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# Weed management approaches in direct-seeded rice in eastern Indian ecologies – A critical and updated review

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**ABSTRACT**

Direct-seeded rice (DSR) is significant in modern day agriculture because it requires less water input (20%) and labour (65-80 person-days/ha). Moreover, it enables farmers to establish rice early, which allows the crop stand more power to resist flush flood happening more frequently in the beginning of the monsoon. Direct-seeded rice produces at par or higher yield compared to manual transplanted rice but significantly higher yield (1.07 t/ha) compared to traditional manual broadcasted rice followed by *beushening* practice. It helps to increase system productivity by 0.25 t/ha, increase income by US$ 150/ha, reduce greenhouse gas emission (20% GWP) besides instrumental in reducing straw burning and environmental footprints. Despite all these advantages, the DSR has not been adopted at large scale at farmers' field in eastern India particularly in Bihar, Odisha and Uttar Pradesh. One of the most important reasons for this is heavy and diversified weed infestation in DSR which consequently reduces rice yields significantly. In the present review article, the authors have tried to compile relevant information on the weed management approaches in DSR with special reference to eastern Indian states. Detailed discussions on weed species based on their occurrence and infestation, critical period of weed competition and different methods of weed management in DSR in eastern Indian ecologies have been enlightened in this paper. It also includes that weed management options in DSR depend on many factors like land situation, soil condition, water status, planting geometry and resources availability; and therefore, one single method of weed management practices may not be sufficient to control all the flushes of diversified weeds. Integrated approach combining cultural, physical and chemical methods can provide a more robust control of weeds in DSR. Relevant data generated in Odisha representing eastern Indian ecologies have also been included herein to further enrich knowledge and skills regarding DSR productivity, in general and possible weed management options, in particular.

## INTRODUCTION

Rice is the staple food for more than half of the world population and is presently grown in more than hundred countries in the world, with a total harvested area of approximately 158 million hectares, producing 756.7 million tons annually (502.2 million tons of milled rice). In Asia, nearly 680 million tons of rice is grown, representing 90% of global production (FAO 2017). India is the second largest producer of rice next to China, where it is grown in an area of 43.2 mha annually with a production of 110 mt and accounts for about 40% of food grain production in the country (GOI 2017-18). Around 23% of rice is direct-seeded in the world (Rao *et al.* 2007). In India, out of total 42.5 mha rice area in last decade, estimated direct-seeded rice (DSR) area was 11.9 mha, which is 28% of the total rice area (Pandey and Velasco 2002). Direct seeding of rice is an alternative method that could reduce the labor and irrigation water requirements for crop establishment (Kumar and Ladha 2011). In eastern India, DSR enable farmers to establish rice early, consequently harvesting rice early and allowing farmers to start sowing a subsequent crop like wheat, leading to higher yield of the crop (Singh *et al.* 2008). Shortage of labour in present day agriculture has driven the shift of interest on DSR from puddled transplanted rice in India as well as in many other countries in south-east Asia. Moreover, huge water inputs, labour costs and labour requirements for puddled transplanted rice have reduced profit margins (Pandey and Velasco 1999). DSR helps increase system productivity by 0.25 t/ha, increase income by US$ 150/ha and reduce greenhouse gas emission (20% GWP) besides instrumental in reducing straw burning and environmental footprints. It requires less water input (20%) and labour (65-80 person-days/ha) compared to traditional broadcasted rice (CSISA 2016).

