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WATER SAVING AND CROP YIELD POTENTIAL OF MODERN IRRIGATION METHODS IN THE SEMI-ARID AREA

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The present study was carried out to determine the quantity of water applied and saved using different irrigation methods. Four irrigation methods i.e. border. furrow. raingun sprinkler and trickle irrigation were compared based on their application efficiency. magnitude of water saved and crop yield. It was found that water saved nnder furrow. raingun sprinkler and trickle irrigation respectively was 14.26 and 34% compared with border irrigation method. Similarly. the crop yield under raingun sprinkler and trickle irrigation methods was found to be 31 and 12% higher than that with border irrigation method. This shows that the trickle irrigation method is a more suitable technique of water application if employed in areas having scarce water resources and undulating topography.
Key words: crop yield potential. modern irrigation methods. water saving

INTRODUcnON

As the world becomes increasingly dependent on the agricultural production from irrigated lands. irrigated agriculture is facing serious challenges that threaten its sustainability (VanSchilfgaarde. 1990). It is prudent to make efficient use of available water resources through minimizing its losses by adopting modern irrigation techniques and bringing more areas under irrigation. The overall irrigation efficiency of the conventional irrigation method (widely adopted in Pakistan) is very low and there appears a great scope for saving large quantities of water by using improved irrigation methods.

Haq (1990) reported that water saving in case of sprinkler irrigation was 30%. The crop production per unit of water used was 41,33 kg/ha/cm for surface irrigation. Trout et al, (1994) concluded that potato produced better quality tubers under sprinkler irrigation than with furrow irrigation. Yohannes and Tadesse (1998) reported that higher yields and increased water use efficiency had been very often attributed to drip irrigation than the conventional furrow irrigation. The present study was carried out to determine quantity of water used and saved under modern irrigation methods as compared to the conventional method. The specific objective of this study was to compare the water use efficiency and to determine the crop yield potential by comparing the efficacy and effectiveness of three modern irrigation techniques with conventional border method.

METIIOOOUXN

The experiments were conducted at the Postgraduate Agricultural Research Station (PARS) of the Universtiy. The site was located at 32° latitude of southern hemisphere. The total area (0.80 ha) was divided into four portions for border. furrow. raingun sprinkler and trickle irrigation SYSt0llIS.The area for border and furrow method was 0.21 ha each while that for raingun sprinkler and trickle irrigation system was 0.23 ha and 0.06 ha respectively. The area for border irrigation was diviced into two borders of 7,5 x 70.0 m each. while for furrow irrigation each replication consisted of 13 furrows measuring 76 and O.7S III. The cotton was sown with hand drill maintaining a row to row distance of 0.75 m and plant to plant distance of 0.23 m. Each irrigation was applied at -",onl., soil moisture deficit (Michael. 1978).

RESULTS AND DISCUSSION

The comparison of rour irrigation methods was made based on the application efficiency. magnitude of water saving and crop yield.

Application Efficiency: The application efficiency varied from 58 to 66% and 66 to 73% for border and furrow irrigation respectivelly as shown in Tabcl I'. The increase in application efficiency after the first irrigation may be attributed to progressively decreasing soil infiltration rate and increasing evapotranspiration with respect to crop growth stages. Sufficient amount of water was lost by' evaporation before it covered the entire root zone. The application efficiency of raingun sprinkler system varied from 78 to 84% during the whole season (Table 1). The decrease in application efficiency with crop growth stages under the raingun sprinkler system \\as due to the interception losses. The interception losses increased due to increase in leaf area index and more water was needed to replenish soil moisture deficiency. which reduced the application efficiency. The application efficiency of trickle irrigation method varied from 87 to 93%. Water was applied at relatively frequent intervals which was almost equivalent to water content at field capacity.

Table I. Comparative application efficiency of four irrigation methods

No. of irngauons	Border	Furrow	Raingun sprinkler	Trickle
1	58	66	84	87
2	(j)	69	82	89
3	63	70	81	90
4	65	71	79	92
5	66	73	78	93

Depth of Water Applied/Saved: The depth of water applied to cotton crop under four irrigation methods is shown in Table 2. It indicated that 67.30. 57.65. 49.90 and 44.41 cm depth of irrigation water was applied under border. furrow. raingun sprinkler and trickle irrigation respectively. Percentage of irrigation water saved in relation to the border irrigation system (which used maximum depth of irrigation) was about 34. 26 and 14 respectively under trickle irrigation. raingun-sprinkler and furrow irrigation methods respectively. The results revealed that the highest water saving (34%) occurred under trickle irritgation.

Table 1. Depth of water applied/saved under different irrigation methods

Irrigation method	Water applied (an)	Water saved (%)	Water saved (%)
Border	67.30	—	—
Furrow	57.65	9.65	14,30
Raingun sprinkler	49.90	17.40	25.85
Trickle	44.41	22.89	34.01

Cotton Yield: The yield obtained for each irrigation technique is given in Table 3. It shows that 1690.' 1580. 1500 and 1400 kg/ha of cotton were obtained under raingun sprinkler. trickle. furrow and border methods of irrigation respectively. The increase in yield in comparison with yield obtained under border irrigation was nearly 7. 13 and 21% using furrow. trickle and raingun sprinkler methods re-spectively.

Table 3.1mlJact of different irrigation methods on cotton yield (kg/ha)

Irrigation method	Yield (kg/ha)	Increase in yield (kg/ha)	Percent increase
Border	1400	—	—
Furrow	1500	100	7.14
Trickle	1580	180	12.85
Raingun sprinkler	1690	290	21.00

Water Use Efficiency: The water use efficiency obtained from four irrigation methods, is shown in Table =t. Water use efficiency is a potential criterion for getting information about crop yield under water stress. This parameter helps determine the level of efficiency the applied water has been used by the crop. In other words. it evaluates the efficiency of water utilization by the crop in terms of final output. depending upon the total water applied and seed cotton yield obtained.

Table 4. Water use efficiency of four irrigation methods

Irrigation method	Irrigation applied (mm)	Yidd (kg/ha)	Water use efficiency (%)
Border	673.<Xl	1400.00	2.13
Furrow	*576.50*	1500.00	2.60
Raingun sprinkler	499.m	1690.00	:\.38
Trickle	441.10	1580.00	:l.55

Conclusions: The raingun sprinkler and trickle systems are more efficient and help improve crop yield. The raingun sprinkler system showed the highest value of water use efficiency. The trickle system showed the highest application efficiency and is recommended for areas having acute water shortage.

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