Watershed Rehabilitation and Irrigation Improvement in Pakistan

Rice Cultivation on Beds - An Efficient and Viable Irrigation Practice

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Pakistan Council of Research in Water Resources (PCRWR)
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Foreword

Pakistan has one of the largest irrigation systems in the world. More than 90% of its water resources are used in agriculture. However, more than 60% of the water used in agriculture is lost during the conveyance and application in the fields. The losses in the field are mainly due to conventional irrigation practices such as flood basins and over irrigation. Over irrigation is mainly due to lack of knowledge about irrigation scheduling and misconception of the farmers that more water will produce more yield.

Growing of rice in standing water is a classical example of this mindset due to which rice has become one of the largest user of freshwater resources. This leads to very low water productivity of rice as compared to other grain crops. With the declining freshwater availability, the production of rice with the existing practices is becoming highly uneconomical and unsustainable.

Infact like other crops, rice has a specific water requirement for a particular agro-climatic region. However, with the existing practices, it is not possible to apply water to rice crop according to its requirements. Various options are now being evaluated to save water in rice fields such as bed and furrow, direct seedling, reducing ponded depth to soil saturation or by alternate wetting/drying.

Pakistan Council of Research in Water Resources (PCRWR) conducted a series of experiments in the field to evaluate the prospects of growing rice on beds. This practice not only saves water but has several other advantages over the conventional flood irrigation (submerged) such as better fertilizer-use efficiency, better yield, ease in transplantation, better crop stand leading to less lodging etc.

This booklet has been designed in such a way that the stakeholders such as professionals, agricultural service providers (ASPs) and farmers can benefit from it. It will also provide guidelines to the policy makers as growing of rice in standing water is no longer an economic and viable option and needs to be stopped.

Dr. Muhammad Ashraf
Chairman, PCRWR

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Executive Summary

Rice is one of the major staple food crops in Pakistan. About 13% of the cropped area of the country is used for rice production. Average yield of rice in the country is 2.95 t/ha, which is much lower as compared to 7.40 t/ha for the USA and 6.19 t/ha for China. On average, the world's rice fields use about 1.4 m^3 of water for producing 1 kg rice with a wateruse efficiency (WUE) of 0.71 kg/m^3, whereas in Pakistan it is less than 0.45 kg/m^3.

A major reason for this low WUE is the conventional flood irrigation practice *i.e.* growing rice under submerged conditions. In the backdrop of increasing water scarcity, the farmers, researchers and scientists are looking for new methods and techniques to improve rice yield and its water-use efficiency. Planting of rice on beds is one of the practices which can potentially improve rice yield and its WUE.

Pakistan Council of Research in Water Resources (PCRWR) conducted series of experiments for growing rice on beds and conventional planting during 2011-13 at its R&D Centre near Sargodha (Punjab). Each treatment was replicated thrice. Under the conventional method, on an average 144 cm of water was applied whereas water applied to bed fields was112

cm. The amount of water applied under the bed and furrows was therefore, 23% less than that for flooded basins. Average yield of rice grown on beds was 4,156 kg/ha whereas it was 3,921 kg/ha in flooded basins. The average WUE of rice grown on beds was 0.37 kg/m^3, whereas it was 0.27 kg/m^3 under the conventional practices. The average net income from the rice planted on beds was Rs. 129,328/ha, whereas it was Rs. 115,260/ha for the flooded basins. Therefore, planting rice on beds has high potential of saving water without compromising the yield.

1. Introduction

Rice (*Oryza sativa* L.) is the largest user of water in Asia, accounting for more than 50% of irrigation water supplies (Dawe, 2005; Barker *et al*., 2001) which itself accounts for 80% of the amount of freshwater diverted (Guerra *et al*. 1998). Most of rice is grown under submerged conditions, in which the fields are frequently flooded from planting to harvesting. This practice consumes huge amount of water. Normally, it consumes more than twice the amount of water required to grow wheat or maize. Rice is grown on about 160 million hectares (Mha) worldwide and consumes about 35-45% of the world's irrigation water withdrawals (Bouman, 2012).

