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# EFFECT OF OPERATIONAL FACTORS ON THE EFFICIENCY OF SPRINKLER SYSTEM

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ABSTRACT

Field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore to assess the effect of Nozzle Size and Operational Pressure on the efficiency of Sprinkler System. The parameters taken for assessing the efficiency of irrigation were the percentage of total water loss and percentage of uniformity in water distribution. Among the four nozzle sizes tested, 4.76 mm x 2.38 mm size recorded the minimum water loss. In case of the operational pressures, lowest pressure of 1.2 KSC was found to be superior by recording the lowest water loss and highest uniformity in water distribution. Under the combination of medium nozzle size of 5.56 mm x 3.17 mm and lowest pressure of 1.2 KSC, the total water loss was minimum.

**KEY WORDS: Sprinkler system, Nozzle size, Operational pressure.**

Sprinkler irrigation becomes popular in tropical countries because the water utilisation efficiency is very high for this system. Reduction in water loss and higher uniformity of distribution during the operation are the major parameters in assessing the efficiency of an irrigation system. In sprinkler system, the water loss can be minimised by altering the operational factors like nozzle size and operational pressure. Kraus (1966) has reported that the nozzle size and operational pressure are important factors in controlling the water loss in sprinkler system. Kohl (1973) and Dutta **et al.** (1977) have studied the effect of nozzle size and operational pressure on the uniformity of distribution.

## MATERIALS AND METHODS

To assess the water loss

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in sprinkler irrigation as influenced by nozzle size and operational pressure, this study has been carried out at Tamil Nadu Agricultural University, Coimbatore during June-September, 1982. The experiment was conducted in sandy loam soil with ragi as test crop. As a control, uncropped area has been included in this study.

Four different nozzle sizes were used alongwith four different operational pressures. The nozzles used were (1) 3.97 mm x 2.38 mm (2) 4.76 mm x 2.38 mm (3) 5.56 mm x 3.17 mm and (4) 6.35 mm x 3.17 mm. The four different pressures tested were (1) 1.2 KSC (2) 2.5 KSC (3) 3.5 KSC and (4) 4.0 KSC. The sprinkler type taken for this study was twin nozzle, single riser No.4 with rotary male connection. The pressure of issuing jet was measured with pressure gauge

During the cropping period 10 irrigations were given and each irrigation was based on the soil moisture estimation. The water required for each irrigation was equally divided into 16 parts and the irrigation was done with 16 combinations of different nozzles and different operational pressures.

The quantity of water supplied to the sprinkler system was measured with a water meter. At the end of each test, the water received at the soil surface was measured by catch cans, placed at the surface level at 3 M x 3 M spacing in a square grid net work pattern. The loss of water was computed by mass balancing the volumes of water delivered and water collected. The uniformity of distribution was calculated by the standard method developed by Christiansen (1942). The data were subjected to statistical analysis without transforming the percentages since the data were assumed to be distributed normally.

## RESULTS AND DISCUSSION

### Nozzle size

The data on the effect of nozzle size on percentage of water loss and percentage of uniformity in distribution are given in Table 1.

The water loss in nozzle size of 4.76 mm x 2.38 mm (N2) was minimum, whereas it was maximum for nozzle size 3.97 mm x 2.38 mm (N1). When the nozzle size was increased from N2 to N4 level and reduced to N1 level, the water loss was increased by 3.01% and 3.36% respectively. This might be due to the easy drifting of smaller droplets produced by the smaller nozzle size. This result is in the line of Kraus (1966).

There was no significant difference in the uniformity of distribution due to the change in nozzle size. Similar finding was made by Kundu **et al.** (1978).

### Operational pressure

The data on the effect of operational pressure on the water loss and uniformity of distribution in sprinkler system are presented in Table 2.

The loss of water was minimum, under 1.2 KSC pressure and the maximum loss was recorded under the maximum pressure (4.0 KSC) studied. When the pressure was increased from 1.2 KSC to 2.5 KSC and 3.5 KSC levels, the loss also increased for each incremental pressure. Higher evaporation and drifting loss might be the reasons for the increased water loss when the operational pressure was increased. This concept is in line with Frost and Schwalen (1960).

