AgriCos e-Newsletter
ISSN: 2582-7049
Volume: 02 Issue: 09 September 2021 Article No: 15

Effect of Bed Planting On Yield in Rice Wheat Cropping System

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SUMMARY

Planting method is of great significance among the different agronomic factors as it not only determines the proper crop stand establishment but also the production of individual plant through balancing plant to plant competition and facilitating the conversion of light energy to harvest yield of crop. Bed planting in rice-wheat cropping systems may be a technique for improving resource use efficiency and increasing the yield. In this system, the land is prepared conventionally and raised bed and furrows are prepared manually or using a raised bed planting machine. Crops are planted in rows on top of the raised beds and irrigation water is applied in the furrows between the beds..

INTRODUCTION

Amount of water required for different irrigations differed remarkably between the conventional and bed planting methods. Recent research activities in India and Pakistan showed many advantages of bed planting of wheat in rice-wheat systems (Connor *et al*., 2003). Bed planting refers to a cropping system where the crop is grown on beds and irrigation water is applied in furrows between the beds. This is a common practice for row crops, but not for small grain crops such as wheat and rice. The advantages are improved fertilizer efficiency, better weed control, and a reduced seed rate. The most important one as an RCT is the saving of irrigation water because of reduced evaporation surface and efficiency in distribution. In addition, the rooting environment is changed and aeration of the bed zone is better than with flat planting. Water savings compared to flat surfaces of 26% for wheat and 42% for transplanted rice have been reported, with yield increases at the same time of 6.4% for wheat and 6.2% for rice (RWC-CIMMYT 2003). Mollah, *et al*., (2009) reported the highest grain yield in 70 cm wide beds with two plant-rows bed^{-1} (2.85 t ha^{-1} in 2002 and 3.34 t ha^{-1} in 2003), which was statistically identical with the grain yield of 70cm wide beds with three plant-rows bed^{-1} (2.82 t ha^{-1} in 2002 and 3.28 t ha^{-1} in 2003) and significantly higher than conventional method and 80 and 90 cm wide beds with both two and three plant rows. The yield increase by bed planting using 70 cm wide beds with two and three plant rows bed^{-1} over conventional method were 21 and 20%, respectively, in 2002 and 19 and 17%, respectively, in 2003. Similar yield increase by bed planting in wheat was also reported by Meisner *et al.* (2005). With the increase in bed width, yield was decreased in both the years. There was no significant yield difference between three and two plant-rows bed^{-1} in same bed width. The highest yield in the bed planting with 70cm beds were attributed to higher number of panicles m^{-2}, grains panicle^{-1} and 1000-grain weight (Table 1) . Mollah, *et al*., (2009) reported that Weed population and dry biomass were greatly influenced by different planting methods of wheat. Bed planting significantly reduced weed population resulting in lower dry biomass than conventional method in both the new and old beds. The lowest number of weeds m^{-2} and dry biomass yield were recorded in the 70 cm wide beds with three plant rows bed^{-1} which was followed by same bed width with two plant rows bed^{-1} (Table 2). Ram *et al*. (2005) also found lower weed biomass in raised beds than the conventional method. Both weed population and dry biomass yield were increased with the increase in width of beds and these were also higher in bed with two plant rows than three plant rows. The low number of weeds in beds might be due to dry top surface of beds that inhibited the weed growth. Moreover, at the time of bed preparation, the top soils of the furrows were mulched to the raised beds, which drastically reduced the weeds in furrows.

Rice Wheat Cropping System

The conventional method received the highest amount of water at every irrigation and total amount was 315 mm and 318 mm in 2001-02 and 2002-03, respectively (Table 3). Total water savings by 70, 80 and 90 cm wide beds over conventional method were 41-46 %, 42-48 % and 44-48 %, respectively. Among the beds, the narrow bed (70 cm) required slightly higher amount of irrigation water than wider bed. In the bed planting,

