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# Influences of Spacing and Weed Management Practices on Growth Parameters and Weed Dynamics of Wet Direct Seeded Rice

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**A B S T R A C T**

At spacing 20×10 cm bidirectional mechanical weeding thrice ($T_4$) recorded the highest plant height. No of tillers, dry matter productions, grain yield and the lowest weed density and dry matter accumulation of weeds at all the stages of crop growth. At spacing 20×20 cm bidirectional mechanical weeding thrice ($T_{10}$) observed the highest plant height, No of tillers, dry matter productions, grain yield and the lowest weed density and dry matter accumulation. Among the spacing 20×10 cm and 20×20 cm at spacing 20×20 cm bidirectional mechanical weeding thrice ($T_{10}$) recorded the plant height, No of tillers, dry matter productions, grain yield and the lowest weed density and dry matter accumulation of weed which was at par with bidirectional mechanical weeding thrice ($T_9$) most of the growth stages of rice.

## Introduction

Rice (*Oryza sativa* L.) is one of the world's most important stable food crops. Currently, more than one third of the human population relies on rice for their daily sustenance (Chauhan and Johnson, 2011). Rice is the vital food for more than two billion people in Asia and four hundred million people in Africa and Latin America (IRRI, 2006). It is primary source of income and employment for more than 100 million households in Asia and Africa (FAO, 2004) World demand projected to increase by 25% from 2001 to 2025 to keep pace with population growth (Maclean *et al.*, 2002). In world, rice has occupied an area of 156.1 m ha, with a production of 680 m t. In India, total area under rice was 45.5 m ha, with production of 106.65 m t and average productivity of 2419 kg $ha^{-1}$during 2013-14 (Anonymous, 2014). Chhattisgarh state is popularly known as "Rice Bowl of India" because of maximum area covered under rice during *kharif* and contributes major share in national rice production. Rice was cultivated over an area of 3.7 m ha with the production of 7.44 m t and productivity of 2020 kg $ha^{-1}$ during 2013-

14 (Anonymous, 2015). Weed is as old as agriculture and from the very beginning farmers realized the interferences of weed with crop productivity (Ghersa *et al.*, 2000). The risk of yield loss from weeds in direct-seeded rice is greater than transplanted rice (Rao *et al.*, 2007), damage to the rice seedling and mistake removal of rice seedlings (Moody and cordova, 1985). The labour requirement for transplanting is very high and also for a short period of the time. Further, the availability of labour is decreasing day by day due to various reasons. Therefore, an alternate technology to substitute transplanting method is needed to gear up rice production in irrigated ecology. One of the alternate technology may be wet direct seeded method. Therefore, the study was conducted to evaluate effect of wet direct seeded rice on growth parameters, no of tillers and dry matter production of rice and weed density and dry matter accumulation of weeds.

## Materials and Methods

The present investigation was conducted during *kharif* season of 2014-15 at the Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The soil of experimental field was *vertisol* in texture, low in nitrogen (223.30 kg ha$^{-1}$), medium in phosphorus (17.40 kg ha$^{-1}$) and medium in potassium (272.80 kg ha$^{-1}$) contents with neutral soil pH and 0.51 per cent organic carbon.

The experiment was laid out in randomized block design comprises of eleven treatments with three replications. The treatments comprised spacing and weed management practices *viz*, $T_1$ – Direct Seeded 20×10 cm + hand weeding twice at 20 and 40 DAS, $T_2$ - Direct Seeded 20×10 cm + herbicidal weed management (Pre. eme. Pyrazosulfuron f.b. Bispyribac-Na), $T_3$ - Direct Seeded 20×10 cm + mechanical weeding unidirectional twice at 20 and 40 DAS, $T_4$ - Direct Seeded 20×10 cm + mechanical weeding unidirectional thrice at 20, 30 and 40 DAS, $T_5$ - Direct Seeded 20×20 cm + hand weeding twice at 20 and 40 DAS, $T_6$ - Direct Seeded 20×20 cm + herbicidal weed management (Pre. eme. Pyrazosulfuron followed by Bispyribac-Na), $T_7$ - Direct Seeded 20×20 cm + mechanical weeding unidirectional twice at 20 and 40 DAS, $T_8$ - Direct Seeded 20×20 cm + mechanical weeding unidirectional thrice at 20, 30 and 40 DAS, $T_9$ - Direct Seeded 20×20 cm + mechanical weeding bidirectional twice at 20 and 40 DAS, $T_{10}$ - Direct Seeded 20X20 cm + mechanical weeding bidirectional thrice at 20, 30 and 40 DAS, $T_{11}$ – Transplanting 20X10 cm + herbicidal weed management (Pre. eme. Pyrazosulfuron followed by Bispyribac-Na). The test variety was maheshwari. Sowing of sprouted seeds was done in puddle soil. Sowing was done on June 29, 2014 and harvesting was done on November 10, 2014. Recommended dose of nutrients (100 kg N: 60 kg $P_2O_5$: 40 kg $K_2O$ ha$^{-1}$) was applied through urea, single super phosphate and murate of potash, respectively.

