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Growth parameters and yield attributing characters of PR-118 (V_1) and PR-116 (V_2) varieties of rice (*Oryza sativa* L.) as influenced by different planting methods

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Abstract: Field experiments were conducted at Punjab Agricultural University, Ludhiana (Punjab) to study the effect of different agronomic aspects of bed planting on growth and yield of rice during *Kharif* seasons of 2012 and 2013. The 30 days old seedlings of both rice varieties PR-118 (V_1) and PR-116 (V_2) were transplanted on 15th June (D_1), 30th June (D_2) and 15th July (D_3). The two rice varieties were transplanted under bed planting (M_1) and conventional planting (M_2) methods respectively. The results showed that growth parameters like number of tillers per plant, dry weight per plant leaf area index (LAI) and plant height were significantly higher in bed planting than conventional method. In bed planting method, grain yield of rice (48.82q/h) was found to be more than the conventional method (35.74 q/h) during 2012.Varieties PR-118 yielded 47.61q/h more than PR-116 (39.97 q/h) in bed planting. Yield contributing characters like number of effective tillers, number of grains per plant and 1000-grain weight of rice were more in bed planting than conventional method. Harvest index and biological yield was also found to be more in bed planting method than conventional planting. Rice transplanted on 15th June yielded (50.15q/h) more than 30th June (41.45q/h) and 15th July (35.27q/h). Similar results were found in *kharif* 2013. Interaction between dates of transplanting and varieties and between varieties and planting methods were found significant.

Keywords*:* Planting methods, Rice, Transplant, Varieties, Yield, Yield attributed characters

INTRODUCTION

Rice (*Oryza sativa* L.) is grown in all continents of the world due to its wide adaptability to diverse agroclimatic conditions. Rice is the main food crop of India, contributing around 45 per cent of the total production and hence hold the key to sustain food sufficiency in the country (Rai and Kushwaha, 2005). It is the major *kharif* crop and ranks second after wheat in terms of area, production and productivity in Punjab. In Punjab, rice currently occupies an area of 28.18 lakh hectare with production of 105.42 lakh tons with an average yield of 37.41 q ha^{-1} (Anonymous, 2013). Agriculture is the primary source of livelihood for about 58 percent of India s population. This yield of rice is much lower than world average which is due to lack of potential varieties and management practices. The reasons for low yield of rice are manifold some are varietals, others are technological and rest are climatic. Undoubtedly, with the introduction of high yielding varieties the yield of rice has been increased, but the trend of increase is not linear. The yield can be increased by using improved cultural practices like bed planting, high yielding varieties, adopting plant protection measures, judicious application of fertilizers, etc. Bed planting is important for sucessful rice production because it influences tiller formation, solar radiation interception, total sunshine reception, nutrient uptake, rate of photosynthesis and other physiological phenomena and ultimately affects the growth and development of rice plant. In densely populated rice field, the inter specific competition between the plants is high which sometimes results in gradual shading and lodging and thus favours production of straw instead of grain (Faruk *et al.*, 2009).

Temperature and light together plays a key role in rice production since light intensity requirement of rice is higher and temperature dependent. Tillering is a varietal character to some extent but emergence and development of rice are primarily influenced by the meteorological factors such as temperature, sunshine hours and rainfall. Tiller number per unit area is an important attribute of rice yields, which was reported to decide the physical capacity of the yield and contribute to 60 per cent of grain yield variations in rice crop. Further expansion of area under rice crop is very unlikely due to tremendous increase in population and urbanization (Sharma *et al.*, 2011). Therefore, the increasing demand of food has to come from increase in productivity per unit area. For achieving this one of the prime requirement and non monetary input is transplanting cultivars at appropriate dimensions of time under bed planting method. The present experiment was, therefore, planned to achieve the target set for sustainable rice production under Punjab conditions.

