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Technical feasibility of raingun irrigation

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Abstract
The present investigation was conducted to study the hydraulic performance of raingun irrigation at demonstration garden of college of Agricultural Engineering, Marathwada Agricultural University, Parbhani (Maharashtra State) during the period 2004-2005. A Jain Komet raingun of nozzle diameter 14 mm was tested for the evaluation of pressure discharge relation and uniformity coefficient at varying operating pressure of raingun. From this investigation, it was observed that the linear curve relationship [$Y = 0.83 + 0.78X$; $r^2 = 0.98$ where, Y = raingun discharge, lps, X = operating pressure, kg/cm^2] was fitted better for raingun irrigation. It was also observed that the average value of uniformity coefficient at operating pressure of 2.0 kg/cm^2, 3.0 kg/cm^2, and 4.0 kg/cm^2 of raingun was found to be 73.36%, 76.52% and 79.54 % respectively. Maximum value of uniformity coefficient was obtained at wind velocity 2.9 km/hr and minimum uniformity coefficient was obtained at 5.6 km/hr.

Key words : Irrigation, Raingun, Technical feasibility.

INTRODUCTION

Irrigated agriculture in India will be in tremendous pressure due to scarcity of drinking water. Hence tough competition among urban, industrial, wildlife, recreation and irrigation users is expected. Out of total national water resources of 370-m ha-m, which receives through rainfall about 85 mha-m and 185 mha-m water is being lost in evapotranspiration and surface runoff, respectively. Therefore a comprehensive strategy is needed for the conservation and development of national water resources. In the course of action we needed to deal with various factors like availability, quality, location, distribution and variation in the occurrence of water, climatic conditions, nature of soil, competing demand and socio-economic conditions. In dealing with each of these, it is required to make every effort for the best use of water in order to increase the level of agricultural production per unit volume of water. The alternatives could be to increases the efficiency of existing irrigation methods or to develop new methods of irrigation to get maximized benefits from a unit input of water. Application of excess water to crop, either due to rainfall or due to surface irrigation resulted in reduction of yields, rise in the ground water table and water logging. Rise of ground water level in irrigated areas brings up harmful salts to the surface layers and such soils may go out of cultivation .The adaptation of efficient irrigation methods is therefore important in view of increasing irrigation as well as water uses efficiency. High application efficiencies can only be obtained by pressurised irrigation methods such as sprinkler, raingun and drip irrigation system. Besides this these methods can be adopted for almost all crops under variables topographic conditions and on different type of soil. Even one conditions out of several, make these system better choices than surface irrigation methods.

MATERIALS AND METHODS

One case study in which Raingun irrigation system installed at college of Agricultural Engineering and Technology, MAU, Parbhani was evaluated for its performance on pressure discharge relationship and uniformity co-efficient. The detail specifications of the raingun used in the present study are shown in Table 1. During evaluation of raingun system the discharges were

Table 1 : Specification of raingun (Yasin *et al.*, 1999)

S. No.	Particular	Dimension
1	Model	JainKomet R163
2	Nozzle size	14 mm (8-16 mm)
3	Connection size	1.5 inches = 3.81 cm
4	Angle adjustment	180^0 (360^0)
5	Trajectory angle	24^0
6	Maximum pressure	4 kg/cm^2 (2.0 to 4.0 kg/cm^2)
7	Maximum discharge	4.63 lps
8	Radius of throw	30m
9	Application rate	0.609 cm/hr (0.24 inch/hr)

measured at the nozzle end under different operating pressures of 2.0 kg/cm^2 to 4.0 kg/cm^2 (pressure heads 20 m to 40 m.) from the observed data the pressure discharge relationships were developed.

RESULTS AND DISCUSSION

The average discharge measured at different operating pressure during experiment is presented in Table 2. Data revels that the Jain Komet Raingun (3.27 lps) gave lower discharges at all the operating pressure as compared to those specified by the manufacturer. The Table 2 shows the percentage deviation between the nominal recommended discharge and observed discharge for different operating pressure of raingun. It is seen that the maximum deviation is 88 at operating pressure of 3.5 kg/cm^2 and minimum deviation is 74 at operating pressure 2.0 kg/cm^2. Therefore the said data on operating pressure and discharge of Raingun were fitted in linear, power and exponential equations. It was observed that for all three cases linear relationship was better on the basis of correlation coefficient (r^2=0.98). The best-fit equation for pressure discharge relation was found to be:

Table 2 : Nozzle discharge at different pressures (Nozzle size 14 mmΦ) (Bhagyawant *et al.*,2004).

S. No.	Operating pressure (kg/cm^2)	Nominal recommended discharge (lps)	Observed discharge (lps)	Deviation	Percentage of Deviation
1	2.0	3.27	2.42	26	74
2	2.5	-	2.62	20	80
3	3.0	4.01	3.35	16	84
4	3.5	-	3.52	12	88
5	4.0	4.63	3.92	16	84

$$Y = 0.83 + 0.78\,X \quad (r^2=0.98),$$

Where

Y = nozzle discharge lps,

X = operating pressure of Raingun, Kg/cm^2

The uniformity coefficient of the raingun system was estimated at specific mean wind velocity using average depth of water applications at different position in the wetted perimeter of raingun. The equation used for calculating uniformity coefficient of raingun is as follows.

Cu = 100 (1.0 - ?X /mn)

Where,

m= average value of all observations (average application rate), mm

n = total number of observation points.

x = numerical deviation of individual observations from the average application rate, mm

The uniformity coefficient was found to be 73.36%, 76.52% and 79.54% at operation pressures of 2.0, 3.0 kg/cm2 and 4.0 kg/cm2 respectively. Maximum value of uniformity coefficient was obtained at wind velocity of 2.9 km/hr and minimum uniformity coefficient at 5.6 km/hr confirming the adverse effect of wind velocity on water distribution.

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