SUPPLEMENTARY IRRIGATION REQUIREMENT FOR EARLY GROWN LOWLAND RICE DURING THE RAINY SEASON IN THE DRY ZONE

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ABSTRACT

Supplementary irrigation requirement, grain yield and water-use efficiency of two rice varieties were studied on the Reddish Brown Earths and Low Humic Gleys during the rainy season (Maha) commencing late September. It was observed that the short-aged variety (3½ months) required less irrigation water than the medium aged variety (4½ months) but its water use efficiency was higher. However, the long-aged variety was more productive. Water use efficiency on Low Humic Gley soils was higher than on Reddish Brown Earths, irrespective of age of crop.

INTRODUCTION

Shortage of water still remains one of the major limiting factors for agricultural production in most of our major irrigation schemes. Therefore, the importance of maximizing the productivity per unit of water cannot be over emphasized. In most of our irrigation schemes, it is seen that rainfall is not fully utilized. In a well planned system of cropping most of the water requirement of a crop could be met by rainfall, by adhering to proper planting dates and preventing any possible moisture stress by supplementary irrigation.

Under the present day system of cropping in most of our major irrigation schemes, the rice crop is established only when most of the rains are over. Somasiri (1981) observed that in both major and minor irrigation schemes farmers are reluctant to commence cultivation that will allow the full utilization of rainfall.

However, for early crop establishment water must be available for land preparation at the beginning of the season in order to practise puddling in low-land rice cultivation, which is the most popular system at present. Major irrigation schemes which receive water from perennial streams or transbasin diversion will have sufficient water in storage at the beginning of the season or they can be augmented with diversions.

This paper discusses the results of an experiment conducted to determine the supplementary irrigation water requirement of two rice varieties when established in late September on two soil groups, namely Reddish Brown Earths (imperfectly drained) and Low Humic Gley Soils (poorly drained). An attempt was also made to calculate the irrigation water use efficiency for the two varieties grown on the two soil types.

MATERIALS & METHODS

The experiment was carried out at the Agricultural Research Station, Maha Illuppallama during Maha season 1980/81. An extent of 1.33 ha (3.29 ac) out of a 4 ha block cultivated to paddy was selected for the study. In this area 0.76 ha (1.88 ac) was imperfectly drained Reddish Brown Earth (RBE/ID) while the balance was poorly drained Low Humic Gley (LHG). Approximately equal extents of land under each soil group were cultivated with two rice varieties, namely Bg 34–6 (3½ months) and Bg 90–2 (4½ months). Land preparation was started in mid September and sowing was done during the latter part of September.

Using irrigation water the land was soaked, ploughed and then inundated with water. The soil was not allowed to dry up after ploughing till final land preparation was complete. During the crop growing period whenever the water level in any paddy plot reduced to the level of the soil surface it was irrigated to about 5 cm standing water above the soil.

All inputs of water were measured by Parshall flumes and weirs. Rainfall data were obtained from an adjacent agro-met station. Effective rainfall was calculated as described by Joshua (1977). Fertilizer application and other management practices were done according to the recommendations of the Department of Agriculture. Weeds were controlled by spraying 3—4 DPA followed by MCPA and any weeds which were not controlled were pulled by hand. The total extents cultivated were harvested for final grain yield.

RESULTS & DISCUSSION

Water Use for Land Preparation

Water use for land preparation is given in Table 1. Values reported for poorly drained soils do not agree with that reported by Murakami *et al* (1965). They utilized 170 mm of water over a period of 25 days whereas in the present study 163 mm water were used within a period of 12—14 days.

The higher duty of water utilized in the present study may be attributed to high percolation and seepage rates resulting from the deep water table prevailing at the time of operation.

Lewis (1976) used 112 mm water on LHG soils for land preparation. This amount is very low compared to the results of Murakami *et al* (1965) and the present study. The lower water use by Lewis could be attributed to the fact that he utilized run off from RBE soils to compensate for part of the requirement on LHG soils.

The results presented in Table 1 indicate that the RBE/ID soils require about 25% more water than that required by LHG soils. Lewis has seen the same trend though the absolute values vary.

However, it is evident from the results of the present study and that of the previous workers that the land preparation water requirement varies with the soil group and duration of the operation.

Water Use During Crop Growth

Water use during the growing period for the two varieties on the two soil groups is given in Table 2. About 175—180 mm more irrigation water was required for the 4½ months variety than that the 3½ months variety, irrespective of soil group. The values reported in Table 2 could be considered field water requirement for the two varieties, as the irrigations were provided on a demand schedule basis. However, these values do not agree with results of Murakami *et al* (1965) or Lewis (1976).