irrigation water was applied only in furrows. The area of furrows unit^{-1} area in the wider beds is lower than the narrow beds. So, it received lower amount of irrigation water. Savings of irrigation water by bed planting of wheat ranged from 18% to 50% were reported by many scientists (Sayre, 2003). Bed planting also has the advantage of lower seed rates, bolder seed and greater panicle length, an important issue for hybrid seed multiplication programmes. The main benefit of bed planting is savings in water. Almost all farmers report 30-35 per cent less irrigation time in tube well irrigated areas and also less crop lodging and possibility of last irrigation to be given. Therefore under high production situations, bed planting exceeds the yields possible on the flat bed. In rice-wheat areas raised beds work best in partially reclaimed alkali soils, low-lying areas where water-logging and weeds are problems, and in cracking soils. Where there is an urgent need for rainwater conservation to prevent receding water-tables and need to increase water-use efficiency dramatically, bed planting is a blessing in disguise. Raised bed prepared from the amended soils increases the depth of rooting zone and improves crop productivity (APAARI vision). Mann *et al*., 2008 conducted a three year experiment in Pakistan (Punjab) at three different locations with four crop establishment techniques and it was observed that mean yield of wheat was more in beds with two rows as compared to other treatments (Table 4). Bhuyan *et al*., 2012 reported that that bed planting method is a new approach for optimum fertilizer and water use efficiency as well as higher yield compared to conventional flat method as the bed planting method increased the Water use efficiency, number of panicle m^{-2}, number of grains panicle^{-1}, 1000-grain weight and increased grain yield of rice up to 16% than the conventional method and Sterility percentage and weed infestation were lower in bed planting than conventional method. He also concluded that about 42% of the irrigation water and time for application could be saved through bed planting in transplanted aman rice cropping system.

Table 1. Effect of planting method on the yield and yield components of wheat

Method of planting		Grain yield (t ha^{-1})		Panicles m^{-2} (no.)		Grains panicle^{-1} (no.)		1000-grain wt. (g)	
Bed width (cm)	Rows bed^{-1} (no.)	2002	2003	2002	2003	2002	2003	2002	2003
70	2	2.85 a (21)*	3.34 a (19)	306 a	310 a	34.3 a	36.3 a	42..3 a	42.3 a
70	3	2.82 a (20)	3.28 a (17)	312 a	325 a	32.0 b	33.8 b	41.7 a	41.9 a
80	2	2.54 bc (8)	2.78 bc (-1)	231 c	260 c	34.2 a	35.9 a	41.3 a	41.5 a
80	3	2.65 b (13)	2.87 b (2)	244 b	282 b	31.1 c	32.9 c	41.4 a	41.5 a
90	2	2.26 d (-4)	2.64 c (-6)	219 c	241 d	34.2 a	36.0 a	41.9 a	42.1 a
90	3	2.43 c (3)	2.67 bc (-5)	231 c	242 d	31.3 bc	33.0 c	41.5 a	41.7 a
Conventional		2.35 dc	2.81 bc	305 a	274 bc	27.3 d	28.3 d	39.2 b	39.6 b

Figures in a column followed by different letters differ significantly at 5% level of probability as per DMRT.

Table 2. Weed vegetation in wheat as influenced by method of planting

Method of planting	Weed vegetation	
Bed width (cm)	2002	2003

	Rows bed^{-1} (no.)	Population (no. m^{-2})	Dry biomass (kgha^{-1})	Population (no. m^{-2})	Dry biomass (kg ha^{-1})
70	2	64 f	55.7 e	77 f	69.6 f
70	3	51 g	47.2 f	59 g	53.5 g
80	2	105 d	96.7 c	120 d	104.5 d
80	3	83 e	71.2 d	96 e	85.5 e
90	2	136 b	115.0 b	162 b	147.4 b
90	3	116 c	97.4 c	136 c	123.5 c
Conventional		205 a	173.2 a	240 a	207.8 a

Mollah, *et al*., (2009)

Table 3. Water required in wheat as influenced by method of planting

Tillage option	Water required at different times of irrigation (mm)					
	Sowing	Crown root initiation	Maximum tillering	Grain filling	Total	Water saved over conventional (%)
2001-02						
70 cm bed	57	49	41	23	170	46
80 cm bed	55	49	40	21	165	48
90 cm bed	55	48	39	21	163	48
Conventional	95	89	76	55	315	-
2002-03						
70 cm bed	58	48	45	35	186	41
80 cm bed	56	46	44	34	180	42
90 cm bed	55	45	42	32	174	44
Conventional	94	85	79	60	318	-

Table 4. Grain yield (t ha^{-1}) in wheat planted with different techniques.

Techniques	M.K. Farm	Zaidi Farm	Dogar Farm	Mean
Beds (two rows)	3.92 a	5.27 a	4.60	4.60
Zero Tillage (flat)	4.02 a	4.95 ab	4.15	4.43
Beds (three rows)	4.25 a	4.70 b	4.37	4.42
Conventional	3.45 a	4.25	4.05	3.95
Mean	3.92	4.80	4.30	4.35

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