There are three types of establishment methods in DSR, i) sowing dry seeds into the dry soil (dry-seeding), ii) sowing pre-germinated seeds in puddled soil (wet-seeding), and iii) sowing seeds into standing water (water-seeding). Among these, dry-seeding is the most common practice in India. Dry seeding has been the principal method of rice establishment since the 1950s in developing countries (Pandey and Velasco 2005). The dry-seeding can be done by two ways-a) sowing by manual broadcasting and b) sowing by seed-cum-fertilizer drill. Direct-seeded rice sowing by seed-cum-fertilizer drill, which is commonly referred as DSR is practiced in eastern India by two methods-(a) In *vattar* condition, where in a well prepared field after pre-sowing irrigation or after rainfall, the field is ploughed followed by planking. Sowing of pre-soaked treated seeds is done when the field reaches to *vattar* condition (field capacity), (b) In dry soil condition, where sowing of dry seeds is done using a seed drill in a well prepared dry field, after that light irrigation is applied or wait for receiving rainfall for crop emergence. In Asia, dry seeding is extensively practiced in rainfed lowlands, uplands, and flood-prone areas, while wet seeding remains a common practice in irrigated areas (Azmi *et al.* 2005, de Dios *et al.* 2005, Kim *et al.* 2001, Luat 2000). DSR can be grown in almost all types of soils suitable for rice, but medium textured soils are more suited (Kamboj *et al.* 2012). DSR is established earlier than puddled transplanted rice (PTR) without growth delays from transplant injury. Rana *et al.* (2014) reported that DSR matures 7 to 10 days earlier than transplanted rice due to absence of transplanting shock; which hastens physiological maturity and reduces vulnerability to late-season drought (Tuong *et al.* 2000). Awan *et al.* (2006) reported that DSR was almost at par in yield with transplanted crop. Similarly, research study in Odisha in Cereal Systems Initiative in South Asia (CSISA) domain areas (20

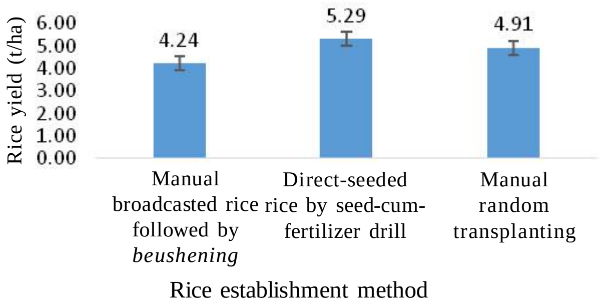


**Figure 1. Performance of different rice establishment method in Odisha (2017-2018)**

locations in Bhadrak and Mayurbhanj districts in 2017-2018, unpublished) revealed that DSR by seed-cum-fertilizer drill produced the highest rice yield (5.29 t/ha) which was at par with manual random transplanting (4.91 t/ha) but significantly higher than manual broadcasted rice followed by *beushening* (4.24 t/ha) (**Figure 1**). Despite these advantages in DSR, poor germination, uneven crop stand and heavy infestation of weeds become critical factors/ constraints for DSR to upscale compared to traditional transplanted rice (Farooq *et al.* 2010).

## Major weed species in direct-seeded rice

More than 50 weed species infest DSR, causing major losses to rice production worldwide (Rao *et al.* 2007). Singh *et al.* (2016) reported that research evidences at different places has shown around 20-100% losses due to weeds such as *Echinochloa* spp., *Leptochloa* spp., *Cyanotis* spp., *Commelina* spp., *Digitaria* spp. and *Alternanthera* spp., in DSR. Among these *Echinochloa colona* and *Echinochloa crusgalli* are the most serious weeds affecting DSR. The density of these weeds in DSR depends upon moisture condition in the field. *Echinochloa colona* requires less water which may be the reason that it is more abundant in DSR. *Cyperus rotundus* and *Cynodon dactylon* may be major problems in poorly managed fields or where un-decomposed farm yard manure has been applied. Singh (2008) also found that *C. rotundus* may pose a severe threat to Direct-seeded rice system where regular flooding is absent. Grasses and broad-leaf weeds are major problem in DSR system and these further led to shift in weed flora towards difficult-to control weeds (Choudhary and Dixit 2018). On an average, yield loss due to weed competition ranges from 15 to 20 per cent, but in severe cases, it may exceed 50 per cent (Hasanuzzaman *et al.* 2009).

