Short communication

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# Weed management under different planting geometry in dry direct-seeded rice

**Neeshu Joshi***, **V.P. Singh, V.C. Dhyani, Subhash Chandra and S.K. Guru**

*Department of Agronomy College of Agriculture, G.B. Pant University Agriculture & Technology, Pantnagar, Uttarakhand 263 145*

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Rice (*Oryza sativa* L.) is the leading cereal of the world and more than half of the human race depend on rice for their daily sustenance. World's rice demand is projected to increase by 25% from 2001 to 2025 to keep pace with population growth (Maclean *et al*. 2002), and therefore, meeting ever increasing rice demand in a sustainable way with shrinking natural resources is a great challenge. Weeds are the greatest yield-limiting constraint to rice. The risk of yield loss from weeds in direct- seeded rice is greater than transplanted rice. Ramzan (2003) reported yield reduction up to 48, 53 and 74% in transplanted, direct-seeded flooded and direct-seeded aerobic rice, respectively. Aerobic rice is subject to much higher weed pressure with a broader weed spectrum than flood-irrigated rice (Balasubramanian and Hill 2002). Season-long weed competition in direct-seeded rice may cause yield reduction up to 80% Sunil *et al*. (2010).

The development and adoption of DSR may enable good crop growth but the lack of sustained flooding will greatly increase potential losses from weeds. These systems may integrate direct-seeding and herbicide use, yet, to be sustainable, effective weed management strategies are required. A multitude of prerequisites, including level land, effective weed control, efficient water management, and timely water supply in relation to crop water demand, need to be met to ensure a successful DSR crop. When weed control in rice is neglected, there is a decrease in yield because of weeds, even if other means of increasing production, including application of fertilizers are practiced. In the NW-IGP, DSR is an emerging production system. The transition from the puddle transplanted rice to DSR can therefore only be successful, if accompanied by effective integrated weed management practices.

A field experiment was conducted during *Kharif* 2013 at Borlaug, Crop Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. The soil was calcareous, medium to moderately coarse textured, with pH 7, high in organic carbon (0.81%) and medium in available nitrogen (215.61 kg/ha) and available phosphorus (21.62 kg/ha) and available potash (141.92 kg/ha). The experiment was laid out in factorial randomized block design with four replications. A set of twelve treatment combinations consisting of three planting geometries, *viz.* 20 cm at regular sowing, 20 x 10 cm and 25 x 25 cm and four weed control treatments consisted of weedy check, pre-emergence application of pendimethalin 1 kg/ha *fb* hand weeding at 30 days after sowing, post-emergence application of bispyribac–Na 25 g/ha *fb* hand weeding at 45 days after sowing and pre-emergence application of pendimethalin 1 kg/ha *fb* post-emergence application of bispyribac–Na 25 g/ha supplemented with one hand weeding at 45 DAS. Rice variety "*Pant dhan - 12*" was sown on 22 June, 2013 with 40, 26 and 8.5 kg/ha seed rate. A common dose of fertilizer at 150:60:40 kg N:P:K/ha was supplied through DAP, urea and muriate of potash. The 25% nitrogen and full dose of phosphorus and potash were applied as basal while remaining nitrogen was applied into two equal *i.e.* 50% nitrogen was given at active tillering and 25% at panicle initiation stage. Weeds were collected four times for count and dry weight through 0.25/$m^2$ quadrate.

***Corresponding author:** neeshu.joshi@gmail.com

## Weed flora

The major weed flora observed in the experimental field included *Echinochloa crusgalli* (15.8%), *Ecinochloa colona* (23.8%), *Leptochloa chinensis* (18.4%), *Ammania baccifera* (14.8%), *Caesulia axillaris* (10.3%), *Cyperus rotundus* (8.9%) and others (8.7%) in rice crop.

## Effect on weed density

Different planting geometries and weed control treatments significantly influenced the density of different species of weeds in rice crop while interaction was found non-significant in all. The planting geometry 20 cm at regular spacing had lesser weed density compared to 20 x 10 cm and 25 x 25 cm. The reason behind this could be mutual competition between weed species. Narrow row planting with increased crop density would have shifted the competitive balance in favour of the crop. All planting geometries had almost same population of broad-leaved weeds while *C. iria* among the sedges and *E. colona* among the grassy weeds were more effectively controlled (Table 1). Among the weed control treatments, pre-emergence application of pendimethalin 1 kg/ha followed by post-emergence application of bispyribac-Na 25 g/ha followed by one hand weeding at 45 days after sowing was at par-with pre-emergence application of pendimethalin 1 kg/ha *fb* hand weeding at 30 days after sowing and post-emergence application of bispyribac-Na 25g/ha *fb* hand weeding at 45 days after sowing in *E. colona* among grassy, *C. axillaris* and *Alternanthera sessilis* among broad leaf weeds and *C. iria* and *C. rotundus* among the sedges. Rao *et al.* (2007) reported that the grasses persist in all of principal crops and have greatest weed pressure and crop-weed competition in aerobic rice.

