

IRRIGATION MANAGEMENT FOR RATOON SORGHUM

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A study was conducted during the year 1982-83 and 1983-84 to study the effect of irrigation at critical stages of growth under two depths of irrigation in ratoon sorghum (CO 24). Irrigating the ratoon sorghum five times, viz., ratooning, knee-high, flag leaf, flowering and soft dough stages, with 4 cm depth, produced higher grain yield with high water use efficiency. Among the stages, flowering is found to be the most critical period for moisture stress.

Ratooning is widely practiced in crops such as sugarcane, banana, cotton and sorghum. Sorghum is grown as a successful ratoon crop in Australia, Hawaii, Arizona, California and Philippines. Vijayakumar (1977) observed that it is possible to harvest one sown crop and one ratoon crop in a single growing season which would otherwise be too long for two consecutively sown crops. The other advantages are reduced cost of cultivation and more production in shorter period. This is being done both in hybrids and short duration varieties of sorghum, which have greater production potential in the tropics.

Water is an important limiting factor in crop production and its efficient use is essential for increasing agricultural production. Though some research information is available on scheduling of irrigation to sown sorghum, experimental data on the most critical stages of irrigation and water

use efficiency for ratoon sorghum is not available. Hence a study on these aspects was taken up.

MATERIALS AND METHODS

Field experiments were conducted for two years (1982-83 and 1983-84) with sown sorghum in the kharif season followed by ratoon sorghum in the rabi season, in a moderately drained sandy clay loam soil of Agricultural College and Research Institute, Madurai, under the ICAR sponsored Co-ordinated project for Research on Water management. The soil is rated low, low and medium in available nutrient status for N (122 kg/ha); P₂O₅ (9.0 kg/ha) and K₂O (146 kg/ha), respectively. The other soil moisture characteristics are; available soil moisture 11.1 per cent, field capacity 16.8 per cent; wilting point 5.6 per cent; hydraulic conductivity in 15-20 cm layer 2.0 cm/hr; bulk den.

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sity 2.6 g/cc; infiltration rate 2.5 cm/hr; pH 7.3 and EC 0.2 m. mhos/cm.

Sorghum variety CO 24 with a main crop duration of 105 days, released from Tamil Nadu Agricultural

University, Coimbatore, was chosen for the study. The experiment was conducted in Factorial Randomised Block Design replicated thrice with the following treatments:

(i) Stages of irrigation

| Treatment | No. of irrigations | Irrigation at the growth stages* | | | | | | | | |
|------------------|--------------------|----------------------------------|----------------------|-----------------|-----------------|-----------------|-------------|------------|-----------|--|
| | | Ratooning | 4 to 5 leaf stage | Knee high stage | Flag leaf stage | Flowering stage | Milky stage | Soft dough | Hardening | |
| S ₁ | 6 | / | / | X | / | X | / | / | / | |
| S ₂ | 5 | / | / | X | / | X | / | X | / | |
| S ₃ | 5 | / | X | / | / | / | X | / | X | |
| S ₄ | 4 | / | X | X | / | X | / | X | / | |
| @ S ₅ | Farmers practice | / | Once 7-10 days | | | | | | | |

* / = denotes irrigation supplied; X = denotes irrigation skipped.

@ This was included only during the year 1983-84, for comparison.

(ii) Depth of Irrigation

D₁ — 4.00 cm

D₂ — 6.00 cm

There were no treatments in the main crop. A uniform dose of 90:45:45 kg/ha of N, P and K was applied to the main crop with scheduling of irrigation at 0.75 IW/CPE ratio. For ratoon crop 45 kg N/ha alone was applied on the day of ratooning. Predetermined quantity of water based on depth and area was applied by using a Parshal flume. The ratoon crop was harvested 85 days after ratooning. All the routine practices were followed and plot-wise grain yield, stover yield and water use efficiency were recorded.

RESULTS AND DISCUSSION

A. Grain yield :

The grain yield is presented in Table 1. Irrigating the sorghum ratoon crop at five stages viz., at ratooning, knee-high, flag leaf, flowering and soft dough (S₃) recorded significantly higher yield of 2220 kg/ha in the first year over other treatments in which irrigation was skipped during flowering stage. Thus, it is clear that among the stages of growth, flowering is most critical for irrigation in ratoon sorghum. Rao (*et. al.*) (1977) reported that the boot leaf and flowering stages in sown sorghum crop are the most critical stages for soil

Table 1. Grain yield of ratoon sorghum (kg/ha) as influenced by stages and depth of irrigation

| Stages of irrigation | 1982-83 | | | 1983-84 | | |
|----------------------|----------------|----------------|------|----------------|----------------|------|
| | Depth | | Mean | Depths | | Mean |
| | D ₁ | D ₂ | | D ₁ | D ₂ | |
| S ₁ | 1689 | 1876 | 1782 | 1493 | 1372 | 1432 |
| S ₂ | 1709 | 1736 | 1722 | 1707 | 2073 | 1890 |
| S ₃ | 2653 | 1787 | 2220 | 1707 | 2621 | 2164 |
| S ₄ | 1770 | 1437 | 1603 | 1814 | 1951 | 1882 |
| S ₅ | — | — | — | 2118 | 1570 | 1894 |
| Mean | 1955 | 1709 | | 1768 | 1917 | |

| | SE D | CD | SE D | CD |
|----------------|---------|-----|---------|------|
| Depth | 98 | 211 | 66.5 | N.S. |
| Stages | 139 | 298 | 105 | N.S. |
| Depth x stages | 195 | 419 | 149 | N.S. |

moisture stress. Palaniappan *et. al.* (1977) also observed ten per cent yield reduction when irrigation was withheld at flowering stage.