## Weedy rice

Weedy rices are broadly defined as plants from the genus *Oryza* that mimic, infest and compete with rice (Delouche *et al.* 2007a). Weedy rice increases production costs and reduces growers' profit through yield reduction. The major traits of weedy rice are early shattering of the grain and variable seed dormancy (Azmi and Karim 2008, Delouche *et al.* 2007b). Weedy rice's origin in India is as old as the cultivation of rice since it occupies a special position in the Vedas from ancient times. Many weedy rice species are present in India as the country is the centre of origin of cultivated rice. Weedy rice spreads rapidly from infested fields to new non-infested areas. Knowledge of the sources responsible for the dispersal of weedy rice can help in preventing its spread to non-infested areas. The use of weedy rice contaminated seed is the most important source of its spread to new areas. Contaminated agricultural machineries also play a vital role in spreading of weedy rice. Otherwise, it can also be dispersed through irrigation water, heavy wind/storm and flooding (Chauhan *et al.* 2013). Weedy rice is very difficult to control with a single method and an integrated weed management (IWM) strategy is needed for its effective control in DSR systems (Chauhan 2013). Farooq *et al.* (2009) found that weedy rice (*Oryza sativa f. spontanea*), which is also known as red rice, is highly competitive and causes severe rice yield losses ranging from 15 to 100%. In eastern India, traditionally farmers control weedy rice by occasional manual rouging of panicles only. Use of weedy rice–free seeds and clean agricultural implements can be the best preventive measures to control weedy rice (Chauhan *et al.* 2013).

### Volunteer rice

Seeds of previous rice crop usually shatters in the field at maturity and after receiving rains/irrigation germinate with following season rice crop. These volunteer rice plants behave like weeds, compete with main rice crop in place and also contaminate the produce. Chauhan (2012) reported that stale seed bed technique which proved to very effective in direct-seeded rice could be a good option to control volunteer rice. Crop rotation with other crops like pulses or oilseeds in double rice cropping systems could be another option to control volunteer rice in direct-seeded rice.

### Critical period of weed competition in DSR

Weeds are a major yield limiting factor in DSR and the literature reporting yield losses are numerous. Weeds adversely affect the yield, quality and cost of production due to competition for various growth factors (Singh 2008). Because of wide adaptability and faster growth, weeds dominate the crops habitat and reduce the yield potential (Rao 2011). Raj *et al.* (2013) reported that season long weed competition in wet seeded rice caused 69.71 and 67.40 per cent reduction in grain yield during *Kharif* and *Rabi* season, respectively. In DSR, competition of weeds is more compared to PTR as weeds and rice seedlings emerge simultaneously, and also due to absence of standing water in DSR. The critical period of weed competition is 14- 41 days after sowing in DSR (Chauhan and Johnson 2011). Azmi *et al.* (2007) reported that critical period for weed control under mixed weed infestation in DSR was from 12 to 60 DAS. The effective control of weeds at initial stages of rice growth (0 to 40 DAS) could help in improving the productivity of DSR (Maity and Mukherjee 2008). Singh (2008) opined that a weed free situation for first 60 or 70 DAS produced yield comparable with weed free situation until harvesting. The competition in DSR beyond 15 days after seeding may cause significant reduction in grain yield. Weeds compete with crop for growth factors such as nutrients, soil moisture, light, space *etc*. and cause losses to the crop (Walia 2016). Estimated losses from weeds in rice are around 10% of total production grain yield; however, such losses can be much higher (Rao *et al.* 2007). In wet-seeded and dry-seeded rice, weed growth reduced grain yield by up to 53 and 74%, respectively (Ramzan 2003), and up to 68–100% for direct-seeded *Aus* rice (cropping season in Bangladesh) (Mamun 1990) and in extreme cases, complete failure of aerobic rice (Jayadeva *et al.* 2011).

## WEED MANAGEMENT

### Cultural method of weed control

Cultural method plays a significant role in reducing crop-weed competition (Dass *et al.* 2016) in many ways.