About 75% of the water requirement of the 3½ months variety on LHG soils was met by rainfall. In the case of 4½ month paddy only 69% of the water requirement was met by rainfall on the same soil group. The corresponding values on RBE/ID soils are 61% and 57% for 3½ and 4½ months varieties respectively. The results indicate that a higher percentage of the water requirement of the short-aged variety has been met by rainfall compared to the long-aged variety when planted in late September. However, the proportion of water requirement that could be met by rainfall depends on the time of sowing and duration of the crop growth. Panabokke *et al* (1974) showed that the Maha season begins between 29th September and 6th October for Anuradhapura district in the dry zone. They also showed that the water requirement of a 95—100 day rainfed cereal crop could be met

by rainfall when planted in the first week of October in the same district. It is evident that the supplementary irrigation water requirement becomes high if planting is delayed from this date or a longer aged variety is grown.

Potential evapotranspiration of the two paddy varieties as calculated from modified penman method (Doorenbos and Pruitt 1975) was 470 and 607 mm for 3½ and 4½ month varieties respectively. If it is assumed that the evapotranspiration of paddy took place at potential level, then field water loss due to seepage and percolation amounts to 383 and 421 mm for 3½ and 4½ month varieties respectively on RBE/ID soils. The corresponding values on LHG soils amounts to 315 and 378 mm respectively for 3½ and 4½ month varieties.

The results suggest that the total field water requirement (including land preparation) on RBE/ID soils is about 10% higher than that on LHG soils irrespective of the variety (Table 2).

Grain Yield and Water Use Efficiency

Grain yield and water use efficiency-defined here as kilograms of paddy (coarse grain) produced per hectare per mm of water-by the two varieties on the two soil groups are presented in Table 3.

According to Senadheera (personal communication, 1982) potential yields of Bg 90-2 and Bg 34-6 are 9880 and 6910 kg/ha paddy (assuming 20 kg per bushel) respectively under ideal conditions in the dry zone. In this study Bg 90-2 reached 80% of the potential yield while Bg 34-6 reached about 95% of its yield potential.

Total water use efficiency or TWUE (Irrigation+Rainfall) of the two varieties on the two soil groups appears to be similar. But the irrigation water use efficiency (IWUE) of the two varieties on the two soil groups is different (Table 3). On LHG soils the rice crop uses irrigation water more efficiently than it does on RBE/ID soils. On the other hand IWUE of 3½ month variety is higher than that of 4½ month variety on both soil groups. The highest IWUE was recorded on LHG soils by the 3½ month variety.

However, total yield of the 3½ month variety is less than that of the 4½ month variety (Table 3). Use of 175-180 mm additional irrigation water by 4½ month variety produced 1297 kg additional paddy per hectare irrespective of the soil group. The extra yield from 4½ month variety per unit of water was

less than the overall yield per unit of water. On this basis it appears more beneficial to grow shorter aged variety than the longer aged variety. The results of this study suggest that the water use efficiency may be increased by growing short-aged varieties. An important aspect that must also be considered in this regard is the economic return that could be obtained in the subsequent season by using the water saved by growing a short-aged variety during Maha season. Presently farmers prefer to grow a medium aged (4—4½ month) variety during Maha season even though there are 3½ month varieties with comparable yield potentials. This may be due to the fact that short-aged varieties require a higher level of management.

CONCLUSIONS

Most of the rainfall could be made available for rice production during Maha season if the crop is established in late September to early October. This can help minimize irrigation water to a considerable extent. IWUE was higher on LHG soils than that on RBE/ID soils. The 3½ month variety has high IWUE compared to that of the 4½ month variety, when grown in late September. However, the total yield of 4½ month variety was higher than that of 3½ month variety.

At present there are 3½ month varieties with potential yields comparable to that of 4½ month varieties. These varieties may give still higher IWUE compared to 4½ month varieties, but without affecting the yields. However, these varieties need high level of crop management to obtain higher yields. Possibility of increasing irrigation water use efficiency by growing short-aged varieties while obtaining high yields comparable with long aged varieties has therefore to be fully investigated with relevant economics in order to use limited irrigation water more efficiently.

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Table 1. Water Use for Land Preparation during Maha Season 1980/81 (mm)

Soil Group	*RBE/ID*	*LHG*
Irrigation	171	130
Effective rainfall	33	33
Total	204	163

Table 2. Water Use for 3½ month and 4½ month Paddy during Growing Period in Maha Season 80/81 (mm)

Soil Group	*RBE/ID*		*LHG*	
Paddy Age Class	*3½ M.*	*4½ M.*	*3½ M.*	*4½ M.*
Irrigation	264	439	196	376
Effective rainfall	589	589	589	589
Total water use for growth	853	1028	785	965
Total (including land preparation)	1057	1232	948	1128

Table 3. Grain Yield and Water Use Efficiency of Paddy during Maha Season 1980/81

Soil Group	*RBE/ID*		*LHG*	
Paddy Age Class	*3½ M.*	*4½ M.*	*3½ M.*	*4½ M.*
Yield (kg/ha)	7106	8403	6743	8040
(bu/ac)	(137)	(162)	(130)	(155)
Water use efficiency (kg/ha/mm)				
(*a*) Total water	8.3	8.2	8.6	8.3
(*b*) Growing period irrigation (IWUE)	26.9	19.1	34.4	21.4