells in India. An alarming rate of ground water table decline is forcing researchers and farmers to consider approaches for increasing the water productivity of rice. The conventional puddled, manual-transplanted and flooded method of rice production not only use a lot of water but it is also cumbersome and laborious. In Punjab and Haryana (India), where agriculture is highly dependent upon migrant labour, labour scarcity for rice transplanting is also now a major concern for the viability of PTR. Unreliable electricity supply to the farming sector due to high demand across different sectors is also adversely affecting the availability of water for puddled transplanted rice. Labour and water (electricity) shortage can lead to delayed transplanting, which can reduce rice yield and delay sowing of wheat, reducing wheat yield also

(Gathala *et al.,* 2013). Now a days, cost of cultivation is increasing year after year but crop yield remains more or less stagnant with the proportional cost of cultivation, so it is a big challenge to scientist, researcher and farmers that how can farmers get maximum production with minimum production cost in sustainable manner for rice-wheat cropping system. Therefore, DSR is the best option to face above challenges and also help in increasing adaptation, mitigation of greenhouse gases and food security.

Direct Seeded Rice (DSR)

Fig. 1. Dry direct seeded rice

Fig. 2. Wet direct seeded rice

Direct seeding of rice refers to the process of establishing a rice crop from seeds sown in the field with the definite row pattern or broadcasting rather than by transplanting seedlings from the nursery.

There are three principal methods of DSR:

- Dry seeding : Sowing of dry seeds into dry soil
- Wet seeding : Sowing of seed into moist (vattar) soil
- Water seeding : Seeds sown into standing water

Smart Package and practices for DSR

Land Levelling:

It is the first most important step for adaptation of DSR. Before direct sowing of rice land should be leveled through Laser land leveller. Laser land levelling technology offers a great potential for water saving, uniform crop establishment, uniform distribution of irrigation, improve nutrient use efficiency, better environmental quality and higher grain yields.

Fig. 3. Land levelling with laser land leveller for DSR

Planting time

The best planting time of DSR is about 10-15 days before onset of the monsoon. Monsoon arrives near 20-25 June in Uttar Pradesh, Haryana and Punjab, so best seeding time in this region is around 15-20 June. Farmers and research

experience with DSR in participatory field and research trails across Indo-Gangetic Plains (IGPs) suggests that the seeding after onset of monsoon is difficult due to high rainfall during monsoon so poor crop establishments and also problem of field access for machinery in wet soil condition resulting poor germination and crop establishment.

Selection of cultivar

In general, high yielding cultivars should be selected according to local environment/region. Basmati type and hybrids cultivar have proven to be suited for DSR than others. Basmati type- Pusa 1121, CSR-30, Pusa Basmati -1, Pusa 2511, Basmati super, Basmati 385, Coarse and Hybrid type- Arize 6129, PR-113, 114, 124, PRH-10, RH 664, Pusa 44, RH 2014, HKRH 1, 401, Sahyadri etc. were suitable for DSR.

Machinery requirement

Fig. 4. Rotary Drill Machine

For precise seeding, rice should be drilled with a multi-crop planter fitted with inclined plates seed metering systems and inverted T-type tynes. For ZT-DSR, when only anchored residues are retained, then same multi-crop planter can be used for seeding. However, when loose crop residues are available on the soil surface, specialized machines are needed for drilling rice. In such situations, rice can be drilled using any of the following machines: Turbo Happy Seeder, Rotary Disc Drill etc.

Fig. 5. Multi crop planter/DSR Machine

Seed treatment

Seed treatment should be done with, common salt or Carbendazim 12% + mancozeb 63% WP, Streptocyclin or Emisan (Methoxy ethyl mercury chloride).

Fig. 6. Seed treatment with fungicide

Seed treatment with recommended fungicide is necessary to manage soil born diseases. For this weighed quantity of seeds are soaked in fungicide (10 g bavistin + 1g streptocyclin in 10 litre water solution for 10 kg seed) solution for 24 hours.

Amount of water used for soaking is equivalent to quantity of seed used for seed treatment. After 24 hours, seeds are removed from fungicide solution and dried in shade for 1-2 hours before sowing to make it friable.

Seed rate and seedling depth

A seed rate of 6-8 kg/acre has been found optimum for DSR. The seeding depth for rice is critical and it should not be drilled deeper than 2-3 cm in dry DSR but depth of wet DSR seedling should be keep 3-5 cm. Fine grain and Basmati cultivars require much less, optimum seeding rates resulted in no nitrogen (N) deficiency and an increased proportion of effective tillers, less incidence of pest and disease and decreased probability of crop lodging causing a substantial reduction in grain yield.

Nutrient Management

Fertilizer recommendation for DSR is same as for puddled transplanted rice. However, it is advisable to apply 10-15 kg extra N in DSR than puddled transplanted rice. For Haryana conditions, following fertilizer doses are recommended for DSR:

Coarse rice : 60 to 65 kg N/acre, 24 kg P_2O_5/acre, 24 kg K_2O/acre, and 10 kg Zinc sulphate/acre)

Basmati rice : 24-30 Kg N, 12 kg P_2O_5 and 10 kg Zn SO_4 per acre

Full doses of P, K, and $ZnSO_4$ and 9.2 kg N/ acre should be applied as basal at the time of sowing using seed cum fertilizer drill or planters. The remaining N should be applied in three equal splits at early tillering, active tillering and panicle initiation. Nitrogenous fertilizers can also be managed using Green seeker. In general, Iron deficiency occurs in DSR field due to alternate wetting and drying so it can be managed through spraying ferrous sulphate @0.5% solution when deficiency symptom occurs.