**Seed rate:** Many researchers confirmed that seed rate plays an important role in controlling weeds in direct-seeded rice. In the Indo-Gangetic Plain, a seed rate of 20 to 25 kg/ha has been recommended for DSR (Kumar and Ladha 2011) under optimum weed control. However, results of Chauhan *et al.* (2011) suggest that a seeding rate of 95 to 125 kg/ha for inbred varieties and 83 to 92 kg/ha for hybrid varieties is needed to achieve maximum yields in competition with weeds. One study showed that there was no effect of seeding rates, ranging from 15 to 125 kg/ha, on the grain yield of direct-seeded rice grown in weed-free conditions (Chauhan *et al.* 2011). Research study in Odisha in CSISA domain areas (29 locations in Puri, Bhadrak and Mayurbhanj districts in

2016-2018, unpublished) on optimization of seed rate and weed management option in manual broadcasted rice revealed that use of lower seed rate (60 kg/ha) with weed control by pre-emergence herbicide pretilachlor + safener followed by post-emergence herbicide bispyribac sodium + 1 hand weeding at 2 weeks after post-emergence herbicide spray recorded highest rice yield (4.80 t/ha), which was significantly higher than that of manual broadcasted DSR using high seed rate (100 kg/ha) and weed control (**Figure 2**) by *beushening* practice (3.68 t/ha). The cost benefit study indicates that net benefit per unit investment was also significantly higher in use of lower seed rate and weed control by chemical method (B:C 1.94) compared to use of higher seed rate and weed control by traditional *beushening* practice (B:C 0.90).

**Stale seed bed:** Stale seed bed technique is an important method of cultural practice to control weeds in direct-seeded rice. In this technique, weeds are allowed/provoked to germinate after application of irrigation water or rainfall and then the weeds are killed either by shallow tillage or by application of non-selective herbicide prior to rice sowing. In general, weed species sensitive to the stale seed bed practice are those that are present in the top-soil layer, have low initial dormancy, and require light to germinate. But weeds which have high initial dormancy cannot be controlled by this method (Chauhan 2012). Singh *et al*. (2016) reported that stale seed bed combined with herbicide (paraquat/ glyphosate) and zero till results in better weed control. This may be due to low seed dormancy of weeds and their inability to emerge from a depth >1 cm (Chauhan and Johnson 2010). About 53% lower weed density was recorded due to stale seed bed. On the basis of farmer's field trials, Singh *et al*. (2009) also observed a 53% lower weed population after stale seed bed practices in DSR. Singh (2013) reported that in dry direct-seeded condition, stale seed bed using glyphosate application 1.0 kg/ha was more effective in reducing the weed density and it recorded higher grain yield and B-C ratio than stale seed bed using shallow tillage. Jose *et al*. (2013) reported that stale seed bed technique effectively controls weedy rice in DSR. Stale seed bed technique was also realized most effective tool against volunteer rice which often causes serious problem in DSR (Yadav and Yadav 2010).

**Brown manuring with *Sesbania*:** *Sesbania* sown on the day of sowing in DSR suppresses the weeds maximum (Singh *et al*. 2007). *Sesbania* is sown 25 kg/ha and after 25-30 days of sowing, it is knocked down by application of 2,4-D ester 0.5 kg/ha. Anita and Mathew (2010) reported that the best time for incorporating *Sesbania* for maximum weed suppression and grain yield was at 30 DAS for semi-dry rice and the best method for knocking down *Sesbania* was 2,4-D spraying 1.0 kg/ha. Kumar and Ladha (2011) found that *Sesbania* was less effective on grasses compared to sedges or broad-leaf weeds. Hence, pretilachlor + safener can be applied as pre-emergence during *Sesbania* sowing to control grasses effectively in DSR. *Sesbania* also helps in fixing atmospheric nitrogen into the soil and facilitate in crop emergence in areas where soil crust exist (Gopal *et al*. 2010). But contrary to this, there are many reports and observations about *Sesbabia* to causing heavy yield penalties when co-cultured with DSR and this could be an important reason for which *Sesbania* is not co-cultured at scale in DSR.

**Land levelling:** It is well known that good land preparation helps to reduce weed problem. Precise land levelling like laser land levelling (LLL) is not yet widely adopted in eastern India. Activities in CSISA domain areas in Bihar, eastern Uttar Pradesh and Odisha confirmed that LLL helps to get uniform crop stand and subsequently help to reduce weed population. Studies in north and western India