In the subsequent year also through the grain yield was not statistically influenced by stages of irrigation, higher yield (2164 kg/ha) was recorded from plots which received five irrigations (S₃) viz., at ratooning, knee high, flag leaf, flowering and soft dough stages.

Among the depths of irrigation, in the first year irrigating the ratoon sorghum at 4 cm (D₁) recorded significantly higher yield of 1955 kg/ha than irrigating the crop with 6 cm (D₂) depth, which recorded only 1701 kg/ha. It was also noticed that significant interaction existed between stages and depth of irrigation. Irrigating the rat-

oon sorghum crop with 4 cm depth at five stages of irrigation viz., at ratooning knee high, flag leaf, flowering and soft dough recorded higher yield of 2653 kg/ha over other combinations. The same trend was noticed in the following year also. But the non-significant yield differences during 1983-84 may be due to the frequent rains (18.44cm) received during the crop growth period, especially during flowering period (12.00 cm).

b. Stover yield :

The stover yield of ratoon sorghum (Table 2) was influenced by stages of irrigation in both the years but the depth of irrigation influenced the stover yield during 1983-84 alone, with the same trend of grain yield. Irrigation given at six stages (S₁) viz., at ratooning, 4-5 leaf, flag leaf, milky,

Table 2. Stover yield of Ratoon sorghum (kg/ha) as influenced by stages and depth of irrigation

| Stages of Irrigation | 1982-83 | | 1983-84 | | | |
|----------------------|----------------|----------------|----------------|----------------|------|------|
| | Depths | | Depths | | | |
| | D ₁ | D ₂ | D ₁ | D ₂ | | |
| S ₁ | 7665 | 8004 | 7834 | 9878 | 8984 | 9431 |
| S ₂ | 8207 | 6918 | 7563 | 6565 | 7337 | 6951 |
| S ₃ | 6331 | 6195 | 6263 | 7053 | 5833 | 6443 |
| S ₄ | 6511 | 5494 | 6003 | 6931 | 6077 | 6504 |
| S ₅ | — | — | — | 8374 | 6138 | 7256 |
| Mean | 7178.5 | 6652.75 | | 7760 | 6874 | |

| | SE D | CD | SE D | CD |
|----------------|---------|------|---------|------|
| Depth | 342 | N.S. | 506 | 1061 |
| Stages | 438 | 1038 | 798 | 1678 |
| Depth x stages | 818 | N.S. | 1128 | N.S. |

soft dough and hardening and farmers practice of supplying irrigation (S₅) once in 7 to 10 days recorded maximum stover yield, indicating that more the irrigations, higher the straw yield at the cost of grain yield. Kandasamy and Subramanian (1980) also observed that stover yield of sown sorghum (CSH 5) increase in Periyar-Vaigai Command area with the increase in the number of irrigations.

C. Water use efficiency

The water use efficiency was higher when the ratoon sorghum received 5 irrigations (S₃), which includes flowering stage, at 4 cm depth. It recorded 74.1 kg/ha cm of water used. The water use efficiency was very low under farmers method of irrigation (S₅) and at 6 stages of

irrigation (S₁), indicating too many irrigations will not correspondingly contribute to the increase in grain yield. This finding corroborates the earlier study conducted at Bhavani-sagar on CO 23 sown sorghum and in Dharwad on sown CSH - SR Jowar (Anon., 1983). In both the centres it was found that lesser the frequency of irrigations, higher the water use efficiency.

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Table 3. Water Use Efficiency (mean of two years)

| Treatments | Total No. of irrigations* | Crain yield (kg/ha) | | Irrigation water used (cm) | | Rainfall (cm) | Total water used (cm) | | Water use efficiency (kg/ha cm) | |
|----------------|---------------------------|---------------------|----------------|----------------------------|----------------|---------------|-----------------------|----------------|---------------------------------|----------------|
| | | D ₁ | D ₂ | D ₁ | D ₂ | | D ₁ | D ₂ | D ₁ | D ₂ |
| S ₁ | 5 | 1591.0 | 1623.5 | 22.0 | 33.0 | 11.41 | 33.41 | 44.41 | 47.6 | 36.5 |
| S ₂ | 5 | 1708.0 | 1904.0 | 18.0 | 27.0 | 11.41 | 29.41 | 38.41 | 58.1 | 44.6 |
| S ₃ | 5 | 2180.5 | 2204.0 | 18.0 | 27.0 | 11.41 | 29.41 | 38.41 | 74.1 | 57.4 |
| S ₄ | 4 | 1791.5 | 1694.0 | 14.0 | 21.0 | 11.41 | 25.41 | 32.41 | 70.5 | 52.3 |
| S ₅ | 10 | 2118.3 | 1569.7 | 36.0 | 54.0 | 18.44 | 54.44 | 72.44 | 38.9 | 21.7 |

* Because of the heavy rainfall during September-October, 1984 one irrigation at ratooning was skipped in all the treatments.

(†) One year data.

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