seed yield and oil-content in black seeded sesame.

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EVALUATION OF AN IRRIGATION MODULE THAT CLAIMS CONSTANT DISCHARGE

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ABSTRACT

Flow measurement forms the backbons of water management. From time to time, devices are evalved for flow measurement and irrigation module is one such expedient. It is claimed of a particular irrigation module that it can maintain a constant discharge irrespective of the depth of flow. To test verify this claim, experiments were carried on two such modules - 3 lit/sec and 6 lit/sec capacities. It has been decisively arrived that the modules do not pass a constant discharge. Instead, the discharges passed through, seem to vary more or less in a linear way causing percentage deviations even to the extent of 108%.

KEY WORDS : Irrigation Module, Free flow, Submerged flow, Discharge.

For efficient water management in agriculture, water needs to be metered. Weirs, watermeters, venturimenters have all become recognised devices to measure the flow. Of these, weirs have assumed for more importance in measurement of flow due to the fact that they are suited to measure flow in open channels and they are simple to operate without involving any sophistication. These weirs discharge constant flows only under the constancy of heads over the notch. If the head over the weir varies over a duration, then the total discharge may be found by knowing the head values at different times and then finding the corresponding discharges and

Table 1 . Fabrication features of irrigation modules

S.N o.	Particulars	Labelled discharge, lps	
		3 lps	6 lps
1.	Length of the module	100 cm	100 cm
2.	H eight of the module	30 cm	30 cm
3.	Width of the module	6.5 cm	10 cm
4.	Height of the module slit	8 cm	10 cm
5.	Number of curved blades	12	12
6.	Spacing between blades	8 cm	8 cm
7.	End clearance	6 cm	6 cm

summing up over the duration. For a user farmer, however, it may be inconvenient to find the varying depths of flow at different timings. Instead, if a device is made available for him which discharges contantly even under varying heads, it would be helpful to him in a large way. But the technical feasibility of this proposition is highly doubtful. In as much as the depth of liquid increases in a container, the pressure should increase and discharge through a given opening should necessarily increase. Therefore, variation in discharge with varying head is something inevitable (Chandresekaran, 1971). And at the most, in practice, a minor variation is to be ignored and the flow may be considered as constant. But this concept of constancy is made for practical convenience. This should not imply that the flow may be constant for varying heads even by theory. However, an information that a device can discharge constantly at different heads aroused the curiosity to experiment and evaluate the performance of such device.

MATERIALS AND METHODS

Two flow measuring devices published (Irudhayaraj, 1986) under the name 'IIT-Karagpur Irrigation Module' of labelled capacities 3 lit/sec and 6 lit/sec (Fig.1) were installed in an experimental set up for flow measurement (Fig. 2). The fabrication features of these devices are presented in Table 1. The module consists of series of curved vanes mounted at a specing with two vertical plates fastened on either side. At the bottom of the vanes is a passage from upstream to downsteam. The module is supposed to control the flow when the flow takes place above the bottom passage and entering into the vanes.

The flow for the experiments was pumped from a sump and then was collected in a collecting tank for measuring purposes and the same flow was recirculated. The module was fixed at a distance of 1.4 m from the outlet of the channel and the stilling arrangement had been made ahead of the module with concrete blocks and stone jellies. The depth of flow was measured from the centre of the rectangular slit in front of the first compartment. Depending on the depth of flow, only the first few vanes were subject to submergence of flow at their bottom portions and the remaining downstream side vanes were above the flow level as the flow passed through the bottom passage at that location. The flow touching only a few upstream vanes is taken as free flow and the one touching the entire vanes is taken as submerged flow. However, during the course of study for the free flow only the first vane was subject t rise of flow within it. The discharge particulars are given in Table 2.

In another set of experiment, obstacles were placed across the width of the channel at outlet end, to create submerged flow. The obstacle was in the form of a metallic plate of height 25 cm. The discharge particulars are given in Table 3.