Fig 7. Nitrogen scheduling based on green

Weed management

Weeds are the major constraint towards the success of DSR, so weed management is a very important practices to success DSR instead of transplanting rice, if anybody fails to control weeds in DSR, yield penalty will be sure even all practices done very precisely. So, if farmers are able to control weeds at initial stage they can get equal or more yield than transplanted rice.

Agronomic / cultural methods:

Stale seedbed method:

In this method, weeds are pushed to germinate by giving one irrigation and then killed by a non selective herbicide (paraquat or glyphosate) or by deep tillage prior to sowing of rice. This method has great potential in suppressing weeds and is feasible under Dry-DSR because of 45-60 days window of fallow period after wheat harvest and sowing of succeeding rice crop.

Sesbania co-culture:

It involves seeding rice and *sesbania* crops (*Sesbania rostrata*) together and then killing *sesbania* with 2, 4-D ester about 25-30 DAS. In DSR field 4-5 kg *sesbania* seeds are sufficient for sowing one acre field, *Sesbania* grows rapidly and suppresses weed.

Fig. 8. Weeds before spray of post emergence herbicide

Fig. 9. Weeds after spray of post emergence herbicide

Chemical methods:

Weeds can be effectively controlled by use of pendimethalin (stomp)/oxadiargyl (top star) as pre-emergence followed by post-emergence application of bispyribac (Nominee gold) or azimsulfuron or bispyribac + azimsulfuron or Bispyribac + Pyrizosulfuron at 1-3 fb 20-30 DAS. Herbicides, alone or in combination, which have been found effective against different weed species are summarized in Table 1. Herbicide should be sprayed by flat fan nozzle to uniform weeds control in DSR field.

Table 1. Effective herbicides against different weed species

Name of Herbicides	Dose/acer	Time of application	Remarks
Pendimethalin (stomp 30%EC)	1000-1500ml (300-450 g ai./acre)	Pre-emergence	Control of most grasses, some broadleaves and annual Sedges. But good moisture is needed for its activity.
Oxadiargyl (Top star 80% WP)	50 g (40 g ai./acre)	Pre-emergence	Control of most grasses, some broadleaves and annual Sedges. But good moisture is needed for its activity.
Bispyribac sodium 10%SL (Nominee gold)	100 ml (10 g ai./acre)	Post emergence 20-30 DAS	Broad-spectrum weed control of grasses, broadleaves and annual sedges. good control of *Echinochloa* species.
Pyrizosulfuron 10% WP (Sathi)	60 g (6g ai./acre)	Post emergence	Control of broadleaves weeds

Azimosulfuron (50 %WGG)	25-30 g (12.5-15 g ai./acre)	Post emergence 20-30 DAS	Controls wide variety of weeds, including broadleaved and sedges like *Cyperus rotundus* and *Dactyloctenium spp.*
Ethoxysulfuron15 % WGG (Sunrise)	53 g (8g ai./acre)	Post emergence 20-25 DAS	Effective on broadleaves and annual sedges such as motha (*Cypers rotundus*). .
Fenoxaprop ethyl + safner 6.7 EC (Rice star)	447 ml (30 g ai./acre)	Post emergence 20-25 DAS	Excellent control of annual grassy weeds, safe on rice at early stage, good control of Barnyard grass. Does not control broadleaves and sedges.
Helosulfuron 75 %WG (Permit)	36 g (27g ai /acre)	Post emergence 15-20 DAS	Effective on broadleaves and annual sedges such as motha (*Cypers rotundus*). .
Cyhalofop 10 EC (Clincher)	400 ml (40 g ai./acre)	Post emergence 15-20 DAS	Good control of annual grassy weeds, safe on rice at early stage.
Metsulfuron + Chlorimuron 20WP (Almix)	8 g (0.8+0.8 g ai./acre)	Post emergence 20-25 DAS	Effective on broadleaves and annual sedges.
Bispyribac + Azimsulfuron	100ml+14ml (10+7 g ai./acre	Post emergence 20-25 DAS	Broad-spectrum weed control of grasses, broadleaves and sedges, including *C. rotundus*
Bispyribac + Pyrazosulfuron	100ml+60g (25 g+6 g ai./acre)	Post emergence 20-25 DAS	Broad-spectrum weed control of grasses, broadleaves and sedges, including *C. rotundus.*

Water management

DSR is a major opportunity to attain high water productivity in water scarce areas. In dry DSR, after sowing of rice, a light irrigation should be applied to maintain proper soil moisture for proper seed germination. But at the time of germination water should not stagnate for long time, In Wet (Vattar) DSR, after sowing of rice, a light irrigation should be applied after full germination to maintain proper soil moisture for excellent crop establishment. After crop establishments irrigation should be applied at an interval of 5 to 6 days (depending on weather conditions) or on the basis of light hair cracks in soil.

Fig 10. Irrigation based on soil hair cracking in DSR field

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