The whole quantity of P and K was applied as basal dressing, while nitrogen was applied in three equal splits at basal, active tillering and panicle initiation stages. 3±2 cm level of water was managed after established of crop till growth stage. Among the treatments when herbicidal weed management was adopted, applied of pre emergence of pyrazosulfuron at 3 days after sowing followed by bispyribac-Na at 25 days after sowing was done. All the growth characters *viz*. plant height, number of tillers m$^{-2}$, dry matter production, dry matter accumulation of weed, weed density, nutrient uptake by weeds and grain yield of wet direct seeded rice were recorded. The total weed density and total dry matter accumulation weeds were also recorded and subjected to square root $\sqrt{x+0.5}$ transformation and statistically analyzed.

## Results and Discussion

### Effect on Plant height

The result reveals that the plant height of rice was significantly influenced by spacing and weed management practices are presented in table 1. At spacing 20×10 cm, mechanical weeding thrice ($T_4$) observed the highest plant height (125.00 cm) which was at par with mechanical weeding twice, hand weeding twice and transplanting with herbicidal weed management. At spacing 20×20 cm, bidirectional mechanical weeding thrice ($T_{10}$) recorded the highest plant height (128.73 cm). The lowest plant height (123.17 cm) was observed under herbicidal weed management ($T_6$). Among the spacing 20×10 cm and 20×20 cm, the effect of weed management practices on plant height was at par with the respective level of weed management.

The possible reason of the maximum plant height in these treatments might be due to favourable and weed free environment during crop growth period which provided better opportunity for overall growth and development of rice plants lead to increased plant height.

Maximum plant height noted under bidirectional mechanical weeding thrice ($T_{10}$) may be due to incorporation of weeds in soil which improve the soil aeration and enhance the additional nutrient uptake by crop. Similar result was also reported by (Rajendran *et al.*, 2007).

### Effect on number of tillers $m^{-2}$

At spacing 20×10 cm, mechanical weeding thrice ($T_4$) recorded the highest number of tillers (341.33 $m^{-2}$) which was at par with ($T_3$), ($T_{11}$) and ($T_1$). The lowest number of tillers (327 $m^{-2}$) was noted under herbicidal weed management ($T_2$). At spacing 20×20 cm, bidirectional mechanical weeding thrice ($T_{10}$) observed the highest number of tillers (366 $m^{-2}$) which was at par with bidirectional mechanical weeding twice ($T_9$). The lowest number of tillers (331 $m^{-2}$) was found under herbicidal weed management ($T_6$). Among the spacing 20×10 cm and 20×20 cm, number of tillers was at par with the respective level of weed management.

The result exhibited that maximum number of tillers per unit area was recorded with mechanical weeding twice or thrice which may be due to aeration of field due to mechanical operation. Similarly with respect to spacing, maximum number of total tillers was recorded in wider spacing (20x20 cm) compared to closer spacing (20x10 cm) which may be due to more space to crop to show their potential due to the lower weed competition in term of dry matter of weeds, which allow crop to absorb required amount of nutrient, water and sunlight for their growth and tillering behavior. Similar results were reported by different workers (Shad 1986, Thiyagarajan *et al.,* 2002)

### Effect on dry matter production of rice

At spacing 20X10 cm, mechanical weeding thrice ($T_4$) noted the highest dry matter accumulation (950.27 g $m^{-2}$) which was at par with transplanting with herbicidal weed management ($T_{11}$), mechanical weeding twice ($T_3$) and hand weeding twice ($T_1$). At spacing 20×20 cm, bidirectional mechanical weeding thrice ($T_{10}$) found the highest dry matter accumulation (1036.63 g $m^{-2}$) which was at par with bidirectional mechanical weeding twice ($T_9$). Among the spacing 20×10 cm and 20×20 cm, the effect of weed management practices on dry matter accumulation was at par with the respective level of weed management.

