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Effect of raised bed planting method of maize under sandy loam soil of West Tripura

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Abstract
A field experiment was conducted on sandy loam soil of North Pulinpur ADC Village of un divided West Tripura district of Tripura for maize cultivation on raised beds as well as in flat beds. It was observed that available water retention capacity (AWRC) did not vary appreciably with bulk density in both the cases. Again, low water stress was observed under raised bed planting as compare to conventional planting method. Field saturated hydraulic conductivity at 10 cm soil depth was 3 times of its value of 0.37 cm/hr under conventional planting. Root length density was also more in upper 45 cm in beds due to porous soil environment. Yield obtained from raised bed planting method was quite higher than that of conventional system of planting with less use of water. These results thus suggested that raised bed planting is superior to conventional planting as it had better water availability and improved soil physical condition which led to enhanced root growth, and higher maize yield.

Keywords: *Maize, Raised bed planting, Conventional planting*

1. Introduction
Furrow irrigated raised bed planting method got wider adaptability in Indo Gangetic Plains of India, Bangladesh, Pakistan and some parts of China, Central Australia (Hobbs and Gupta 2003, Timsina and Connor 2001) [5, 10]. Aggarwal and Goswami (2003) [1], Zhang *et al.* (2007) [11] and Sing *et al.* (2010) [9] found lower water consumption and higher wheat yield under furrow irrigated raised bed planting than under conventional flatbed planting due to decrease in irrigation amount. Bed planting also created better soil physical environment all throughout the crop growth, which led to higher crop productivity (Aggarwal and Goswami 2003, Sharma and Bhushan 2001) [1, 8]. Research trials at Delhi showed that beds were most suited for growing crops like maize, wheat and soybean as they significantly decreased water use (Aggarwal and Goswami 2003) [1].
Hence an attempt was made to evaluate the suitability by monitoring changes in water availability, rooting characteristics under raised bed furrow planting system as compared to the conventional practice for showing its effect in improving or deteriorating soil physical environment and crop yield.

2. Materials and Methods
The study was carried out during the year 2014-15 at North Pulinpur ADC Village of undivided West Tripura district. The soil was sandy loam in texture with acidic soil condition (P^H: 5.2). Main treatments included two methods of planting, viz, i) raised bed furrow irrigation method of planting (sowing of one row of maize on 37.5 cm wide beds alternating with 30 cm wide furrows) and ii) conventional planting (line sowing on flat beds at 67.5 cm row to row spacing). Soil Bulk Density (BD) was determined by core method (Blake and Hartage 1986) [3] at 10, 30, 60 DAS. A root auger (0.15 high and 0.05 m in diameter) was used to collect the root samples in 0-45 cm in soil profile at 15 cm depth interval at flowering stage of the crop. The field saturated hydraulic conductivity was measured by Guelph Parameter (GP).

Table 1: *General physico-chemical properties of experimental soil*

Soil Properties	Values/description
Soil Texture	Sandy loam
Soil P^H	5.2
Available P by Bray's method (Kg/ha)	16.8
Available N_2 (Kg/ha)	177.5
Available K_2O (Kg/ha)	189.5

3. Results and Discussion

A. Effect on Bulk Density

Studies on temporal variation of average BD of 0-30 cm sandy loam soil under bed furrow and conventionally planted maize revealed that BD measured on 10 DAS at the centre of raised bed was lower by 9% than BD of 1.48 mg/m^3 under conventional method. The trend continues during the later stages of crop growth but the differences among the treatments narrowed down.

Table 2: *BD at 10, 30 and 60 DAS*

Method of planting	BD at 10 DAS (mg/m$^{3)}$	BD at 30 DAS (mg/m^3)	BD at 60DAS (mg/m^3)
Conventional planting	1.48	1.58	1.72
Raised bed furrow irrigation	1.35	1.50	1.68

Date presented in Table 2 revealed that the decline in BD was sharper in conventional method than that of raised bed furrow irrigation method which indicated better physical condition in raised bed furrow irrigated method of planting, with more water availability and lesser mechanical impedance to growing roots than in conventional method. Similar trends also were reported earlier (Da silva *et al.* 1994, Betz *et al.* 1998, Lapen *et al.* 2004) [4, 2, 7].

B. Effect on Available water retention capacity (AWRC)

AWRC did not show much variation with increase in BD in both the treatments.

C. Effect on rooting Characteristics

It was observed that for both methods of planting nearly 80-85% of maize roots were confined in upper 0-15 and 15-30 cm of soil layers. Horizontal and vertical root length densities (RLD) were also more under raised bed than under flat planting system, which is because of better physical condition of the soil i.e., less bulk density and more porous environment of raised bed method of planting. Similar results were obtained by Aggarwal *et al.* (2003) and Kay *et al.* (2006) [1, 6].

D. Effect on Field saturated hydraulic conductivity

Results revealed that saturated hydraulic conductivity under raised bed method was 3 times of its value of 0.37 cm/hr under conventional system because of more porous environment of the bed.

Table 3: *Saturated hydraulic conductivity in different methods of planting*

Method of planting	Saturated hydraulic conductivity K_S (cm/hr)
Conventional planting	0.37
Raised bed furrow irrigation	1.11

E. Water use and Yield

Maize grain yield data reveals that there is more than two fold increase in maize yield in raised bed as compare to flatbed method by using hybrid variety of Maize (Disha-3502) in both the method of planting. Total water use by crop during the whole season was also less by 3.7 cm in raised bed over conventional method of planting.

Method of planting	Yield(q/ha)	Water Use (Cm)
Conventional planting	45	26.2
Raised bed furrow irrigation	22	22.5

4. Conclusion

It could be concluded that that raised bed furrow irrigation method of planting is superior to conventional method of planting as it has having better physical condition leading to more water availability to plant i.e., less water stress period for plants, higher root growth and significantly higher maize yield with less water use.

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