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# INFLOW RATE AMD CUTOFF RATIO FOR IRRIGATION IN NEARLY LEVEL BORDER STRIPS*

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At present, in the command areas of major irrigation projects and wherever lift irrigation facilities are available a third crop of rice is taken, during the dry season. The total water requirement of rice in the first and second crop seasons is 10-15 mm per day in loamy sand. The percolation loss in these seasons, is 6-8 mm perday. But in summer months, rice needs 25-30 mm of water per day in which the percolation alone comes to about 20 mm of water per day. Hence if rice is grown during summer months, there is an additional wastage of 12 mm of water due to deep percolation. Since in all other crops, no standing water is kept in the field and the field is irrigated only upto field capacity, the loss due to deep percolation is almost eliminated. The water requirement of other field crops like pulses, oil seeds and vegetables is only 6-8 mm per day. In other words, the water needed to raise one hectare of rice in summer months can be more profitably used to raise about 4 ha of any other crop.

But there is no satisfactory method of irrigation for the dryland crops in the rice fallows. Border strip method of irrigation is hardly practised anywhere in Kerala, even though this is a very popular method in the other parts of India for raising cereals, pulses and oilseeds. However, this method is practised there on slopping lands. In Kerala as the area is under paddy during kharif and rabi seasons the level of the land cannot be disturbed. For this situation, a technology has to be developed for efficient use of the limited water available in this season for irrigating nearly level rice fallows. The objective of this project was to study the hydraulics of border strip irrigation in nearly level lands and to recommend the optimum rate of discharge and the best cutoff time of inflow.

## Materials and Methods

The experiments were done during 1981-82 at the Agronomic Research Station, Chalakudy and an observational trial was conducted prior to the main experiment during 1980-81. The average slop of the field where the trial was done, was 0.01 per cent The widths of 2 m, 3 m and 4 m combined with four discharge rates of 2, 3, 4 and 5 l/s/m were tried. The length of border was 50 m in all cases. The infiltration rate of the soil was 1 cm/h and the cumulative infiltration followed theequation, $y = 0.08002\, t^{0.763} — 0.036$, where y is accumulated infiltration (cm) andt is elapsed time (min).

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Several cutoff lengths were tried to determine the best cutoff length. It was seen during the trial that when the stream was cutoff before the waterfront advance reached 66 per cent of the strip length, the water did not reach the downstream end in many cases. When the water was cutoff at 88 per cent, there was excess ponding at downstream. But for a cutoff length of 77 per cent, uniform distribution of water could be obtained. From these results, the cut off length was designed as 77 per cent of the strip length for the main experiment.

The stream sizes selected for the main experiment were 2 l/s/m and 4 l/s/m. The experiment was laid out in RBD with four treatments and five replications arranged in 45 m long strips. The treatments were T1) 4m width with 2 l/s/m discharge rate; T2) 4m width with 4 l/s/m discharge rate; T3) 6m width with 2 l/s/m discharge rate; and T4) 6m width with 4 l/s/m discharge rate. The mean slope of the field was 0.04 per cent. The theoretical cutoff time, or the time required to irrigate each strip to the desired depth of 5 cm was calculated and the actual cutoff times, or the time taken by the waterfront to reach the designed cutoff length of 77 per cent for each irrigation were noted. The theoretical cutoff time and the actual cutoff time were compared. The velocity of flow and the hydraulic resistance were estimated and compared.

## Results and Discussion

The times required to apply 5 cm depth of irrigation for both the discharge rates were theoretically calculated. They were 1125 seconds and 562 seconds for the discharge rates of 2 l/s/m and 4 l/s/m respectively.

During the experiment, in some cases the inflow had to be stopped before the theoretical cutoff time, because the waterfront reached the cutoff length before that time. In some other cases, the inflow had to be continued even after the theoretical cutoff time because the waterfront advance did not reach the cutoff length. The actual cutoff time when the water front advance reached 77 per cent of the strip length for each irrigation is noted and is shown in Table 1.

The actual cutoff time in the field and the estimated theoretical cutoff time were compared. From this, it was seen that the actual cutoff time exceeded the theoretical cutoff time in four instances in T1, three times in T3, 21 times in T2 and 31 times in T4 out of a total of 35 irrigations. Chisquare test applied to this data revealed that the overall effects of treatments influenced highly the cutoff time. The treatments T1 and T3 were found to be significantly superior to the treatments T2 and T4. In other words, the lesser discharge of 2 l/s/m took less time than the theoretical time to reach the cutoff length in most of the cases while the higher discharge of 4 l/s/m exceeded the theoretical time in majority of the cases.