**Table.1** Influences of Spacing and weed management practices on growth parameter of wet direct seeded rice

| Treatments | | Growth parameters of Rice | | | Grain yield q $ha^{-1}$ |
|---|---|---|---|---|---|
| | | Plant height (cm) at harvest | Number of tillers $m^{-2}$ at harvest | DMP (g $m^{-2}$) at harvest | |
| $T_1$ | DS 20X10 HW at 20 & 40 DAS | 124.37 | 336.67 | 907.27 | 43.12 |
| $T_2$ | DS 20X10 HWM | 122.63 | 327.00 | 888.83 | 41.32 |
| $T_3$ | DS 20X10 MWM at 20 & 40 DAS | 124.90 | 340.00 | 915.47 | 43.18 |
| $T_4$ | DS 20X10 MWM at 20, 30 & 40 DAS | 125.00 | 341.33 | 950.27 | 44.25 |
| $T_5$ | DS 20X20 HW at 20 & 40 DAS | 124.47 | 340.67 | 924.00 | 43.40 |
| $T_6$ | DS 20X20 HWM | 123.17 | 331.00 | 902.23 | 42.64 |
| $T_7$ | DS 20X20 MWM at 20 & 40 DAS uni. | 125.27 | 345.00 | 934.47 | 43.58 |
| $T_8$ | DS 20X20 MWM at 20, 30 & 40 DAS uni. | 126.07 | 349.33 | 961.30 | 44.86 |
| $T_9$ | DS 20X20 MWM at 20 & 40 DAS bi. | 126.57 | 359.67 | 1014.57 | 48.02 |
| $T_{10}$ | DS 20X20 MWM at 20, 30 & 40 DAS bi. | 127.27 | 366.00 | 1036.63 | 49.12 |
| $T_{11}$ | TP 20X10 HWM | 124.10 | 338.67 | 926.23 | 43.43 |
| **SEm ±** | | **0.91** | **4.92** | **14.65** | **0.78** |
| **CD (P=0.05)** | | **2.70** | **14.51** | **43.21** | **2.31** |

Figures in the parentheses are original value, data were transformed through √ x+0.5 which are given in bold.
DS=Direct seeded: HW= Hand weeding: MWM= Mechanical weed management: HWM= Herbicidal weed management: DAS= Days after sowing: TP= Transplanting: uni= Unidirectional: bi= Bidirectional, DMP= Dry matter production.
*Significant at 5% level of significance

**Table.2** Effect of Spacing and weed management practices on Weed density (No. $m^{-2}$) and Dry matter accumulation of weed (g $m^{-2}$) of wet direct seeded rice

| Treatments | | Weed density (No. $m^{-2}$) | | | | Dry matter accumulation of weed (g $m^{-2}$) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 30 DAS | 60 DAS | 90 DAS | at harvest | 30 DAS | 60 DAS | 90 DAS | at harvest |
| $T_1$ | DS 20X10 cm HW at 20 & 40 DAS | **2.90** (8.0) | **2.67** (6.7) | **2.79** (7.3) | **2.53** (6.0) | **0.88** (0.27) | **2.13** (4.06) | **3.19** (9.73) | **2.34** (4.97) |
| $T_2$ | DS 20X10 cm HWM | **2.41** (5.3) | **2.79** ( 7.3) | **3.02** (8.7) | **2.53** (6.0) | **0.81** (0.16) | **2.65** (6.55) | **3.39** **(**10.99) | **2.51** (5.81) |
| $T_3$ | DS 20X10 cm MWM at 20 & 40 DAS | **3.32** (10.7) | **3.23** (10.0) | **3.23** (10.0) | **3.02** (8.7) | **1.83** (2.88) | **2.97** (8.33) | **3.67** (13.00) | **2.73** (6.99) |
| $T_4$ | DS 20X10 cm MWM at 20, 30 & 40 DAS | **3.23** (10.0) | **3.12** (9.3) | **3.02** (8.7) | **2.90** (8.0) | **1.78** (2.68) | **2.75** (7.07) | **3.44** (11.35) | **2.52** (5.85) |
| $T_5$ | DS 20X20 cm HW at 20 & 40 DAS | **2.90** (8.0) | **2.67** (6.7) | **2.53** (6.0) | **2.26** (4.7) | **1.01** (0.55) | **2.01** (3.57) | **3.28** (10.33) | **2.34** (5.02) |
| $T_6$ | DS 20X20 cm HWM | **2.53** (6.0) | **2.79** (7.3) | **2.79** (7.3) | **2.41** (5.3) | **0.84** (0.21) | **2.68** (6.68) | **3.29** (10.31) | **2.49** (5.73) |
| $T_7$ | DS 20X20 cm MWM at 20 & 40 DAS uni. | **3.23** (10.0) | **3.11** (9.3) | **3.11** (9.3) | **2.79** (7.3) | **1.79** (2.71) | **2.89** (7.85) | **3.37** (10.83) | **2.69** (6.72) |
| $T_8$ | DS 20X20 cm MWM at 20, 30 & 40 DAS uni. | **3.12** (9.3) | **3.02** (8.7) | **2.90** (8.0) | **2.53** (6.0) | **1.74** (2.55) | **2.63** (6.43) | **3.28** (10.25) | **2.51** **(**5.81) |
| $T_9$ | DS 20X20 cm MWM at 20 & 40 DAS bi. | **2.53** (6.0) | **2.08** (4.0) | **2.41** (5.3) | **2.08** (4.0) | **1.42** (1.51) | **2.21** (4.40) | **2.70** (6.81) | **2.10** (3.91) |
| $T_{10}$ | DS 20X20 cm MWM at 20, 30 & 40 DAS bi. | **2.41** (5.3) | **1.94** (3.3) | **2.26** (4.7) | **1.94** (3.3) | **1.44** (1.58) | **1.98** (3.49) | **2.50** (5.75) | **2.09** **(**3.81) |
| $T_{11}$ | TP 20X10 cm HWM | **0.71** (0.0) | **2.79** (7.3) | **2.90** (8.0) | **2.53** (6.0) | **0.71** (0.00) | **2.66** (6.57) | **3.38** (11.01) | **2.64** (6.51) |
| **SEm ±** | | **0.07** | **0.19** | **0.18** | **0.19** | **0.07** | **0.08** | **0.13** | **0.08** |
| **CD (P=0.05)** | | **0.20** | **0.55** | **0.55** | **0.55** | **0.20** | **0.25** | **0.39** | **0.24** |