In Pakistan, rice occupies about 25% of the cultivated area in summer season and 10% of the total cropped area (Khan *et al*. 2006). Punjab is the biggest producer of rice and contributes up to 70% in the national production whereas the share of Sindh, Balochistan and Khyber Pakhtunkhwa (KP) are 25, 3 and 2%, respectively. During 2013, rice was grown on about 2.8 Mha with an average yield of 2.95 t/ha (GoP, 2014). This yield of rice is much lower as compared to reported yields of 7.40 t/ha in the USA and 6.19 t/ha in China. Rice can be grown in any part of the country from sea level to 2500 m high fields depending upon the water availability.

Pakistan has favorable climate and fertile soils for the cultivation of rice. However, water is a limiting factor. Moreover, the existing irrigation practices for growing rice are wasteful. Huge quantity of water is lost during land preparation and crop establishment, which leads to excessive evaporation and deep percolation. It is observed that farmers generally apply more water to rice field for control of weed germination than what is needed for meeting the crop water requirement. In the lower Indus basin of Pakistan pancho irrigation system (draining of water after 4-5 days from the fields) is practiced. Ashraf *et al*., (2014) concluded that under pancho irrigation, on an average 785 mm (59%) more water was applied as compared to non-pancho irrigation systems.

On average, the world's rice fields use some 1.4 m^3 of water for producing 1 kg rice with a water use efficiency of 0.71 kg/m^3 whereas the WUE of rice in Pakistan is less than 0.45 kg/m^3. In case of Basmati rice, the WUE is even lower. Ashraf *et al*., (2010) while working in the Lower Bari Doab Canal (LBDC) command found WUE of rice as low as 0.08 kg/m^3 (producing only 80 gm of rice grain with 1000 liters of water).

The demand for rice is increasing with growing population, whereas per capita water availability is decreasing. Therefore, the future rice production would mainly depend on developing and adopting efficient irrigation methods. Growing of rice on beds is an option, which utilizes less water without affecting the crop yield.

The raised beds and furrows are either prepared manually or by using a bed planter. Crops are planted in rows on the raised beds and irrigation water is applied in the furrows. In conventional rice transplantation, land is prepared by puddling the soil. In puddling, the soil is tilled in saturated conditions in order to develop a hard pan underneath the root zone to reduce deep percolation and leaching of nutrients and salts (Figure 1). For direct seedling of pre-germinated rice seed, land is also prepared by puddling. Puddling and continuous inundation until maturity have significant effects on the physical, chemical, and biological conditions of soils that influence the growing conditions of all the subsequent crops in the system.

Figure 1: Puddling through animals and tractor

Determination of different agronomic and design aspects of rice bed planting like appropriate width of beds, optimum numbers of plant rows per bed, seed and fertilizer rates are essential for development of the irrigation practice. This study was conducted to evaluate the performance of rice cultivation on beds and to compare it with conventional flood basins in terms of rice yield, water-use efficiency and the net income.

2. Methodology

2.1 Experimental Site

The study was conducted at R&D Centre, Sial Mor, Sargodha during *Kharif* 2011, 2012 and 2013. The centre with an area of 8.5 ha is located in Chaj Doab (the area between rivers Chenab and Jhelum). The soil of the experimental area is sandy loam, non-saline, non-alkaline having pH 7.9 and EC_e 1.3 dS/m. The trials were conducted under the bed and furrow (T_1) and conventional irrigation practices (T_2). Each treatment was replicated thrice. The profile of rice trials are given in Table 1.

Table 1: Details of rice trials conducted at the R&D Centre

Description	Bed Plantation (T_1)			Conventional (T_2)		
	2011	2012	2013	2011	2012	2013
Plot size (ha)	0.60	0.60	0.50	0.38	0.60	0.50
Nursery planting	Jun 09	*	Jun 09	Jun 06	*	Jun 09
Nursery transplantation	Jul 25	Aug 01	Jul 21	Jul 27	Aug 02	Jul 22
Plant density (plants/m^2)	**	23	20	**	15	13
Harvesting	Nov 09	Nov 12	Nov 18	Nov 09	Nov 12	Nov 18

* Nursery was bought from farmers. ** Plant density was not measured.

2.2 Land Preparation

For flood basins, the land was prepared with two ploughings followed by LASER leveling (Figure 2). Finally, four ploughings and two planking were done before applying soaking dose (pre planting irrigation). After irrigation, puddling (two ploughings in standing water) was made before transplantation of rice nursery. For bed planting, in the conventionally prepared land, raised bed and furrows were made with the help of a bed shaper (Figure 2).