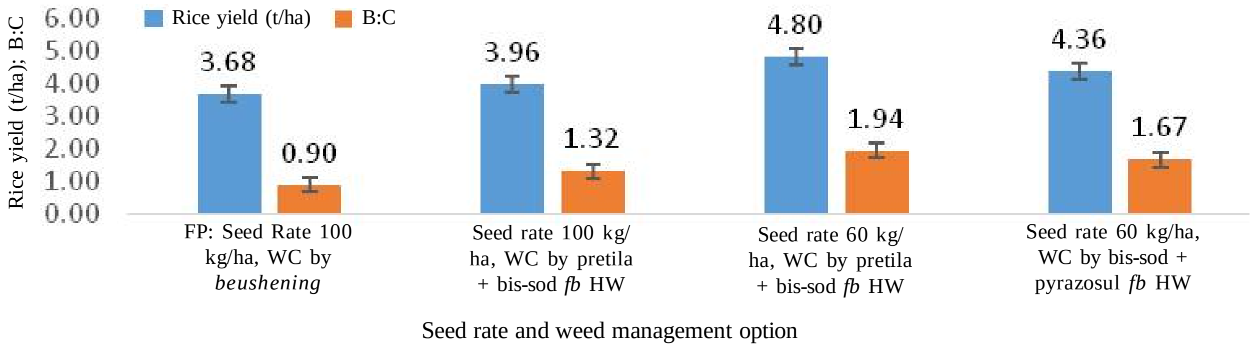


**Figure 2. Optimization of seed rate and weed management in manual broadcasted rice in Odisha (2016-2018)**

revealed that laser land levelling ensures better crop establishment (Jat *et al.* 2009), precise water control, energy savings, improved weed control, increased nutrient use efficiency and increased herbicide use efficiency (Chauhan 2012). Rickman (2002) reported that laser land levelling reduces the weed population by up to 40% and the labour requirement for weeding by 75% (16 person-days/ha).

**Crop rotation:** Crop rotation sometimes could be adopted to control obnoxious weeds. Singh *et al.* (2013) reported that rice crop rotation with other crops like mung bean, soybean, cotton and maize effectively controls weedy rice. In coastal Odisha, in double crop areas, some farmers practice rice in rotation with mung bean to control weedy rice and volunteer rice seedlings. Watanabe *et al.* (1998) reported similarly in Malaysia, Suriname and Vietnam. DSR can be rotated with transplanted rice after 2-3 years, if need be, to check build-up of problematic weeds such as *Leptochloa chinensis*, *Eragrostis* spp., weedy/volunteer rice *etc*. (Bharti *et al.* 2016). In eastern Indian states like Bihar, Odisha and Uttar Pradesh, direct-seeded rice is mainly grown in only one season (mostly in *Kharif*) particularly in double rice crop areas to avoid emergence of voluntary rice (the rice seed from previous season germinate in the field in next season) in the DSR field.

**Cultivars:** Seed germination in anaerobic condition and tolerance of early submergence of rice cultivar are crucial in weed management in direct-seeded rice. In rainfed situation, risk of uncertainty of rainfall and possibilities of flooding after seeding can be controlled by development of suitable variety. In many places in eastern India, germination and crop establishment in DSR fail because of poor germination of rice seeds in anaerobic condition. Rice cultivars with Sub-1 gene though can tolerate complete submergence at seedlings stage but they are susceptible to anaerobic germination (Iftekharuddaula *et al.* 2011). Development of cultivar which can germinate under anaerobic condition will help to control early flush of weeds by initial flooding. The cultivars should have characteristics like high seedling vigour and rapid leaf area development in the early vegetative growth stage to suppress weed growth. Besides cultivars with having allelopathic effect and herbicide resistance will add value to this to control weeds. With the use of cultivars having anaerobic germination, the cost of herbicides may decline as weeds can be controlled by early flooding (Yamauchi 1996). QTLs for this trait have been identified (Septiningsih *et al.* 2009) at the International Rice Research Institute (IRRI). Evaluation trials are also undergoing at many Indian Institutes in close collaboration with IRRI and initial outcomes are encouraging (personal communication).