MATERIALS AND METHODS

A field experiment was conducted for two years during *kharif* season of 2012 and 2013 at Punjab Agricultural University Research Farm, Ludhiana. It is situated at 30^{o}54'N latitude and 75^{o}48'E longitude and is 247 m above mean sea level. The area experiences an average annual rainfall of 705 mm of which about 80 per cent is received during June to September. Two varieties of paddy, PR-118 (V_1) and PR-116 (V_2) were transplanted under bed planting method (M_1) and conventional method (M_2) on three different dates viz. 15th June (D_1), 30th June (D_2) and 15th July (D_3) in both the crop seasons. Seedlings were transplanted at a spacing of 20 cm x 15 cm in conventional method and 30 cm x 10 cm in bed planting method. The experiment was laid out in the factorial split plot design. Each treatment was replicated four times. Fertilizers (Nitrogen N and Phosphorus P) were applied as per the recommendations by Punjab Agricultural University, Ludhiana. Two sprays of Butachlor at 3 litre/ha and Metsulfuron at 75g/ha were used to control the grassy and broad leaf weeds. One spray of Monocrotophos at 1.4l litre/ha was given to control the rice stem borer and leaf folder. Green leaf area (cm^2) was recorded at 15 days interval with the help of calibrated Plant Canopy Analyzer (LICOR -make). The leaf area index was measured by placing the sensor once above the canopy followed by placing it at four different points below the crop canopy diagonally across the rows.

Ten plants were tagged in each plot and their numbers of tillers were counted periodically. For dry weight samples were sun dried and then dried in an oven at 60±5°C. Yield and yield attributes were calculated based on the data of final harvest of the crop. The variability in the parameters of yield and associated components was tested by the standard statistical procedures, software's and modules.

RESULTS AND DISCUSSION

Tiller count: Tiller count per plant which is one of the main yield components was taken into account and was observed in all treatments. The number of tillers per plant of rice during both the seasons registered significant variation under different treatments respectively. Among the different dates of transplanting, rice transplanted on15th June had higher number of tillers per plant ranging from 12.5-17.6 followed by 30th June (9.1-12.5) and 15th July (8.9-11.2) during 2012 crop season (Table1.). This may be due to availability of favourable soil and air temperature during growing cycle of the crop. Similarly these findings were supported by Sharma *et al.* (2011) and Barun (2008) that the numbers of tillers per plant of rice varieties (PR-116 and PAU-201) were more on 15th June transplanted crop. Narasimharao *et al.* (1999) reported that the number of tillers increased with the increase in temperature. The variability in the microclimatic conditions of a crop alters the number of tillers per plant which is linked with number of panicles per unit area and variability in the yield. The tiller numbers differed significantly with varieties possibly due to their genetical traits. The number of tillers per plant was higher in PR-118 ranged from 10.8-16.0 as compared to PR-116 (9.5- 12.5). Dhaliwal *et al.* (2007) also reported that number of tillers were maximum in PR-118 rice variety. The data presented in Table 1. revealed that the number of tillers per plant had been significantly influenced by planting methods. Bed planting resulted in higher number of tillers per plant ranged from 11.5-15.8 as compared to conventional method (8.9-11.2) during 2012 crop season. This may be due to the more radiation interception, favourable soil temperature, and more water use efficiency of bed transplanted rice as compared to conventional transplanted rice. The number of tillers was increased as the vegetative growth of crop increased, but at later stages the number of tillers decreased due to improper utilization of radiation interception. Likewise in 2013 crop season, PR-118 rice variety which was transplanted on 15th June under bed planting method had higher number of tillers as compared to rice variety transplanted on 30th June and 15th July. The number of tillers per plant was higher in 2012 than 2013 crop growing season due to climatic variability. Mahajan *et al.* (2009) revealed that 15th June transplanted rice crop experienced mean temperatures between 31˚C and 33˚C during tillering stage for more number of days. This lead to more production of tillers m^{-2} as compared to 25th June and 5th July transplanted crops. At early stage of growth the interaction effect was not significant. However, 90 DAT and onwards the interaction effect on the number of tillers per plant was significant during both the crop seasons.

Leaf area index (LAI): Leaf area is one of the most important factors that influence interception of radiation, transpiration and ultimately photosynthesis. Leaf area development and maintenance are considered to be a key factor for maximum dry matter production. Change in the environmental production factors during the active period of the growth is believed to be one of the main causes for the variation in the yield. The higher productivity of a crop depends on the persistence of high LAI over a greater part of its vegetative phase. The rate of crop photosynthesis depends on the LAI. After germination LAI increases and reaches the peak levels after that it declines due to increased senescence (Ahmed, 2006). The periodic data on leaf area of rice crop was measured at the interval of 15 days, starting from 45 days after transplanting (DAT) when the sufficient amount of leaf area in the crop was observed. These observations of the leaf area were continued till maturity.