### Effect on weed dry weight

Dry weight was found significant except some species both among planting geometry and weed control practices while interaction was found non-significant. Continuous drilling at 20 cm recorded minimum dry weight of the weeds which is at par with 20 x 10 cm spacing. This might be due to lesser space in narrow spacing which reduces the weed dry weight. Among weed management practices, lowest weed density was observed in both pre- and post-

**Table 1. Effect of planting geometry and weed management practices on weed density at 60 DAS in dry direct-seeded rice**

| Treatment | Weed density | | | | | | | Total weed density (no./m$^2$) |
|---|---|---|---|---|---|---|---|---|
| | Grassy weeds | | Broad-leaved weeds | | | Sedges | | |
| | *E. colona* | *L. chinensis* | *A baccifera* | *C. axillaris* | *A. sessilis* | *C. iria* | *C rotundus* | |
| *Planting geometry* | | | | | | | | |
| Continous drilling at 20 cm | 3.1(13.5) | 3.7(17.5) | 3.5(12.3) | 1.3(1.25) | 1.7(2.6) | 1.5(2.0) | 4.0(22.7) | 6.1(47) |
| 20 x 10 cm | 2.1(7.7) | 3.0(9.1) | 4.8(22.6) | 1.6(1.8) | 1.3(1.1) | 1.5(2.5) | 5.7(36.5) | 6.7(56) |
| 25 x 25 cm | 2.6(8.9) | 2.3(6.6) | 3.5(14.2) | 1.8(2.7) | 1.7(2.6) | 2.0(6.0) | 5(35.7) | 7.0(62) |
| LSD (P=0.05) | 0.3 | 0.3 | 0.3 | 0.3 | NS | 0.13 | NS | 0.4 |
| *Weed management* | | | | | | | | |
| Pendimethalin *fb* hand weeding (30 DAS) | 1.5(1.58) | 2.3(4.6) | 3.2(11.3) | 1.5(1.7) | 1.2(1.0) | 1.0(0.0) | 5.0(28.3) | 5.7(31.7) |
| Bispyribac *fb* hand weeding (45 DAS) | 2.1(4.6) | 2.1(4.3) | 3.3(13.5) | 1.0(0.0) | 1.1(0.3) | 1.0(0.0) | 3.0(13.0) | 4.8(22.6) |
| Pendimethalin *fb* bispyribac *fb* hand weeding (45 DAS) | 1.1(0.3) | 1.8(2.7) | 4.4(18.3) | 1.4(1.3) | 1.3(1.0) | 1.0(0.0) | 4.6(27.7) | 3.7(12.9) |
| Weedy check | 5.9(33.6) | 5.6(32.7) | 4.8(22.5) | 2.4(4.8) | 2.6(6.0) | 3.7(14) | 7(57.7) | 12.3(153.1) |
| LSD (P=0.05) | 0.34 | 0.33 | 0.38 | 0.34 | 0.4 | 0.16 | 1.9 | 0.5 |

Original values are given in parentheses

**Table 2. Effect of planting geometry and weed management practices on weed dry weight (g/m$^2$) at 60 DAS in direct dry seeded rice**

| Treatment | Weed dry weight | | | | | | | Total weed dry weight (g/m$^2$) |
|---|---|---|---|---|---|---|---|---|
| | Grassy weeds | | Broad-leaved weeds | | | Sedges | | |
| | *E. colona* | *L. chinensis* | *A baccifera* | *C. axillaris* | *A. sessilis* | *C. iria* | *C rotundus* | |
| *Planting geometry* | | | | | | | | |
| Continous drilling at 20 cm | 3.5(19.8) | 3.9(19.8) | 2.3(4.8) | 1.1(.26) | 1.9(4.1) | 1.5(2.1) | 1.7(2.6) | 7.4(71.8) |
| 20 x 10 cm | 2.4(10.7) | 3.2(10.7) | 3.6(12.6) | 1.3(0.73) | 1.4(1.6) | 1.5(2.1) | 2.2(4.4) | 8.0(80.7) |
| 25 x 25 cm | 2.9(12.5) | 2.7(10.1) | 2.9(9.2) | 1.9(7.1) | 1.8(3.4) | 1.9(5.0) | 2.5(9.8) | 7.9(77.8) |
| LSD (P=0.05) | NS | 0.3 | 0.27 | NS | NS | 0.7 | NS | 0.4 |
| *Weed management* | | | | | | | | |
| Pendimethalin *fb* hand weeding (30 DAS) | 1.5(1.8) | 2.5(5.2) | 2.4(6.0) | 1.3(0.8) | 1.3(1.4) | 1.0(0.0) | 2.8(12.0) | 6.4(40.9) |
| Bispyribac *fb* hand weeding (45 DAS) | 2.3(6.7) | 2.3(4.8) | 2.8(9.4) | 1.0(0.0) | 1.1(0.49) | 1.0(0.0) | 1.3(1.0) | 5.5(29.9) |
| Pendimethalin *fb* bispyribac *fb* hand weeding (45 DAS) | 1.1(0.4) | 1.9(2.9) | 3.2(9.8) | 1.8(8.5) | 1.3(1.5) | 1.0(0.0) | 2(3.4) | 4.5(19.6) |
| Weedy check | 6.8(48.3) | 6.4(41.2) | 3.2(10.3) | 1.6(1.5) | 3(8.8) | 3.6(12.4) | 2.4(5.8) | 14.7(216.8) |
| LSD (P=0.05) | 1.0 | 0.33 | 0.3 | NS | 0.5 | 0.8 | NS | 0.5 |