Figure 2: LASER land leveling (left) and bed preparation with a bed shaper (right)

The soil at the study site is sandy loam in texture with a field capacity of 14%, whereas the permanent wilting point is at 6%. The bulk density of the soil is 1.5 g/cm^3. Keeping in view the soil texture (sandy loam), top width of beds was adjusted at 30 cm each. The furrow to furrow distance was 60 cm. Similarly, base width of beds was 60 cm, whereas the beds were kept 22 cm high at the time of preparation (Figure 3). The beds were prepared a day before transplanting the rice nursery. After 1-2 irrigations, the loose soil was a little bit compacted and triangular shaped furrows converted to parabolic shape reducing the height of furrows, and increasing the top width of the beds (Figure 4).

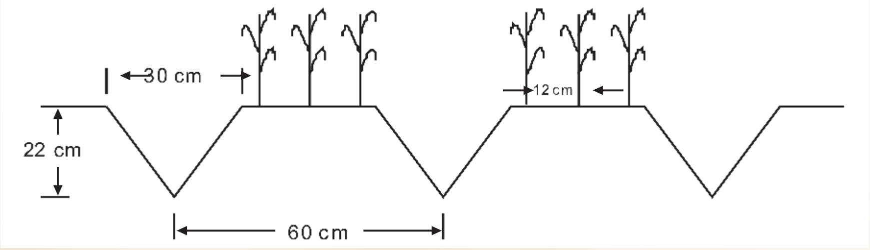

Figure 3: Schematic diagram of bed & furrows at the time of sowing

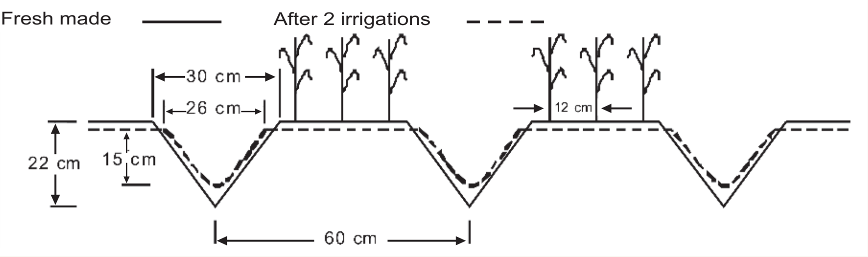

Figure 4: Schematic diagram of bed & furrow after irrigations

2.3 Tillage Practices

Super basmati rice nursery was transplanted during last week of July or first week of August each year maintaining plant to plant and row to row spacing of 22 cm in conventional plots. However, three rows were developed on the beds with an approximate row to row distance of 12 cm and plant to plant distance of 22 cm. In both the treatments, number of plants was the same and varied from 130,000 to 230,000 plants per hectare. The recommended plant density ranges from 200,000 to 250,000 per hectare. Thirty days old nurseries (seedlings) were carefully transplanted. Irrigation water was applied a day before transplantation in furrows for ease in transplantation and attaining optimum moisture level (Figure 5).

Figure 5: Conventional transplantation of rice nursery (left) and planting on beds (right)

2.4 Fertilizer Applications

Fertilizer was applied with N, P, K, and Zn at the rates of 100, 100, 60 and 10 kg/ha, respectively. The sources of N, P, K, and Zn were Di-ammonium phosphate (DAP), Urea, Sulphate of Phosphate (SoP) and Zinc Sulphate ($ZnSO_4$), respectively. All DAP and SoP were applied at the time of final land preparation as basal dose with conventional broadcasting method. Urea was however, applied in three splits after 15, 30, and 50 days of transplantation. Zinc sulfate was applied at the rate of 10 kg/ha about one month after planting to avoid zinc deficiency, which is common in this area. The calculated amount of fertilizers was applied by mixing with irrigation water ($ZnSO_4$) and by broadcast method (urea) as shown in Figure 6. Equal doses and type of fertilizers were applied in both the treatments.

Figure 6: Application of liquid $ZnSO_4$ (left) and Urea (right)

2.5 Pest and Weed Control

The rice was infested by stem borer at tillering and by rice bug at grain filling stages. Pesticide namely Nateevo containing taboconozole (50%) and trifloxistrobin (25%) was applied at the rate of 62 gm/ha after 60 days of transplantation to control rice bug. To control weed growth during the initial stages of growth, weedicide (Sunstar/Ethapy chloran) was applied after stabilization of crop @ 62 gm/ha.