There was a continuous increase in LAI upto 90 DAT

Table 1. Number tillers per plant of rice varieties (PR-118 and PR-116) as influenced by different planting methods during *kharif* 2012 and 2013.

2012					
Days after transplanting					
Treatments	**45**	**60**	**75**	**90**	**At harvest**
15th June (D_1)	18.1	16.1	15.1	17.6	12.5
30th June (D_2)	11.0	10.9	11.3	12.5	9.1
15th July (D_3)	10.6	11.2	10.4	9.5	8.9
CD (P=0.05)	NS	NS	NS	1.11	0.77
PR-118 (V_1)	14.0	14.4	14.5	16.0	10.8
PR-116 (V_2)	12.5	11.1	10.0	10.5	9.5
CD (P=0.05)	NS	NS	NS	0.90	0.63
Bed planting (M_1)	15.6	15.8	14.7	15.3	11.5
Conventional planting (M_2)	10.9	9.7	9.8	11.2	8.9
CD (P=0.05)	NS	NS	NS	1.55	0.77
Interactions DV	NS	NS	NS	1.57	1.09
MV	NS	NS	NS	2.20	1.09
2013					
15th June (D_1)	13.2	12.3	12.5	16.5	11.2
30th June (D_2)	12.5	11.7	10.3	12.2	10.4
15th July (D_3)	11.2	9.2	10.5	9.4	9.9
CD (P=0.05)	NS	NS	NS	2.24	0.61
PR-118 (V_1)	11.9	11.6	11.2	14.5	10.8
PR-116 (V_2)	12.8	10.6	11.1	10.7	10
CD (P=0.05)	NS	NS	NS	1.83	0.50
Bed planting (M_1)	12.9	12.4	12.3	14.5	11.6
Conventional planting (M_2)	11.7	9.8	10.0	10.8	9.4
CD (P=0.05)	NS	NS	NS	1.61	0.81
Interactions DV	NS	NS	NS	3.17	1.46
MV	NS	NS	NS	2.28	0.98

*NS = Non Significant

of the crop thereafter it decreased. Date of transplanting significantly affected the leaf area index (LAI) of rice crop. Among three dates of transplanting, crop transplanted on 15th July recorded the highest LAI ranged from 2.00-4.32 followed by 30th July (1.34-3.79) and 15th June (0.65-3.22) crop it may be due to better crop growth in early transplanting crop during 2012 crop season. (Table.2). Mohammad *et al* (2008) also reported that 15th June transplanted rice crop has maximum leaf area index (LAI). Different types of varieties (PR-118 and PR-116) significantly influenced the leaf area index (LAI) and it was observed that the maximum LAI was obtained in the variety PR- 118 ranged from 1.43-4.27 as compared to variety PR-116 (1.22-3.28) during 2012 crop season. This might be due to the production of comparatively lower tillers of the variety PR-116 than the variety PR-118 which consequently decreased the number of leaves plant^{-1} and leaf area index. Takeda *et al*. (1983) observed that high-yielding rice varieties (IR-8) had higher LAI. Planting methods of rice also influenced the leaf area index (LAI) significantly. The highest leaf area index was observed in bed planting ranging from 1.44-4.69 as compared to conventional method (1.22-2.86) due to higher number of leaves m^{-2} during 2012 crop season. Trend of LAI was same during *kharif* 2013. Meanwhile it was indicated that higher leaf area index (LAI) on 15th June transplanted PR-118 rice variety has contributed towards higher rice yield during 2012 and 2013 crop seasons. The higher LAI during 2012 could be attributed to biological variability between the years (Table2.) that resulted in a different leaf shape (length, width) and possibly number of

Table2. Leaf area index (LAI) of rice varieties (PR-118 and PR-116) as influenced by different planting methods during *kharif* 2012 and 2013.