Original values are given in parentheses

**Table 3. Effect of planting geometry and weed control practices on yield and harvest index**

| Treatment | Grain yield (t/ha) | Straw yield (t/ha) | Biological yield (t/ha) | Harvest index (%) |
|---|---|---|---|---|
| *Planting geometry* | | | | |
| Continous drilling at 20 cm | 3.47 | 6.77 | 10.4 | 32.7 |
| 20 x 10 cm | 3.41 | 6.37 | 10.2 | 32.9 |
| 25 x 25 cm | 2.89 | 4.59 | 7.87 | 34.6 |
| LSD (P=0.05) | 0.40 | 1.05 | 1.25 | NS |
| *Weed management* | | | | |
| Pendimethalin *fb* hand weeding (30 DAS) | 3.72 | 6.51 | 10.5 | 33.2 |
| Bispyribac *fb* hand weeding (45 DAS) | 3.66 | 6.53 | 10.7 | 34.9 |
| Pendimethalin *fb* bispyribac *fb* hand weeding (45 DAS) | 4.79 | 7.97 | 13.7 | 36.7 |
| Weedy check | 0.8.5 | 2.63 | 2.9 | 28.8 |
| LSD (P=0.05) | 0.46 | 1.21 | 1.45 | 3.7 |

Original values are given in parentheses

emergence herbicide application along with one hand weeding at 45 days after sowing (Table 2). Rao *et al.* (2007) reported that the grasses persist in all of principal crops and have gratest weed pressure and crop-weed competition in aerobic rice.

### Effect on yield

The grain yield of rice was influenced significantly due to different planting geometry and weed management practices. The planting geometry continuous drilling at 20 cm spacing produced the highest grain yield which was at par with 20 x 10 cm plant spacing and significantly superior than the wider (25 x 25 cm) spacing. The reason may be closer spacing which resulted in mutual competition between the weeds and rice plants which cause lower weed population under 20 x 10 cm spacing (Table 3).

While among the herbicidal treatments, pre-emergence application of pendimethalin (1 kg/ha) *fb* post-emergence application of bispyribac –Na (25 g/ha) supplemented with one hand weeding 45 days after sowing recorded the highest grain yield which was significantly superior than both pre and post emergence herbicide application along with one hand weeding (Table 3). The integrated approaches of the chemicals along with hand weeding resulted in higher grain yield and this might be attributed due to effective weed control due to both pre- and post-herbicide which control both early and later weeds in the treatment which resulted in optimum tiller density, more panicle bearing tillers ($m^2$), more number of grains per panicle and more 1000- grain weight as reported by several workers (Hasanuzzaman *et al.* 2008). The higher grain yield in planting geometry continuous drilling at 20 cm and sequential application of pre- and post-emergence herbicide application along with hand weeding might be attributed to long term effective control of weeds by both herbicides during the growing period of crop.


## SUMMARY

A field experiment was conducted during *Kharif* 2013 at Pantnagar, Uttrakhand, to find out the effect of planting geometry in direct-seeded rice by different weed management practices. The experiment comprised of twelve treatments with four replications in factorial randomized block design of which main factor was three different planting geometry and sub-plots have four factors with three different weed control treatments with one weedy check. The treatment pre-emergence application of pendimethalin 1 kg/ha *fb* post-emergence application of bispyribac–Na 25 g/ha supplemented with one hand weeding along with planting geometry 20 cm at regular spacing increased the grain yield, weed control efficiency and net returns over all the other treatments of rice .


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