2.6 Water Quality

Good quality groundwater (tubewell) with an average EC of 0.84 dS/m, SAR 2.7 and pH 7.13 was used for irrigating rice fields under both the treatments. The water-table depth at the centre is around 6 m, which slightly increases in October than in July i.e. the onset of *Kharif* season. However, no substantial changes in water-table depth and quality was noticed over the study period.

2.7 Irrigation Application

After transplantation, water was applied in furrows as needed to keep the rice seedlings alive. The irrigations were frequent to maintain soil moisture in beds at saturation level. The furrows were filled about three fourth of their height in each irrigation. The tubewell discharge was measured by volumetric method. The amount of water applied in each irrigation was determined by multiplying tubewell discharge with the time of irrigation. The flood basins were irrigated according to the conventional practices (almost daily) to keep water standing in the field. Irrigations on all plots were discontinued when the crop began to ripe.

Figure 7: Rice grown under conventional method

Figure 8: Rice grown on beds

2.8 Rainfall

A rain gauge has been installed at the experimental site. Rainfall data was recorded regularly and irrigation scheduling was decided accordingly. The monthly rainfall and the pan evaporation during the study period is given in Figure 9.

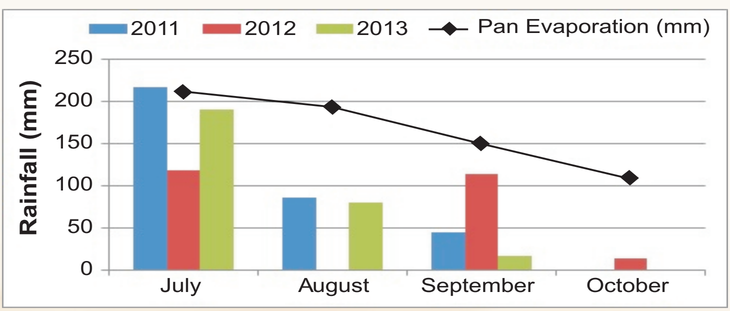

Figure 9: Rainfall and pan evaporation during the study period

2.9 Crop Yield

Rice was harvested using a combine harvester (Figure 10). The yield was determined on whole plot basis. The crop from the three replications of each treatment was harvested separately and the average yield was calculated.

Figure 10: Harvesting of rice by combine harvester on beds (left) and conventional fields (right)

2.10 Benefit-Cost Analysis

For each crop season, cost of production and income was recorded and the net income was calculated accordingly. The cost of production included all direct and indirect costs incurred from planting to harvesting. Similarly, the income included both from the grain and biomass.

3. Results and Discussion

3.1 Water Applied

Theoretically, the water requirement for land preparation is 150-200 mm but it can be as high as 650-900 mm when its duration is long (Bhuiyan *et al*., 1995). Field water input during growing season may vary from 500 to 800 mm. Although rice grows well under submerged conditions, however, deep and prolonged submergence adversely affects its growth.

Crop had to be irrigated after short intervals during initial stages. Under the conventional method (T_2), on an average 144 cm of water was applied to the crop against 112 cm for bed and furrows. The amount of water applied under the bed and furrow system was therefore, about 23% less as compared to conventional method (Table 2). The water applied in each irrigation in bed and furrow method was less as compared to conventional practice.

Similar results were found by Bhuyan *et. al* (2012) who conducted field experiments in Chuadanga district of Bangladesh on different agronomic aspects of bed planting rice. The conventional method received higher amount of water with each irrigation with a total amount of 143 cm. However, in bed planting, the total amount applied was 101 cm thereby showing water saving of about 42%.

Table 2: Water applied (cm) under conventional and bed plantation

Year	Bed Plantation (T_1)	Conventional Plantation (T_2)
2011	108	141
2012	124	157
2013	103	135
Average	112	144

However, the water applied depends on the soil type, rice variety and the climatic conditions. The results of the study were statistically analyzed by applying t-test to determine significance of difference between the two treatments (Table 3). The analysis reveals that the amount of water applied under the two treatments was significantly different at 95% confidence interval. It can therefore, be concluded that planting of rice on beds can help save significant amount of water.

3.2 Yield

The yield of rice grown with conventional method was 3340, 4784, 3640 kg/ha during 2011, 2012 and 2013, respectively, whereas for bed and furrows it was 3580, 4972 and 3917 kg/ha respectively. The yield in bed and furrow was 4-8% higher than conventional flood basins (Table 3). However, there was no significant difference in yield between the two treatments. This indicates that significant amount of water can be saved in bed and furrows without compromising rice yield.