Treatments	2012			2013		
	Days after transplanting					
	45	75	90	45	75	90
15th June (D_1)	2.00	4.19	4.32	1.04	2.74	2.76
30th June (D_2)	1.34	3.27	3.79	0.86	2.11	2.12
15th July (D_3)	0.65	2.50	3.22	0.40	1.73	1.79
CD (P=0.05)	0.27	1.32	0.83	0.31	0.29	0.28
PR-118 (V_1)	1.43	3.65	4.27	0.86	2.38	2.40
PR-116 (V_2)	1.22	3.13	3.28	0.67	2.01	2.05
CD (P=0.05)	NS	NS	0.68	NS	0.23	0.22
Bed planting (M_1)	1.44	3.76	4.69	1.08	2.51	2.86
Conventional planting (M_2)	1.22	3.01	2.86	0.45	1.88	1.59
CD (P=0.05)	NS	0.65	1.11	0.34	0.47	0.32
Interactions DV	NS	NS	NS	NS	NS	NS
MV	NS	NS	NS	NS	NS	NS

*NS = Non Significant

leaves plant^{-1}.

Dry matter production: Different dates of transplanting, varieties and planting methods showed remarkable differences in dry matter production by rice plants. From the Table. 3 it was evident that among dates of transplanting the 15th June ranged from 712.80-3196.63 gm^{-2} transplanted crop produced the highest amount of dry matter in all the growth stages followed by 30th June (589.38 -284.56 gm^{-2}) and 15th July (531.96-2277.12 gm^{-2}) during 2012 crop season. However the differences were not significant at earlier stage (45 DAT) due to slower growth rate. Maximum increment of dry matter was noticed after 90 DAT to harvest. The higher dry matter with 15th June (D_1) transplanted crop was due to increased amount of photosynthate accumulation which was provided by more availability of PAR, nutrient and soil moisture compared to conventional method. At harvest, maximum dry weight was observed. However significant differences were also noticed in dry matter production of rice varieties. It was indicated that higher dry matter production was found in variety PR-118 ranging from 642.18 -3347.33 gm^{-2} as compared to variety PR-116 (580.47 -2201.10 gm^{-2}). Also the 90 DAT and harvest of both the planting methods have shown significant differences in dry matter production. Bed planting method had higher dry matter production ranging from 704.55 -3185.30 gm^{-2}as compared to conventional method (518.10-2361.13 gm^{-2}). This may be due to higher day time temperature which can increase the fixation and reduction of CO_2 and reduce in respiration loss, might have favored this rapid growth and dry matter accumulation during 2012 crop season. Similar results were found in 2013 crop season. Also Studies by Villanueva *et al.* (1989) and Singh *et al.* (1989) reported that closer plant spacing has significantly reduced the dry weight. Dry matter production was influenced by the combined effect between dates of transplanting and varieties. Similarly interaction between different varieties and planting methods were found during both the crop seasons. At early stage of growth the interaction effect was not significant. However, 90 DAT and onwards the interaction effect on the dry matter production was significant during both the seasons.

Yield and yield contributing characteristics: The transplanting time influenced the number of effective tillers per plant at harvest in both the varieties. Significant differences in number of effective tillers per plant were observed among the varieties under different dates of transplanting during both the years (Table 4.). The 15th June transplanted crop had highest number of effective tillers per plant (17.65) as compared to 30th June (12.56) and 15th July (9.55) during 2012 crop season). Similar results were obtained by Om *et al.* (1997) and Gill *et al.* (2006). For late transplanting, low temperature at the pollen development stage may cause a sharp decline in fertile or filled spikelets particularly in the photosensitive cultivars. Among the varieties, variety PR-118 (V_1) produced highest number of effective tillers per plant at harvest (16.03) than PR-116 (V_2). Planting methods had a significant effect on effective tillers per plant at harvest (Table 4). Bed planting had more number of effective tillers (15.27) as compared to conventional planting (11.24) during 2012 crop season. Gupta and Hobbs (2002) observed that bed planting method not only saves water but also gave higher yield of rice crop. The grain yield of rice during both the seasons registered significant variation under different treatments respectively. The data presented in Table 5 revealed that the grain yield had been significantly influenced by planting methods. Highest grain yield was registered by 15th June (50.15 q/ha) followed by 30th June (41.45 q/ha) and 15th July (35.27 q/ha) during 2012 crop season. Dhaliwal *et al.* (2006) and Mahajan *et al.* (2009) reported that the grain yield more in 15th June transplanted crop than 1st June and 30th July transplanted crop. The higher yield for early transplanting (15 June) was mainly due to favorable climatic conditions especially at the time of tillering, flowering and grain filling. Crop

Table 3. Dry matter per plant (gm^{-2}) of rice varieties (PR-118 and PR-116) as influenced by different planting methods during *kharif* 2012 and 2013.