Table 2. Deviation of labelled discharge 3 lps and 6 lps from actual discharge (free flow)

S. No.	Upstream Head (cm)	Average time taken for 10 cm rise of water level in the collecting tank (Sec.)	Measured discharge (lps)	Deviation (lps)	Percentage diviation (%)
I. 3 lps					
1.	7.0	79	2.85	0.15	5.00
2.	10.5	67	3.36	0.36	12.00
3.	13.5	57	3.95	0.95	31.62
4.	14.0	55	4.09	1.09	36.30
5.	15.4	53	4.25	1.25	41.63
6.	17.5	51	4.41	1.41	47.00
7.	20.0	50	4.50	1.50	50.00
8.	21.6	47	4.79	1.79	59.90
9.	23.0	45	5.00	2.00	66.60
10.	25.4	43	5.23	2.23	74.26
II. 6 lps					
1.	11.5	30	7.50	1.50	25.00
2.	12.0	29	7.75	1.75	29.10
3.	14.0	27	8.33	2.33	38.84
4.	15.0	25	9.00	3.00	50.00
5.	16.5	24	9.36	3.36	56.00
6.	18.5	22	10.23	4.23	70.51
7.	20.5	21	10.70	4.10	78.35
8.	22.5	20	11.25	5.25	87.50
9.	24.0	19	11.84	5.84	97.33
10.	25.0	18	12.50	6.50	108.33

RESULTS AND DISCUSSION

The stabilized discharges varied from 2.85 lps to 5.23 lps and the percentage deviations of the actual discharges measured from the labelled discharge 3 lps were found to vary from 5% to 74% (Table 2). Likewise, the stabilised discharges varied from 7.5 lps to 12.5 lps and the percentage deviations of the actual discharges measured from the labelled 6 lps were found to vary from 25% to 108% (Table 3). These are the results for free flow conditions.

Under submerged flow condition, the stabilized discharges varied from 1.25 lps to 4 lps and the percentage deviations of the actual discharge measured from the labelled discharge 3 lps were found to vary from 1% to 58% (Table 4). Similarly, the stabilised discharges varied from 2.7 lps to 4.8 lps and the percentages deviations of the actual discharge measured from the labelled discharge 6 lps were found to vary from 20% to 56% (Table 5).

It is interesting to note that both modules under either conditions of flow, discharge in linearly increasing manner with increase in head (Fig. 3 and 4). Also, the percentage deviation of the measured discharge from the labelled on is higher at higher discharges under free flow condition where as it is reverse under submerged flow condition. It may be seen futher that these deviatio[illegible] transgres[illegible] level which is

Table 3 . Deviation of labelled discharge 3 lps and 6 lps from actual discharge (submerged flow)

S. No.	Upstream Head (cm)	Average time taken for 10 cm rise of water level in the collecting tank (Sec.)	Measured discharge (lps)	Deviation (lps)	Percentage diviation (%)
I. 3 lps					
1.	11.0	180	1.25	1.75	58.33
2.	13.5	108	2.08	0.92	30.67
3.	15.5	92	2.45	0.55	18.33
4.	16.5	82	2.74	0.26	8.67
5.	17.3	81	2.78	0.22	7.33
6.	19.7	74	3.04	0.04	1.33
7.	20.8	68	3.31	0.31	10.33
8.	22.3	61	3.69	0.69	27.00
9.	23.1	58	3.88	0.88	29.33
10.	24.0	56	4.02	1.02	34.00
II. 6 lps					
1.	12.0	84	2.67	3.33	55.56
2.	13.0	75	2.98	3.02	50.33
3.	13.7	64	3.50	2.50	4.67
4.	14.1	62	3.66	2.34	39.00
5.	15.1	56	4.09	1.91	31.83
6.	17.5	55	4.13	1.87	31.17
7.	19.0	54	4.18	1.82	30.33
8.	20.0	51	4.40	1.60	26.67
9.	21.5	49	4.64	1.36	22.67
10.	22.5	47	4.80	1.20	20.00

normally tolerable for flow measuring devices (Chandrasekaran, 1971). For some discharges, the deviation has assumed even as high as 108%.

From the above study, it is clear that the modules claimed to discharge constant flow really do not maintain the constancy and the claim is a misleading one. In fact, these modules discharge linearly increasing flows with increasing heads. The rate of increase of flow per cm of head is higher under submerged flow condition in comparison with the free flow condition, for the case of 3 lps module. However, this trend is reversed for the case of 6 lps.

The fact of discharge being a function of the head is both of physical and analytical necessity. At the most, for the purpose of practical adoption, the change in discharge may be ignored in some flows if the variation is within such a narrow limit. Otherwise, all weirs must discharge varying flows under varying heads.

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