The potential agronomic merits of beds also include improved soil structure due to reduced compaction through controlled trafficking. Moreover, waterlogging conditions are also reduced. These are responsible for improved rice production (Humphreys *et. al.* 2005).

Table 3: Comparative analysis of water applied, rice yield and WUE under both the treatments

Irrigation practice/ treatment	Water applied (cm)	Yield (kg/ha)	Yield difference (%)	WUE (kg/m^3)	WUE difference (%)	Water saving (%)
2011						
T_1	108	3580	+7	0.33	+38	23
T_2	141	3340	-	0.24	-	-
2012						
T_1	124	4972	+4	0.40	+29	21
T_2	157	4784	-	0.31	-	-
2013						
T_1	103	3917	+8	0.38	+41	24
T_2	135	3640	-	0.27	-	-
Average						
T_1	112[a]	4156[a]	+6	0.37[a]	+37	23
T_2	144[b]	3921[a]	-	0.27[b]	-	-

Note: The means with the same letters are not significantly different at P = 0.05.

3.3 Water Use Efficiency (WUE)

Water-use efficiency is an estimate to measure how precisely irrigation water has been used for crop production. The WUE can be improved either by increasing crop yield or by reducing the amount of water needed without affecting the crop yield (Molden *et. al*., 2010). The WUE of rice grown on beds varied from 0.33 to 0.40 kg/m^3, whereas that for conventional flood basins, it varied from 0.24 to 0.31 kg/m^3. On average, WUE of rice grown on beds was 37% higher than the conventional planting (Table 3). It was found that the WUE under the two treatments was significantly different at 95% confidence interval. The results are in agreement with those of Thompson *et. al.,* (2003) who studied rice on both raised beds and flooded basins.

Studies in the USA have also shown considerable water saving with irrigated rice on raised beds over conventional flooding (Vories *et. al.,* 2002). This may protect deep percolation of irrigation water in the field. The better performance of raised beds over conventional methods was attributed to reduced waterlogging, improved soil physical properties, reduced lodging, and decreased incidence of disease. Kahlown *et. al.,* (2006) hypothesized that puddling (a traditional method of reducing downward movement of water in rice fields before transplantation) breaks down the structure of the soil, destroying most of the large pores in which water moves rapidly. Bed and furrow irrigation method can therefore, eliminate the need for puddling soils for rice production, which is cumbersome and energy intensive. Puddling is not only expensive but also accelerates the destruction of organic matter and reduces the ability of the soil to provide conditions optimum for growth of subsequent crops.

Despite puddling, a major portion of the water used in the production of rice in flooded basins percolates down through the soil profile. By reducing application of water and keeping the water content of the soil at or below the field capacity, most of the time, deep percolation of the water can be reduced.

3.4 Soil Analysis

The soils were analyzed before and after each trial for determining any impact of treatment on its chemical properties and organic matter content. The details of the analyses are presented in Table 4:

Table 4: Pre and post-trial properties of the soil*

Year		EC (dS/m)		pH		OM (%)		P (mg/kg)		K (mg/kg)	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
2011	T_1	1.77	1.48	8.1	7.9	0.57	0.78	18.3	19.4	208	148
	T_2	1.36	1.26	8.0	7.9	0.57	0.67	3.0	8.6	150	156
2013	T_1	2.37	1.30	8.9	7.9	0.41	1.25	7.0	12.4	124	92
	T_2	1.51	1.13	8.5	7.7	0.55	1.39	10.8	11.7	86	96

*Data for 2012 not available.

As rice is reclamative crop, therefore the EC and pH of the soil decreased after each season, whereas the organic matter and phosphorous improved particularly under bed plantations. Potassium contents however, improved only under bed plantation, presumably due to less leaching because of less irrigation water applied.

3.5 Economic Analysis

The economic analysis involves the total production cost, gross income and net return of conventional and bed planting rice (Table 5). On average, under bed planting the cost of production was 3% less, gross income 6% higher and net income 11% higher as compared to conventional plantation.

