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RESEARCH ARTICLE

Evaluation of hydraulic characteristics of different micro and mini sprinklers

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ABSTRACT : The study was conducted to evaluate the hydraulic characteristics of different micro and mini sprinklers in the department of Irrigation and Drainage Engineering at College of Agricultural Engineering, Raichur. The results reveal that the average discharge was found in rate for micro sprinkler at 0.5 kg/cm^2 was 24.47 lph, at 1 kg/cm^2 it was 41.58 lph but for mini sprinklers the average discharge was increased 26 lph to 45.42 lph as pressure increases from 0.5 to 1 kg/cm^2 . The coefficient of uniformity for micro sprinkler was found to be 40.4 per cent at an operating pressure of 1.0 kg/cm^2, but it was 48.4 percent in mini sprinkler. The moisture distribution pattern for both micro and mini sprinklers of different make found to be excellent, the moisture content of soil can be increased only to a depth of 25 cm when operated the mini sprinkler for 2 hours at a operating pressure of 1.0 kg/cm^2 and having discharge rate of of 65 lph in deep black cotton soil.

Key words : Micro sprinkler, Mini sprinkler, Pressure, Discharge, Coefficient of uniformity

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INTRODUCTION

The availability of adequate, timely and assured supply of water is an important determinant for agricultural productivity. Irrigation is thus critical to the agricultural development of the country. The development of major and minor irrigation projects with huge investments has quite extent release agriculture from the dependence on monsoon. But, as the quantity of water available for irrigation is decreasing at faster rate, there is a need for the scientist to design a system of irrigation which manages the available water to the crop so as to maximize the yield and hence profit.

Micro and mini sprinkler irrigation system was originally introduced for irrigating highly productive crops, orchards and lawns in areas where water is scarce and expensive. Now a day's micro and micro mini sprinklers are used for irrigating a wide range of crops, orchards in areas where water is abundant. However, micro and mini sprinkler irrigation are profitable when used in areas with hilly topography, poor soils and /or scarcity of water.

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EXPERIMENTAL PROCEDURE

Study was carried out in the department of Irrigation and Drainage Engineering at College of Agricultural Engineering, Raichur. This place is situated in the North-eastern dry zone (Zone-2, Region-1) of Karnataka state at 160 15' N latitude and 770 20' E longitude at an elevation of 389 m above the mean sea level. A single lateral was used for the experiment; to this three micro sprinklers were attached to accomplish the experiment one at a time. The same experiment was followed by the mini sprinkler attachment. The discharge of micro and mini sprinklers were measured at three different pressures beginning at 0.5 kg/cm^2 increased to 1.0 kg/cm^2 and further increased to 1.5 kg/cm^2. Lower pressures were used to micro and mini sprinklers because of their sensitivity to pressure for the discharge rate. The experiments were done simultaneously for pressure-discharge and coefficient of uniformity to have accurate readings. Pre experiment set up was made by adjusting the required pressure in the lateral line. After one hour the water collected in the

containers were measured. The same test was repeated for all the micro and mini sprinklers. In this way the pressure-discharge relationship was found out. The coefficient of uniformity was computed from field observation of the depths of water caught in open cans placed at regular intervals within sprinkled areas. In the field experiments studies soil samples were collected after irrigating the field for 2 hours and leaving for 1 hour from the mini sprinkler randomly up to 200cm from the mini sprinkler at soil surface and from soil depth of 0,15,30,45 cm by screw auger. The moisture content of soil samples was determined by gravimetric method for studying the moisture movement in the soil.

EXPERIMENTAL FINDINGS AND ANALYSIS

The micro and mini sprinklers test studies were conducted to evaluate the pressure-discharge characteristics of ten micro and five mini sprinklers under different operating pressures. The data given in Table 1 and 2 which reveals that, as the operating pressure increased for each type of micro and mini sprinklers. However, the nominal variation in discharge with respect to pressure was observed. But as the operating pressure increased or decreased the co-efficient of uniformity changes, hence the problem of drift was found to be cause for co-efficient uniformity. Therefore, the safe pressure for operation was determined as 1 kg/cm^2.

Totally ten micro sprinklers were tested for pressure discharge relationship, were of four different companies and of different orifice sizes. The micro sprinklers were fixed head operating pressures are given in Table 1.