2012					
	Days after transplanting				
Treatments	**45**	**60**	**75**	**90**	**At harvest**
15th June (D_1)	712.80	841.5	1201.53	1529.55	3196.63
30th June (D_2)	589.38	718.08	1192.62	1420.98	2848.56
15th July (D_3)	531.96	711.15	904.86	1031.91	2277.12
CD (P=0.05)	NS	NS	NS	3.19	5.20
PR-118 (V_1)	642.18	760.32	1148.07	1406.79	3347.33
PR-116 (V_2)	580.47	753.72	1051.38	1248.06	2201.10
CD (P=0.05)	NS	NS	NS	2.61	4.24
Bed planting (M_1)	704.55	901.23	1264.23	1517.34	3185.30
Conventional planting (M_2)	518.10	612.48	935.22	1137.51	2361.13
CD (P=0.05)	NS	NS	NS	2.46	5.34
Interactions DV	NS	NS	NS	4.52	7.36
MV	NS	NS	NS	3.48	7.56
2013					
15th June (D_1)	808.50	981.75	1159.29	1481.04	2484.9
30th June (D_2)	396.00	687.39	881.10	1402.5	1770.45
15th July (D_3)	369.60	552.75	759.99	1163.25	1303.50
CD (P=0.05)	NS	NS	NS	2.26	6.94
PR-118 (V_1)	535.26	845.79	1032.90	1615.35	2308.02
PR-116 (V_2)	514.14	635.25	833.91	1082.4	1397.55
CD (P=0.05)	NS	NS	NS	1.84	5.66
Bed planting (M_1)	554.40	802.89	1002.54	1556.94	2115.3
Conventional planting (M_2)	495.00	678.15	863.94	1140.81	1590.6
CD (P=0.05)	NS	NS	NS	1.97	4.78
Interactions DV	NS	NS	NS	3.20	9.81
MV	NS	NS	NS	2.79	NS

*NS = Non Significant

transplanted beyond mid-June were exposed to low minimum and maximum temperature (12.5^{o}C and 23.6 ^{o}C, respectively) at flowering stage (from last week of August to first week of September), whereas early transplanted crops were flowered when temperature were favourable for fertilization. The 15th June transplanted crop experienced mean temperatures between 31^{o}C-33^{o}C during tillering and flowering stage of the crop for the more number of days, which is favourable temperature range for rice crop at tillering and flowering stage. The perusal of data in Table 4 indicated that with each delay in transplanting of rice, there was significant decrease in grain yield of rice during both the crop seasons. Similarly Oteng *et al.* (2013) reported that planting date can have a dramatic effect on rice crop development and yield. The response of rice cultivars to planting date is important when selecting the most appropriate cultivar for a particular planting date. Among the varieties, variety PR-118 yielded (47.61 q/ha) more as compared to variety PR-116 (36.97 q/ha

Bed planting of rice yielded (48.82q/ha and 40.26 q/ha) significantly more as compared to conventional planting method (35.74 q/ha and 30.20 q/ha) during 2012 and 2013 crop season (Table 4). The higher rice yield recorded in bed planting method was attributed to good crop conditions, efficient utilization of natural resources (soil, light, water, air etc.) which resulted in higher number of effective tillers, number of tillers per plant and number of grains per plant than conventional method. Bhuyan (2012) showed that bed planting method increased grain yield of rice up to 16 per cent than conventional method. Similarly Singh *et al.* (2008) observed that transplantion under bed planting method was profitable as compared to conventional method. Pandey *et al.* (2012) revealed that yield of rice transplanted on FIRB (furrow irrigated raised beds) is comparable with traditional rice culture with as much as 25 per cent to 50 per cent saving in irrigation water. Significant interactions were found on the effect of effective tillers per plant and yield between dates of transplanting and varieties. Similarly interactions were

Table 4. Growth parameters, yield and yield attributing characters of rice varieties (PR-118 and PR-116) as influenced by different planting methods during *kharif* 2012 and 2013.