Table 5: Benefit-Cost analysis

Irrigation Practice	Production Cost (Rs/ha)	Gross Income (Rs/ha)	Net Income (Rs/ha)
2011			
T_1	72,401	1,43,200	70,799
T_2	74,409	1,33,600	59,191
2012			
T_1	76,376	2,28,727	1,52,351
T_2	78,565	2,20,064	1,41,499
2013			
T_1	79,979	2,44,813	1,64,834
T_2	82,412	2,27,500	1,45,089
Average			
Bed & furrow (T_1)	76,252	2,05,580	1,29,328
Conventional (T_2)	78,462	1,93,721	1,15,260

4. General Discussions

It is generally believed that standing water is required for growing rice crop. Moreover, the farmers also keep water standing to control weeds in the rice fields. Due to this mindset, huge amount of precious water is lost either as deep percolation or as evaporation. This is not only the wastage of water but also the wastage of precious nutrients present in the soil. Moreover, it also leads to the twin menace of waterlogging and salinity.

This study helped to break this myth. Like any other crop, rice has its specific water requirement. In Pakistan rice water requirement varies from 600 mm to 1400 mm depending on the crop variety and agro-climatic conditions (PCRWR unpublished reports). For the area under study, the rice water requirement is about 600 mm. This requirement can be met using any appropriate method even with sprinklers (Kahlown *et. al*., 2007; Spanu *et. al*., 1996). However, in Pakistan farmers are applying 2-3 times or even more water to rice crop than its actual requirements in a growing season (Ashraf *et. al*., 2010; 2014). By planting rice on beds, it is possible to apply water close to its actual requirements thereby saving a huge amount of water.

During 2013, rice was grown on an area of 2.8 Mha. With a modest saving of 32 cm (though the farmers are apply much more water), about 9 billion cubic meter (BCM) of water can be saved without compromising the rice yield. This saved water can be used to increase horizontal (cropped area) and vertical (cropping intensity) expansion of agriculture. Even it is sufficient to further irrigate 0.8 Mha of rice crop. Planting of rice on beds is relatively easy with common labour that helps to achieve the required plant density which is an issue in the Indus basin of Pakistan. Similarly, harvesting of rice both manual and with harvester is easy as compared to conventional planting. It has also been observed that the lodging of rice crop is less under bed planting as compared to conventional planting.

One of the major reasons for keeping water standing in the rice fields is to control weeds. It has been observed that weed infestation in bed planting fields is relatively less as compared to conventional planting as water is applied in the furrows only. Therefore, weed growth takes place mainly in the furrows that can be easily eradicated either manually or by using weedicides. Moreover, due to better crop emergence and stand, the weeds on the beds are suppressed.

Moreover, we need to understand the importance of water as its excessive use has much more implications than using weedicides. As canal water is insufficient to meet the rice water requirement, therefore, farmers keep on pumping the groundwater. This is an energy loss and has direct bearing on the groundwater as well as on farmers' income.

5. Conclusions

Like any other crop, rice has it specific water requirement and does not essentially need submerged conditions. Rice can be successfully grown on beds without compromising the yield with a water saving of over 23%. Therefore, there is need to demonstrate this technology to the farmers for its large-scale adoption.

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Guidelines for Planting Rice on Beds/Ridges

1. Nursery Plantation

Rice nursery should be sown by 1st week of June for the Basmati variety and by 20th June for coarse varieties (Figure A).

Figure A: Planted rice nursery

2. Land Preparation

Carry out ploughing followed by planking and preferably laser leveling under dry condition (Figure B).

Figure B: Laser land leveling

3. Bed preparation

Make beds with the help of a bed planter/shaper. The beds should be 1 ft (30 cm) wide at the top and 2 ft (60 cm) at the bottom. In this way, the furrow to furrow distance is 2 ft (60 cm). The beds height should be 22 cm (Figure C).

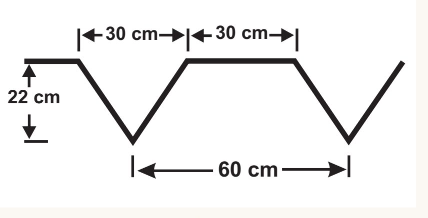

Figure C: Bed making through shaper and its' dimensions

If bed planter is not available, use conventional ridger. On ridges, transplant rice nursery on both sides of the ridge maintaining plant to plant distance of 12-15 cm and row to row distances of 20 cm (Figure D)