There was no significant difference in the uniformity of distribution due to the change in operational pressure.

### Interaction of Nozzle size and operational pressure

**A. Effect on total water loss:**

The data on the effect of nozzle size and operational pressure on the loss of water are presented in Table 3.

The pressure of 1.2 KSC with 5.56 mm x 3.17 mm of nozzle size recorded the lowest water loss. When pressure was increased from this level, the loss also increased. The maximum water loss was encountered under N1 and P4 combination. This might be due to the finer break-up of water droplets under the highest pressure. The environmental factors like temperature and wind velocity might have

Table 1. Effect of nozzle size on total water loss and uniformity of distribution

| Nozzle size | Total water loss (%) | Uniformity in distribution (%) |
|---|---|---|
| N1 3.97 mm x 2.38 mm | 33.92 | 86.29 |
| N2 4.76 mm x 2.38 mm | 30.56 | 86.05 |
| N3 5.56 mm x 3.17 mm | 30.96 | 86.40 |
| N4 6.35 mm x 3.17 mm | 33.57 | 86.08 |
| SEm ± | 0.385 | 0.253 |

Table 2. Effect of operational pressure on the water loss and uniformity of distribution

| Pressure employed | Total water loss (%) | Uniformity in distribution (%) |
|---|---|---|
| P1 1.2 KSC | 28.91 | 85.99 |
| P2 2.5 KSC | 31.93 | 86.21 |
| P3 3.5 KSC | 33.75 | 86.52 |
| P4 4.0 KSC | 34.44 | 86.11 |
| SEm ± | 0.385 | 0.253 |
| CD at 5% | 1.068 | N.S |

Table 3. Interactional effect of nozzle size and operational pressure on the total water loss.

| Nozzle size | Pressure employed | | | |
|---|---|---|---|---|
| | P1 1.2 KSC | P2 2.5 KSC | P3 3.5 KSC | P4 4.0 KSC |
| N1 3.97 mm x 2.38 mm | 31.48 | 33.59 | 34.70 | 35.92 |
| N2 4.76 mm x 2.38 mm | 28.02 | 29.74 | 31.91 | 32.57 |
| N3 5.56 mm x 3.17 mm | 24.56 | 31.93 | 33.54 | 33.81 |
| N4 6.35 mm x 3.17 mm | 31.57 | 32.45 | 34.84 | 35.44 |
| SEm ± | | | | |

Table 4. Effect of Nozzle size and operational uniformity in distribution

| Nozzle size | Pressure employed | | | |
|---|---|---|---|---|
| | P1 1.2 KSC | P2 2.5 KSC | P3 3.5 KSC | P4 4.0 KSC |
| N1 3.97 mm x 2.38 mm | 86.27 | 86.19 | 86.89 | 85.79 |
| N2 4.76 mm x 2.38 mm | 85.76 | 86.18 | 86.90 | 86.47 |
| N3 5.56 mm x 3.17 mm | 85.91 | 86.43 | 86.81 | 86.51 |
| N4 6.35 mm x 3.17 mm | 86.04 | 86.02 | 86.62 | 85.66 |
| SEm ± | 0.506 | | | |

caused the heavy water loss under this combination level. Similar results were reported by Kraus (1966).

**B. Effect on uniformity in distribution**

The data on the effect of nozzle size and operational pressure on the uniformity in water distribution are presented in Table 4.

Eventhough there was a numerical difference in uniformity of distribution from 85.66% to 86.90%, it was not significantly affected by the combination of different nozzle sizes and operational pressures. Neither the nozzle size nor the operational pressure has any influence on the uniformity of water distribution. Similar findings were given by Ido Seginer (1971), Singh and Radhey Lal, (1975) and Hollis and Dyll (1975).

From this study, it is concluded that maximum water use efficiency in sprinkler system could be obtained by reducing the water loss to the minimum level. This is possible by adopting a nozzle size of 5.56 mm x 3.17 mm and applying an operational pressure of 1.2 KSC. The uniformity of water distribution was not significantly altered by adopting different nozzles and operational pressures.

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