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EVALUATION OF DIFFERENT IRRIGATION SYSTEMS FOR ECONOMIZING WATER USAGE AND ENHANCING CROP PRODUCTIVITY

Saleem-ul-Haq Siddiqui, Muhammad Imtiaz, Parvez Khan, M. Yousuf Memon, Muhammad Aslam and S. K. Hussain Shah

Soil Science Division, Nuclear Institute of Agriculture, Tando Jam-70060, Pakistan
Email: moeedaslam@gmail.com, Telephone No. 022-880868, 2765750

ABSTRACT

A field experiment was conducted to study of different irrigation systems for economizing water usage and enhancing crop productivity. The biomass obtained, on average basis by bed and furrow method of planting amounted to be 7256 kg ha^{-1} by ridge sowing method 7069 kg ha^{-1} . The Bed and furrow system of planting gave numerically better grain yield for both the years and averaged to 2525 $kgha^{-1}$. Ridge planting technique was ranked second 2442 kg grain ha^{-1}. The maximum quantity of water was applied through basin irrigation, which amounted to be 10.42 acre inch. The bed and furrow system of planting proved economical as in this method the crop was applied with 4.78 acre inch during its growth period to get even better yield. The moisture contents of the field under all the planting systems were monitored for 15 days to check any change in moisture level of the soil where similar moisture contents were found in all treatments.

Key words: Ridges, Bed and furrow, Basin, wheat, Irrigation system

INTRODUCTION

Out of Pakistan's total geographical area of 79.61 million hectare, an area of about 17.82 million hectare is irrigated one. Total annual water availability is 134.77 Million Acre Feet (MAF) including that derived from surface water flow (84.22 MAF) and groundwater reservoir (50.55 MAF) (Agricultural Statistics of Pakistan 2000-01). The Indus Basin Irrigation System is the main irrigation system, which supports Pakistan's agriculture. Reduced canal water supplies, rapidly depleting groundwater resources, poor water productivity and declining rate of development of water resources are some of the major water related constraints for sustainable agriculture (Gill *et al.,* 2001).

Water conservation is of paramount importance for plant and animal production in dry land agriculture (Unger, 1983). Since planting techniques are receiving much attention now a days to conserve the water resource, the present study is under taken to assess the relative efficacy of different irrigation application systems in economizing water usage and enhancing crop productivity.

MATERIALS AND METHODS

This study was conducted during Rabi 2003-2004 and 2004-2005 at the Experimental Farm of the Nuclear Institute of Agriculture, Tando Jam. The soil of experimental site was clayey in texture with 41 % water holding capacity, non-saline in nature (EC: 0.68 dSm^{-1} in 1: 2 soil water ratio), low in O.M (0.69%), total N (0.04%) and Olsen's P (7.2 mg kg^{-1}). The experiment comprising of three planting method namely Control (Flat bed planting), Bed & Furrow planting and Ridges planting was laid out according to RCB design with four replications. Wheat was cropped at an inter-row spacing of 30 cm at recommended seed rate. In bed and furrow planting method, the middle area of 30 cm was raised so that the roots of wheat could receive the irrigation from one side using furrows as sub-channels. In ridges planting method, ridges were made 30 cm apart, so that every row could receive irrigation water from both sides. Both of these planting methods were compared with normal sowing to assess their suitability for enhancing water usage efficiency. The measured quantity of irrigation was applied to all treatments using cutthroat flume. Fertilizer N, P and K were applied to all treatments uniformly at recommended rates to fulfil the nutritional requirement of the crop at the time of sowing. However, N dose was divided into two splits one half at sowing and other half at tillering stage.

RESULTS AND DISCUSSION

Biological Yield

The biological yield was not affected significantly by water treatments (Table 1). The biological yield was however, slightly higher in bed & furrow planting compared to other treatments. The biomass obtained by bed and furrow method of planting was amounted to be 7256 kg ha^{-1}. On an average, ridge sowing yielded 7069 kg ha^{-1} of

biomass which was second better treatment. These results revealed that each method of planting could manage to provide required quantity of moisture for producing a unit of biomass by the crop (Malik and Hassan 1990).

Grain Yield

The data on grain yield have been depicted in (Table 1).The results showed that the effect of planting methods on grain yield was similar for both the years. Although traditional way of flooding gave the lower yield for both the years, however the decrease in yield was non-significant. The Bed and furrow system of planting gave numerically better yield for both the years which averaged 2525 kgha^{-1}. Ridges way of planting ranked second as it produced 2442 grain kg /ha. These results are in agreement to those of (Saeed and Yousaf 1994). The results revealed that all of the methods were equally effective for successful crop husbandry however, the bed and furrow and ridges have edge over the conventional methods as it utilizes less quantity of water to produce unit mass of grain (Malik and Hassan 1990).

Quantity of water

The crop was applied with normal four irrigations during the growth period, however the quantity of water applied was entirely different (Table 3). The maximum quantity of water was applied through basin irrigation, which was amounted to be 10.42 acre inch. The bed and furrow system of planting proved economical as in this method crop was applied with 4.78 acre inch water during its whole growth. It was observed that bed and furrow irrigation system saved 54% water and ridges irrigation saved 21% water as compared with basin irrigation system. The authenticity of the bed & furrow and ridges has also been reported by the other researchers (Chaudhry *et al*., 1994).

Moisture contents in soil

The moisture contents of the field under all planting systems were monitored for 15 days to check any change in moisture level of the soil. The results showed that similar moisture contents were found in all treatments. The moisture contents decreased with passage of time in similar way (Table 2) suggesting the uniform distribution of water by all methods of planting (Gill, 1994). These results suggested that each of the method was effective enough to provide sufficient moisture in the root zone for crop growth.

Table 1. Yield as affected by different irrigation methods (Average two years)

Irrigation Method	Yield (Kg/ha^{-1})	
	Biological	Grain
Basin	6931	2373
Bed & Furrow	7256	2525
Ridge	7069	2442

Table 2. Soil moisture contents in soil after irrigation (Average of four irrigations)

	At 5th day		At 10th day		At 15th day	
Method	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
Basin	12.87	12.70	9.22	9.89	7.31	6.41
Bed & Furrow	12.60	12.16	9.21	9.08	6.45	6.82
Ridge	12.64	11.97	10.12	9.86	7.58	7.28

Table 3. Amount of water required as affected by different irrigation system

	Irrigation (acre inch)					
Method	1st	2nd	3rd	4th	Total	Average
Basin	4.02	3.49	1.48	1.43	10.42	2.61
Bed & Furrow	1.64	1.53	0.78	0.83	4.78	1.20
Ridge	3.26	2.79	1.02	1.09	8.16	2.04

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