Figures in the parentheses are original value, data were transformed through $\sqrt{x+0.5}$ which are given in bold

DS=Direct seeded: HW= Hand weeding: MWM= Mechanical weed management: HWM= Herbicidal weed management: DAS= Days after sowing: TP= Transplanting: uni= Unidirectional: bi= Bidirectional

*Significant at 5% level of significance

In general, all the treatments where herbicides, cultural and mechanical methods applied to control weeds and accumulated of dry matter of rice was the effect of weed management on weeds so rice plant received more space, moisture, light and nutrient for their proper growth the higher dry matter accumulation of rice. The possible reason of higher accumulation and this favoured the higher dry matter accumulation of rice per unit area.

## Effect on weed dynamics

The result reveals that the weed density (no. $m^{-2}$) was significantly influenced by spacing and weed management practices are presented in table 2. At 20 DAS, only *Echinochloa colona* was the observed weed flora which population decreased with advancement of crop period. *Cyperus iria* was appeared at 40 DAS and its population was increased with the advancement of crop period. Broad leaved weeds were not found in experiment field throughout the crop period.

At spacing 20X10 cm, hand weeding twice ($T_1$) recorded the lowest weed density $m^{-2}$ which was at par with herbicidal weed management and transplanting with herbicidal weed management at 30, 60, 90 DAS and at harvest. At spacing 20X20 cm, bidirectional mechanical weeding thrice ($T_{10}$) found the lowest weed density $m^{-2}$ which was at par with bidirectional mechanical weeding twice and herbicidal weed management at 30, 60, 90 DAS and at harvest. Among the spacing 20X10 cm and 20X20 cm, the weed density $m^{-2}$ was at par with respective level of weed management at 30, 60, 90 DAS and at harvest.

## Effect on dry matter accumulation of weeds

The dry matter production of weeds decreased due to use of different weed management practices are presented in table 2. At spacing 20X10 cm, the lowest dry matter production of weeds was registered under hand weeding twice ($T_1$) which was at par with herbicidal weed management and transplanting with herbicidal weed management at 30, 60, 90 DAS and at harvest. At spacing 20X20 cm, bidirectional mechanical weeding thrice ($T_{10}$) found the minimum dry matter production of weeds which was at par with bidirectional mechanical weeding thrice at 30, 60, 90 DAS and at harvest. Among 20X10 cm and 20X20 cm, the dry matter production of weeds $m^{-2}$ was at par with respective level of weed management. Dry matters of weeds were incorporated in the field by mechanical weeding which enhances the organic matter and properties of the soil.

## Effect on yield

The result reveals that the grain yield of rice was significantly influenced by spacing and weed management practices are presented in table 1. At spacing 20×10 cm, mechanical weeding thrice ($T_4$) produced the highest grain yield (44.25 q $ha^{-1}$) which was at par with mechanical weeding twice ($T_3$), hand weeding twice ($T_1$) and transplanting with herbicidal weed management ($T_{11}$). At spacing 20×20 cm, bidirectional mechanical weeding thrice ($T_{10}$) produced significantly the highest grain yield (49.12 q $ha^{-1}$) which was at par with bidirectional mechanical weeding twice ($T_9$). Among the spacing 20×10 cm and 20×20 cm, the effect of weed management practices on grain yield was at par with the respective level of weed management.

Grain production, which is the final product of growth and development, is controlled by the growth and yield attributing characters such as effective tillers, dry matter accumulation, test weight, etc. Growth and all yield attributing characters were more in bidirectional mechanical weeding thrice ($T_{10}$)

because of lesser weed competition and better aeration which enhances better uptake of nutrients through enhanced root growth. The beneficial effect of mechanical weeding in rice production by System of rice intensification is attributed by different workers (Vijayakumar *et al.,* 2004 and Rajendran *et al.,* 2007).

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