**Physical method of weed control**

**Manual hand weeding:** In eastern India, traditional farmers practice to control weeds in rice is by hand weeding. Though, in present day agriculture, it is not economically viable option to go for manual hand weeding in direct-seeded rice because of shortage of labour and rising price of labour besides being less effective. Hand weeding is environment friendly however, practice is tedious/cumbersome, labour intensive and costly. Roder (2001) reported that 150-200 labour-day/ha are required to keep rice crop free of weeds. In some parts of eastern India, farmers sometimes prefer to go for spot hand weeding particularly after application of post-emergence herbicide to remove escaped weeds, which are not controlled by herbicides. Chopping of panicles or cutting of whole weedy rice by manually are practiced in rice field in many parts of India to control weedy rice. Singh *et al.* (2013) reported that weedy rice panicles are cut with the help of a machete or a special knife attached to a stick in India as well as in many other countries.

**Mechanical weeding:** In direct-seeded rice, mechanical method can effectively control weeds due to the fact that desired spacing in between rows can be obtained by adjusting tynes in the seed drill machines while sowing in DSR. Mechanical weeders are used to control weeds in between rows; though by this method, weeds which are within rows cannot be removed. Sufficient soil moisture during weeding operation plays a vital role to increase efficiency of mechanical weeder. Though, mechanical weeding by hand pushed cono-weeder is tedious and time consuming, it is still in practice in many parts of eastern India. Recently farmers now showing interest in mechanical weeding by petrol/diesel operated rice power weeder in eastern India. Two-row rice power weeder has the capacity of weeding one acre within 2-3 hours depending on density of weeds in DSR fields. The rice power weeder operates well in standing water in the field and there should be at least 25 cm row-row spacing to avoid cutting of rice seedlings during weeding operation. An early operation at younger stage of weeds (15-25 DAS) and also in combination of effective pre-emergence herbicides will help make the power weeder operation more easy and effective. We have also observed in CSISA Project Domain in Odisha during 2016 and 2017 that herbicide use can be totally displaced by mechanical weeding through use of power weeder twice (15 and 30 DAS) in the field of DSR supplemented with manual hand weeding to remove left over weeds in general and within the rows, in particular. It requires adequate training of the operator and custom hiring could be more practical and feasible way to scale it up. Actually, concerted efforts need to be invested to promote this eco-friendly technique in DSR and mechanical transplanted rice (unpuddled) as well.

### Chemical method of weed control

Chemical method of weed control proved to be the best alternative compared to manual or mechanical method of weed control in rice (Chauhan *et al*. 2014). In cases where weeds are morphologically similar to rice crop, chemical method of weed control is the viable option (Chauhan 2012). Jacob *et al*. (2014) opined that the major advantage in herbicide based weed control in DSR is the reduction in the cost of cultivation. Hill *et al*. (2001) reported that the success of herbicidal method of weed control is closely linked to water management to provide suitable condition for achieving specificity in weed control and minimizing the risk of phytotoxicity to rice seedlings. Chauhan and Yadav (2013) reported that combination of two or more herbicides may become an effective and integrated approach to control complex weed flora in DSR. Singh *et al*. (2005) reported to successfully control weeds in DSR by using the stale seed bed technique combined with a pre-emergence herbicide, pendimethalin, applied within 2 days after seeding. Several pre-emergence herbicides including butachlor, thiobencarb, pendimethalin, oxadiazon, oxyfluorfen and nitrofen, alone or supplemented with hand weeding, resulted in good weed control as expressed by reduced weed density and improved yields (Moorthy and Manna 1993, Pellerin and Webster 2004). Paraquat (0.5% by volume) is recommended for burndown application. If fields are infested with perennial weeds, glyphosate should be applied instead of paraquat (Kamboj *et al*. 2012). CSISA on-station and on-farm studies revealed that pendimethalin/oxadiargyl as pre-emergence followed by post-emergence application of bispyribac or azimsulfuron or bispyribac + azimsulfuron 15-20 DAS yielded similar to weed-free conditions. In DSR, time of application of pre-emergence herbicide (particularly pendimethalin) is very important under rainfed condition as pendimethalin can create toxicity to rice seed and damage rice seedling emergence if it comes in direct contact of seeds. Pretilachlor with safener 30.7 EC 500 g/ha or oxadiargyl 80 WP 90 g/ha using 375-500 litre/ha water volume control grasses, broad-leaf and sedges when applied on the same day of sowing under *vattar* condition and within 1-3 days after seeding in case sown in dry and irrigated condition (Kumar *et al*. 2017). Application of post-emergence herbicide in DSR in situations where application of pre-emergence herbicide is missed due to unfavourable weather or other reasons or weeds are not controlled effectively can be one of the suitable options to control weeds which are in 4-5 leaf stage. To cover broad spectrum of weeds, herbicide mixtures increase chances of getting better results for weed control in rice. Post-emergence herbicide bispyribac-sodium 10 SL 20 g/ha controls grasses and broad-leaf and particularly very effective on *Echinochloa* sp. and *Ischaemum rugosum*, but poor on *Leptochloa chinensis*, *Eragrostis* spp. and *Dactyloctenium aegyptium* when sprayed at 15-25 days after sowing using 300 litre water/ha. Fenoxaprop-p-ethyl with safener 6.9 EC 90 g/ha + ethoxysulfuron 15 WG 18.75 g/ha controls complex weed flora including *Leptochloa* and *Dactyloctenium*. Bispyribac sodium + pyrazosulfuron-ethyl 20 + 20 g/ha controls complex weed flora including grasses, broad-leaf and sedges. It is particularly effective on complex weed flora dominated by *Cyperus rotundus* (Kumar *et al*. 2017). Singh *et al*. (2004) reported that a ready mix formulation of metsulfuron-methyl 10 WP + chlorimuron-ethyl 10 WP 4 g/ha was very effective against diverse weed flora. Selection of herbicide(s) or their combinations should be done very carefully depending upon weed infestation in DSR. For post-emergence herbicides, the field should be moist but without stagnating water before spray and the field should not be irrigated at least up to the next day also.