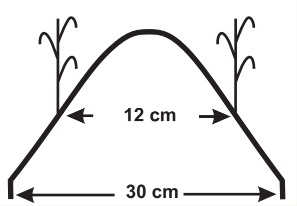

Figure D: Dimensions of ridge plantation of rice

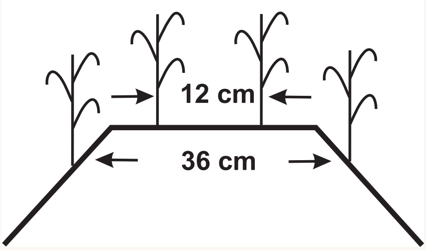

Figure E: Rice transplantation on beds and its' spacing

4. Nursery transplantation

Basmati rice nursery may be transplanted on beds by first week of August and by 20th July for coarse varieties. The plant distance on a section (row) is maintained at around 5 inch (12 cm). The row to row distance should be 8 inches (20 cm).

The recommended plant population of 200,000/ha (80,000/acre) should be obtained under the narrated plant and row spacings. Transplantation should be done under wet conditions, with furrows half-filled with water (Figure E).

5. Irrigation criteria

Irrigation should be applied in furrows 2/3rd of the height of the bed whenever the available moisture depletes by 50%. The condition can be sensed by farmers by touch and feel method. The total water requirement of rice is 600 mm in Punjab. The recommended depth per irrigation in furrows is 5 cm (Figure F). Hence, depending on soil type and field conditions, 10 to 12 shallow irrigation are enough. These may be further reduced in case of rainfall.

Figure F: Irrigated rice on beds

6. Pest and Weed Management

Rice is affected by stem borer and weeds growth in furrows. Pesticides containing tabocononazole (50%) and trifloxistrobin (25%) and weedicide containing Ethapy chloran may be applied by spraying @ 60 gm/ha. Weeds can also be removed by hoeing.

7. Fertilizer Application

Rice needs fertilization as per its soils. Soil analysis should be done to know nutrient status in the soil. Generally, it needs N, P, K, and Zn. The fertilizers are provided in the form of DAP, Urea, SoP and Zinc sulphate, at the rates of 100, 100, 60 and 10 kg/ha, respectively. DAP and SoP may be applied during land preparation as basal dose with irrigation water (Figure G). Whereas, urea is applied in 3 equal doses by broadcasting after 15, 30 and 50 days of transplantation.

Figure G: Fertilizer application (Zinc sulphate and Urea)

8. Harvesting

Rice may be harvested manually or by a combine harvester (Figure H) after proper ripening most probably by first week of November.

Figure H: Rice harvesting on beds

Tensiometer - An Equipment Locally Developed by PCRWR

One of the most important thing that leads to wastage of precious water is the lack of knowledge about irrigation scheduling (when to irrigate and how much to irrigate?). Due to lack of this knowledge, farmers keep on applying water even when a crop does not need irrigation. This is not only the wastage of water but also wastage of precious nutrients that are leached down with excess water.

Tensiometers can be used to decide when to apply irrigation. PCRWR has made the use of tensiometers farmers friendly. The blue range shows that the soil is at saturation. When needle is on green strip, it means there is sufficient moisture available. However, when needle is on yellow line, the farmer or the manager should prepare to irrigate his field. When needle moves to the red zone, the water must be applied. However, it should be noted that tensiometer installed at particular depth will give matric potential (or moisture content) at that depth and sufficient moisture may be available at the deeper depth. Therefore, tensiometers should be installed at different depths to have an idea of moisture content in the entire root zone. These tensiometers are available with PCRWR at cheap price.

About PCRWR

PCRWR is an apex body of the Ministry of Science and Technology and is mandated to conduct, organize, coordinate and promote research on all aspects of water resources including irrigation (surface and groundwater), drainage, soil reclamation, drinking water and wastewater. It has five regional offices located at different agro-ecological zones and conducts research on water-related issues of the respective zones. These regional offices are located at Lahore, Bahawalpur, Tandojam, Quetta and Peshawar. Besides these five regional offices, PCRWR has a setup of 18 water testing laboratories in major cities of the country. It has all types of infrastructure such as soil and water testing laboratories, groundwater assessment equipment, research farms to conduct and disseminate the research. It is the only organization in Pakistan that owns drainage type lysimeters in Lahore, Tandojam, Quetta and Peshawar. PCRWR has done considerable work on crop water requirements, tile drainage, soil reclamation, on-farm water management technologies, rainwater harvesting, artificial recharge, groundwater assessment & management, skimming wells, drinking water, and indigenous development of salinity and moisture sensors.

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