The Table 1 shows that, the average discharge of 22 lph , 15 lph, 68.6 lph and 25.05 lph for EPC, Jet, Premier and for Jain respectively at 0.5 kg/cm^2 operating pressure. The minimum discharge of 11.5 lph was found in Jet Orange (B) at 0.5 kg/cm^2 and maximum discharge of 68.6 lph for Premier (orange). The maximum average discharge of 54.75 lph, 43.25 lph, 119.9 lph and 52.5 lph for EPC, Jet, Premier and for Jain, respectively at 1.5 kg/cm^2. The maximum discharge was found in Premier (orange) *i.e.*, 119.9 lph and minimum was in Jet (orange) was 32.0 lph. Two different pieces of micro sprinklers of Jain Company were tested for pressure- discharge relationship. Jain Black micro 340^0 was operated for 0.5 kg/cm^2, 1 kg/cm^2 and 1.5 kg/cm^2. The flow rate was found to be constant and it was best suited for logarithmic type. The pressure discharge relationship was found for Premier Orange micro sprinkler. The discharge was found to be maximum, among all the tested micro sprinklers at 0.5 kg/cm^2 and also at 1.5 kg/cm^2

Pressure discharge relationship for mini sprinklers:

Discharge rates were tested for different operating pressures for mini sprinklers of EPC and Jain, having different orifice sizes. Totally five mini sprinklers were tested for pressure-discharge relationship. The results were presented in Table 2

The Table 2 gives us an idea about how the discharge was interrelated with the operating pressure. At 0.5 kg/cm^2 the minimum discharge was found in Jain Blue, where as maximum in Jain Black. At 1.0 kg/cm^2 pressure and at 1.5 kg/cm^2, the minimum discharge was found in Jain Blue only, but maximum was found in Jain white(65 lph) and Jain black at respective pressures.

Coefficient of uniformity:

The coefficient of uniformity for micro and mini sprinklers of different make were determined and enlisted in Table 3. The maximum coefficient of uniformity for micro sprinklers was found in Jet blue (N) the minimum was EPC green. For min sprinklers maximum was found in Jain blue.

Soil moisture movement in mini sprinkler irrigation:

Table 4 shows that before irrigation, the soil moisture was continuously on higher side with the increase in soil depth. It was observed that the moisture content at 15 cm depth increased by 18.97 per cent after 1 hour irrigation. At 6 hour the

Table 1 : Discharge for micro sprinkler under different operating pressures

Sr. No.	Pressure kg/cm^2	EPC				Jet		Premier	Jain	
		Blue 90	Blue	Green	Orange B	Blue N	Blue E	Orange	Black 340	Black
1.	0.5	25	15	25.5	11.5	16	15	68.6	15	35.10
2.	1	44	30	44.5	21.5	28.8	30	100	30	55
3.	1.5	58	58	58.20	32	48	47	119.9	35.08	69.2

Table 2 : Discharge for mini sprinklers under different operating pressures

SI. No.	Pressure kg/cm^2	Discharge in LPH				
		Jain				EPC
		White	Blue	Green	Red	
1.	0.5	32.8	13	23	37.2	24
2.	1.0	65	24	40	56.1	42
3.	1.5	84	31	49	71.2	63

Table 3 : Coefficient of uniformity for mini and micro sprinklers

Make	Colour	Uniformity coefficient (%)	Presure kg/cm^2
For mini sprinklers			
Jet	Blue N	73.8	1
	Orange B	33.35	1
EPC	Blue 90	61.88	1
	Green	18.27	1
Jain	Black	23.05	1
	Black (semi)	23.67	1
For micro sprinklers			
EPC	Green	68.79	1
Jain	Green	40.45	1
	Red	59.1	1
	Blue	74.26	1

moisture content at 15 cm depth was increased by 31.16 per cent. At 24 hours, the moisture content reduced by 6.78 per cent. Khol and Deboer (1984) and Giavi *et al.* (1988) has worked on some aspects related to the present investigation. Argade and Thombal made studies on spray pattern of micro sprinkler

Table 4 : Average soil moisture (%) recorded at different soil depths, time periods

Operating pressure kg/cm^2	Soil depth cm	Average soil moisture db (%)	Time after termination of irrigation hrs		
			1	6	24
1	0	17.54	28.60	24.05	23.83
	15	18.71	22.26	24.54	23.27
	30	19.98	19.77	19.46	18.88
	45	4520.6	18.51	17.61	18.72

in respect to pressure discharge.

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