Treatments	**Plant ht. at harvest (cm)**		**No. of effective tillers/pl.**		**No. of grains/pl.**		**1000 grain wt. (gm)**		**Yield (q/ha)**		**Biological mass (q/ha)**		**Harvest index (%)**	
	2012	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
15th June (D_1)	81.73	84.25	17.65	16.46	415.08	393.25	23.89	21.02	50.15	43.11	105.46	94.87	42.68	37.95
30th June (D_2)	80	78.73	12.56	12.16	392.91	370.58	22.13	18.99	41.45	35.61	93.85	83.82	40.19	28.14
15th July (D_3)	76.76	73.3	9.55	9.36	319	297.83	21.11	17.89	35.27	26.98	86.09	77.6	35.63	25.89
CD (P=0.05)	2.87	2.16	1.11	2.24	28.35	29.05	0.99	0.64	2.83	4.78	12.77	12.23	5.27	4.39
PR-118 (V_1)	82.57	80.23	16.03	14.62	389.22	371.44	23.9	21.84	47.61	41.05	102.86	93.64	42.16	33.72
PR-116 (V_2)	76.42	77.29	10.47	10.69	362.11	336.33	20.85	16.76	36.97	29.42	87.41	77.22	36.85	27.6
CD (P=0.05)	2.34	1.77	0.9	1.83	23.14	23.72	0.8	0.52	2.31	3.91	10.43	9.98	4.3	3.58
Bed planting (M_1)	83.76	81.23	15.27	14.48	422.72	400.55	23.93	21.13	48.82	40.26	99.18	92.18	43.56	33.41
Conventional planting (M_2)	75.23	76.29	11.24	10.84	328.61	307.22	20.82	17.46	35.74	30.2	91.08	78.68	35.46	27.91
CD (P=0.05)	3.43	1.75	1.55	1.61	21.41	18.24	0.8	0.8	3.45	5.74	7.7	11.13	5.28	3.01
Interactions DV	NS	NS	1.57	3.17	NS	NS	NS	NS	4.01	6.77	Nil	Nil	Nil	Nil
MV	NS	NS	2.2	2.28	NS	NS	NS	NS	4.89	8.12	Nil	Nil	Nil	Nil

*NS = Non Significant

also found between different varieties and planting methods during both the crop seasons.

The yield contributing characteristics like plant height at harvest, effective tillers per plant, 1000 grain weight, number of grains per plant, biological mass and harvest index differed significantly in all the treatments. Among the different dates of transplanting, rice transplanted on15th June (D_1) has maximum plant height at harvest, number of effective tillers , 1000 grain weight, number of grains per plant , biological mass, yield and harvest index of rice (Tables 4) .This may be due to availability of favourable temperature during panicle and grain initiation period during15th June transplanted crop. These findings were also supported by Soomro *et al.* (2001) and Sharma *et al.* (2011) who observed that the yield contributing characteristics were maximum on 15th June transplanted crop as compared to 30th June and 15th July transplantings. The yield contributing characteristics of PR-118 rice variety was higher than PR-116 rice variety. The data presented in Tables 4. indicated that planting methods had a significant effect on plant height at harvest, number of effective tillers, 1000 grain weight, number of grains per plant, biological mass, yield and harvest index of rice in bed planting method over conventional method. The maximum number of grains in bed transplanted crop was due to producing maximum number of tillers per unit area on account of higher availability of solar radiations. Bed planting resulted in higher biological mass (99.18 q/ha) and harvest index (43.56 per cent) than conventional method resulted into higher yield in bed planted method than conventional during 2012 crop season. It might be due to the reason that each individual tiller has uniform supply of nutrients due to ample availability of space, light and aeration and also the advantage of less severe competition amongst germinated seeds /seedlings, which resulted in more number of panicle-bearing tillers per unit area in bed planting method. Similar results were found during 2013 crop season. The yield and yield contributing characters during 2013 crop season was comparatively low than 2012 crop season in all the treatments due to severe attack of stem borer and sheath blight. Moreover the weather conditions were more favourable during 2012. During booting stage 252.1 mm rainfall was received was which resulted in high humidity conditions which were favourable for stem borer attack and lower yield was obtained as compared 2012.

Conclusion

This study concludes that bed planting method increased rice yield up to 13% than the conventional planting method. These findings also indicates that periodic number of tillers per plant, leaf area index and dry matter production for grain production and crop productivity were higher in bed planting method than conventional method. The potential gains from growing rice production on beds are considered to be associated with better agronomic management than conventional method. Also, the crust problem on the soil surface was eliminated and soil physical status was greatly improved in bed planting plot over conventional flat system.

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