When the actual cutoff time is less than the theoretical time, it meant that the depth of irrigation applied is less than 5 cm. Hence in such cases, it is easy to apply the desired depth by extending the cutoff time. But if the cutoff time is

Table 1

Actual cutoff time at 77 per cent advance length, seconds

| Treatment | | Order of irrigation | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| T1 | $R_1$ | *1680* | 750 | 960 | 725 | 630 | 1070 | 1070 |
| | $R_2$ | *1680* | 785 | 790 | 720 | 670 | 950 | .1025 |
| | $R_3$ | *1120* | 720 | 875 | 700 | 880 | 895 | 960 |
| | $R_4$ | *1570* | 780 | 760 | 830 | 825 | 825 | 845 |
| | $R_5$ | *1325* | 735 | 1020 | 775 | 730 | 785 | 970 |
| T2 | $R_1$ | *590* | *590* | *605* | *595* | *795* | 530 | *600* |
| | $R_2$ | 555 | *660* | *590* | *670* | *795* | 540 | *590* |
| | $R_3$ | *605* | *742* | 555 | *700* | 390 | 530 | 525 |
| | $R_4$ | 740 | *755* | *615* | *570* | 480 | 545 | 755 |
| | $R_5$ | *605* | 540 | *625* | 550 | 530 | 555 | *740* |
| T3 | $R_1$ | 1080 | 1085 | 865 | 1010 | 810 | 1055 | 1060 |
| | $R_2$ | *1290* | *1205* | 980 | 1000 | 720 | 960 | 1090 |
| | $R_3$ | *1380* | 1100 | 780 | 825 | 825 | 905 | 1040 |
| | $R_4$ | 1120 | 1080 | 800 | 840 | 835 | 920 | 900 |
| | $R_5$ | 1090 | 1070 | 865 | 910 | 770 | 880 | 980 |
| T4 | $R_1$ | *1090* | *770* | 725 | 705 | *745* | *600* | 735 |
| | $R_2$ | *1020* | *725* | *1085* | 750 | 705 | *565* | *720* |
| | $R_3$ | *1085* | *685* | *700* | 730 | 510 | *615* | *780* |
| | $R_4$ | *1150* | *785* | *820* | *620* | 555 | *610* | *970* |
| | $R_5$ | *1090* | *740* | *800* | 535 | *665* | 5[illegible]5 | *195* |

Note: The values in italics, represent the cutoff times that exceeded the theoretical cutoff time.

more than the estimated theoretical time, it is not possible to limit the depth of application to 5 cm and spread the water in the entire field uniformly. In these cases, more than 5 cm of water have to be applied for uniform distribution of water in the field.

In treatment T1, all the four cases in which the cutoff time exceeded the theoretical cutoff time were during the first irrigation and in treatment T3, this happened two out of three times during the first irrigation.

Results of the experiment revealed that the depth could be limited to 5 cm when the rate of application was 2 l/s/m excepting during the first irrigation. This result coincides with the result obtained by Ram (1975). He concluded that for the first irrigation the best cutoff ratio was 85 per cent, and for the second and third irrigations the cutoff ratio were 80 per cent and 75 per cent respectively.

Among the treatments T2 and T4, T2 was found to have marginal superiority though both the treatments were not satisfactory. The actual cutoff time in T3 exceeded the theoretical cutoff time 21 times out of 35 irrigations. This implied that except for a few cases, the depth of irrigation could not be limited to 5 cm. With 2 l/s/m discharge rate, the widths of 4 m and 6 m were on par. The variation observed in these treatments might be due to chance.

The velocity was maximum in treatment T2 and this was only 3.6 m/min. Petrasovits (1971) observed that erosion was caused when the velocity exceeded 8 m/min. Hence the velocity is within the safe limit.

The hydraulic resistance "n" was found to be significantly higher in the treatments T3 and T1. In these treatments n value ranged between 0.02 and 0.185.

## Summary

The experiment was done to study the hydraulics, of border strip irrigation in nearly level lands, during 1982.

The study revealed that the discharge rate of 2 l/s/m and the inflow cutoff length of 77 per cent of the strip length are optimum for uniform distribution of water for the following reasons: 1) The depth of irrigation could be limited to 5 cm even in soils having high rate of infiltration; 2) The lower discharge rate of 2 l/s/m reduced the time of ponding at the downstream end and this minimised the wastage due to deep percolation at the downstream end; 3) Soil erosion was minimum at this rate of discharge; 4) Long strips upto 45 m length in loamy sand could be irrigated with high degrees of efficiency; and 5) As only a low rate of discharge was required to practise this method, even in areas having limited availability of water an additional crop could profitability be raised.

## References

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