### Integration of weed management practices

Many researchers have emphasized that integration of different weed management practices depending on land situation, soil condition, water status, planting geometry and resources available, can provide great control of weeds as well as cost of production can be minimized. Integration of different weed management practices (cultural, physical and chemical) effectively control weeds in DSR than depending on a single method of weed management practice. Chauhan and Yadav (2013) reported that the combination of two or more herbicides may become a part of an effective and integrated approach to achieve more satisfactory control of complex weed flora in DSR. The sequential applications of a pre-emergence herbicide (*e.g.*, pendimethalin or oxadiargyl) followed by post-emergence herbicide (*e.g.*, bispyribac-sodium) can provide effective weed control in DSR, if supplemented with some other weed management strategies like hand weeding, mechanical weeding and/or other need based herbicides (ethoxysulfuron, pyrazosulfuron, 2,4-D, Almix etc.) (Yadav and Yadav 2010). There is a need to watch weed infestation scenario in the crop to select suitable herbicide(s) accordingly. It is imperative to educate not only the farmers but all other stakeholders including dealers to emphasize more on integrated management of weeds in DSR rather than only chemicals. One has to move in a step-wise manner according to recommended package of practices to harness full benefits of this resource conserving technology not only in the eastern ecologies but also in other parts of the country and South Asia as well.

## Conclusions

Direct-seeded rice is catching interest of researchers, planners and farmers in eastern Indo-Gangetic Plain. However, weeds are still perceived as the major limiting factor in wider adoption of DSR. An integrated approach is required to attain effective control of complex weed flora including weedy rice and volunteer rice. Chemical control is the smartest and most economic option for weed management in present day agriculture. Pretilachlor with safener 30.7 EC 500 g/ha as pre-emergence followed by post-emergence herbicide bispyribac sodium 10 SL 20 g/ha at 15-25 DAS takes care of most of the weeds in DSR. One manual/mechanical weeding may also be employed after one week of post-emergence herbicide application to control escaped weeds. Pyrazosulfuron-ethyl, ethoxysulfuron and metsulfuron-methyl + chlorimuron-ethyl may be used as tank mixture with post-emergence herbicide depending upon weed flora and particularly in situations where manual weeding is not feasible. Knowledge and skills of different stakeholders needs to be strengthened on improved herbicide spraying techniques, weed identification and new herbicide molecules along with cultural method of weed management including stale seed bed, competitive varieties and crop rotation.

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