



Dry-seeded rice productivity in relation to sowing time, variety and weed control

Harjeet Singh Brar and M.S. Bhullar*

Department of Agronomy, Punjab Agricultural University, Ludhiana, Punjab 141 004

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In Punjab in India, rice is raised by puddled transplanting which causes high losses of water through puddling, surface evaporation and percolation. An alternate method of rice planting which reduces water and labour needs to be explored. Direct dry-seeded rice (DSR) is one of the options. The success of DSR, however, lies in effective weed control. The weed flora in DSR consists of aerobic and anaerobic grasses, broad-leaved and sedges, which emerge in several flushes during the crop growth period. The risk of crop yield loss due to competition from weeds is higher in DSR than for transplanted rice. Sowing time has significant influence on weed species composition and intensity. A short duration (125 days) and early maturing rice variety 'PR 115' gave highest yield in DSR, followed by medium (140 days) variety 'PR III' at Ludhiana, Punjab (Gill *et al.* 2006).

A field experiment was conducted at the Research Farm, Department of Agronomy, Punjab Agricultural University Ludhiana during *Kharif* 2008. The soil was sandy loam, pH 7.1, low in organic C (0.32%) and available N (252.7 kg N/ha), medium in available P (12.9 kg P/ha) and available K (246.1 kg K/ha). The experiment comprised of 24 treatment combinations, *viz.* six sowing dates (dry seeding on 0 (5 June), 7, 14, 21, 28 days after nursery sowing (DANS) and transplanting 28 days after nursery sowing) assigned to main plots, and four combinations of two rice varieties, 'PR 115' (short duration, 125 days) and 'PAU 201' (mid-duration of 144 days), and two weed control treatments (pendimethalin 0.75 kg/ha pre-emergence, followed by bispyribac-sodium 0.030 kg/ha as post-emergence 25 days after seeding/transplanting) and 3 hand hoeings at 20, 40, 60 days after seeding/transplanting) to sub-plots, replicated three times in a split-plot design. The rice was seeded in moist soil with hand drill in 20 cm spaced rows using 30 kg seed/ha. The soil was kept moist throughout and irrigation was stopped two weeks before crop harvest. Data on population and dry matter accumulation by different weed species was recorded at 60 days

*Corresponding author: bhullarms@pau.edu

placing 50 cm square quadrant at two spots in a plot. Ten crop plants were randomly selected at harvest and panicle length and grains per panicle were recorded.

Weed flora in the experimental field consisted mainly of grasses (*Digitaria sanguinalis*, *Echinochloa* spp, *Eleusine aegyptiacum*, *Leptochloa chinensis* and *Eragrostis* spp), broad-leaved (*Ammania baccifera* and *Caesulia axillaries*) and sedges (*Cyperus rotundus*, *Cyperus iria* and *Cyperus compressus*). Population of *Echinochloa* sp, *L. chinensis* and *D. sanguinalis* did not vary among sowing dates except *Eragrostis* sp. which was higher under rice seeded on 28 DANS than all the other dry seeding dates and transplanting. *Ammania baccifera* and *C. axillaris* infestation was significantly higher in rice seeded directly on 21 and 28 DANS as compared to all the other dry seeding dates and transplanting. Dry-seeding rice on 7, 14 and 28 DANS recorded significantly higher *C. compressus* intensity as compared to other sowing dates. Higher pressure of broad-leaved weeds in rice seeded directly on 21 DANS reduced the *C. compressus* intensity. Rice seeded directly on 0 DANS recorded the lowest total weed density similar to transplanted treatment. The delay in dry seeding increased total weed population as compared to early seeding dates.

Weed population and dry matter did not vary among rice varieties. Among weed control, pendimethalin *fb* bispyribac-sodium gave effective control of *Echinochloa* sp. and *D. sanguinalis* and recorded similar population to that of three hoeings. Poor control of *Eragrostis* sp. and *L. chinensis* by these herbicides significantly increased their population as compared to three hand hoeings which removed different flushes of these weeds. Pendimethalin provided effective control of broad-leaved weeds and proved as effective as three hoeings. Total weed density under herbicides was statistically similar to three hand hoeings due to effective control of majority of weeds by the sequential application of herbicides (Table 1). Hand hoeings twice was highly effective in controlling weeds in dry-seeded rice (Kathiresan and Manoharan 2002, Singh

et al. 2004), and had higher weed control efficiency than herbicides (Behera and Jena 1998).

Grassy weeds accumulated the lowest dry matter in transplanting treatment which was at par with all the direct sowings except 28 DANS (Table 1). Higher pressure of weeds increased dry matter under late sowings and standing water in transplanted crop did not allow weeds to germinate and accumulate dry matter. Transplanted crop recorded lower weed dry matter as compared to direct sown crop (Singh et al. 2003). Rice cv. 'PAU 201' recorded significantly lower weed dry matter than 'PR 115'. Weed control treatments did not influence grassy weeds dry matter because herbicides and hand hoeings gave good control of prominent grassy weeds. The dry matter of broad-leaved weeds and sedges did not vary statistically among sowing dates and varieties. However, herbicidal treatment recorded significantly higher dry matter of broad-leaved weeds and sedges as compared to three

hoeing. Although pendimethalin kept population of broad-leaved weeds under check, still they accumulated dry matter sufficiently higher than three hoeings. Higher population of *C. rotundus* increased the dry matter of sedges under chemical as compared to three hoeings.

Transplanted rice crop produced the highest rice grain yield, which was at par with direct seeding on 0 DANS but significantly higher than other direct seeding dates. The rice grain yield in transplanted treatment was 11.9, 22.1, 20.7, 41.8 and 71.3% higher as compared to direct seeding on 0, 7, 14, 21 and 28 DANS, respectively. Rice seeded directly on 0, 7 and 14 DANS yielded at par but significantly higher than that seeded on 21 and 28 DANS. Three hand hoeings produced significantly higher rice grain yield as compared to sequential application of pendimethalin and bispyribac. Lower weed pressure in hand-hoed plots helped the crop produce more number of effective tillers which increased the grain yield than herbicide treated plots.

Table 1. Effect of sowing time, variety and weed control on weed growth and yield performance of rice

Treatment	Total weed count at 60 DAS (no./m ²)	Weed dry matter at 60 DAS (kg/ha)			Effective tiller/m ²	Panicle length (cm)	Grains/panicle	Grain yield (t/ha)
		Grassy weeds	Broad-leaved weeds	Sedges				
<i>Sowing time</i>								
Direct sowing on 0 DANS	29.6	119 (44)	115 (33)	129 (72)	492	22.0	113.2	5.03
Direct sowing on 7 DANS	56.1	112 (29)	147 (136)	173 (239)	492	22.2	97.4	4.62
Direct sowing on 14 DANS	69.0	124 (62)	114 (35)	138 (103)	529	22.1	99.4	4.67
Direct sowing on 21 DANS	102.4	117 (44)	115 (34)	162 (187)	510	20.3	88.9	3.97
Direct sowing on 28 DANS	96.4	154 (148)	143 (117)	160 (173)	504	20.4	85.8	3.29
Transplanting on 28 DANS	25.4	108 (16)	108 (18)	129 (72)	364	25.2	125.7	5.64
LSD (P=0.05)	30.5	16	NS	NS	82	1.7	14.5	0.59
<i>Variety</i>								
'PR 115'	68.1	128 (74)	125 (68)	148 (144)	483	22.4	106.9	4.46
'PAU 201'	58.2	116 (40)	122 (57)	153 (152)	481	21.7	96.6	4.61
LSD (P=0.05)	NS	11	NS	NS	NS	0.6	5.7	NS
<i>Weed control</i>								
Pendimethalin 0.75 kg/ha fb bispyribac 0.03 kg/ha	66.3	124 (61)	132 (87)	167 (199)	467	22.0	103.1	4.36
Hand hoeing at 20, 40 and 60 DAS	60.0	121 (53)	115 (38)	134 (96)	497	21.1	100.4	4.71
LSD (P=0.05)	NS	NS	11	16	NS	NS	NS	0.21

Data subjected to square root transformation. Figures in parentheses are means of original values. DANS - days after nursery sowing

Interaction revealed that rice seeding directly on 0, 7 and 14 DANS produced similar grain yield under herbicides and three hand hoeings but further delay in rice seeding significantly reduced the grain yield under herbicides as compared to hand hoeing. Higher weed pressure under late sowings put more competition which reduced the grain yield under herbicide treated plot while three hoeings successfully removed the weeds even under late sowings.

SUMMARY

Transplanted crop recorded the lowest total weed population and dry matter and similar to dry seeding on 0 days after nursery sowing. Total weed population and dry matter was lower under early sowing on 0, 7 and 14 DANS as compared to delayed sowings. Sequential application of herbicides effectively controlled *Echinochloa* sp. and *D. sanguinalis* while control of *Eragrostis* sp. and *L. chinensis* was very poor. Transplanted crop recorded the highest rice grain yield, at par with dry seeding on 0 DANS but significantly higher than dry seeding on later dates. Three hand hoeings gave significantly higher grain yield than herbicides. Rice seeding directly on 0, 7 and 14 DANS

produced similar grain yield under herbicides and three hand hoeings. Further delay in seeding significantly reduced grain yield under herbicides as compared to hand hoeings.

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