Available online at www.scholarsresearchlibrary.com

Scholars Research Library

Annals of Biological Research, 2021, 12 (S4): 016
(http://scholarsresearchlibrary.com/archive.html)

ISSN 0976-1233
CODEN (USA): ABRNBW

Feasibility Studies on Rain gun Method of Irrigation System in Groundnut

Praveen Kumar*, K. Bhanu Pradeep, S.G. Farida Begum, K. Ashok Kumar and P. Sumathi

Department of Agricultural Engineering, Acharya NG Ranga Agricultural University, Madakasira, Andhra Pradesh, India

***Corresponding Author**: Praveen Kumar, Department of Agricultural Engineering, Acharya NG Ranga Agricultural University, Madakasira, Andhra Pradesh, India, Tel: 8239661351; E-mail: praveenpkmatrix@gmail.com*

ABSTRACT

A field study was conducted on groundnut by using different irrigation techniques, such as raingun, check basin and sprinkler irrigation systems. Irrigation is mainly a branch of engineering as it involves construction and maintenance storage and distribution works. In our country, raingun method of irrigation is becoming more popular for sugarcane due to convince in shifting. Sufficient formation such as coefficient of discharge, percentage of overlapped diameter for uniformity, etc is not available for designing the raingun system. The medium volume rainguin model was operated at different operating pressures of 2.0, 2.5 and 3.0 kg/cm^2 with 14 mm diameter nozzle. The discharge is found increasing with increase in pressure head for raingun of nozzle size 14 mm is 3 kg/cm^2. It was observed that increase in pressure increased the discharge of medium volume raingun irrigation system. The minimum discharge was observed at 2 kg/cm^2 as 10.30 m^3 /h for 14 mm diameter nozzle. The maximum discharged was observed at 3 kg/cm^2 as 12.13 m^3/h for 14 mm diameter nozzle. The coefficient of uniformity of the raingun was determined at different operating pressure. The high coefficient of uniformity was found at 3 kg/cm^2 operating pressure and low uniformity of coefficient was found at 2 kg/cm^2 operating prerssure. The water application rates of the raingun under various pressures were determined. The maximum application rate of 10.86 mm/h was found at 2 kg/cm^2 and the minimum application rate of 9.32 mm/h was found at 3 kg/cm^2. The maximum water use efficiency was maximum in case of raingun method of irrigation as compared to check basin and sprinkler irrigation system. Use of raingun sprinkler irrigation during early crop season helped in saving water when the soil infiltration rate was very high and need of water in the root zone was less. Using raingunmethodofirrigationsystem, 0.79 kg/m^3 higherwateruseefficiencywasachievedascompared to checkbasinand sprinkler irrigation system, respectively. Benefit cost ratio of the raingun method of irrigation was found as 1.05, which indicated that the raingun method of irrigation was economically feasible.

Keywords: Nozzle size, Operating pressure, Uniformity coefficient, Irrigation methods

INTRODUCTION

Groundnut is an important crop that provides food for direct human subsistence and other several food products. Groundnut is legume cash crop for the farmers in arid and semi-arid regions and its seeds contain high amounts of edible oil (43%-55%), protein (25%-28%), and minerals (2.55) [1]. The origin of this plant is in area called Granchaco in Brazil. China, India, the United States, Nigeria, Indonesia, Burma and Senegal are the major groundnut producing countries. Groundnut is grown under both rainfed and irrigated conditions. Drought is one of the limiting factors in the yield of groundnut in most of the countries. In recent years, due to drought and its yield has declined [2].

Raingun irrigation system saves labour, electricity, water, time. In flood irrigation, more than 75% of the water goes as percolation loss. The fertility in top soil is washed away and goes as percolation loss i.e. the top soil is leached away. In raingun irrigation there is no percolation loss or leaching. Atmospheric air contains 785 of nitrogen which is major nutrient for plants. As raingun resembles rain, the water dissolves the nitrogen (nitrogen fixation) from air and gives it to soil, thereby adding nutritive value to soil is one of the reasons for increase in yield. Pests and insects get washed away during raingun irrigation. Raingun are associated with water losses due to wind effects and evaporation. Distribution uniformity has also been affected due to wind.

Rainguns are available with operating pressures of 2.0 to 7.5 Kg/cm^2 and flow rate of 3 to 30l ps usually with nozzle diameters ranging from 10 to 30 mm and with a wetting radius of 27 to 60 meters. The increase in radius of coverage was proportionate with pressure and nozzle size. The layout of the raingun irrigation should be designed in such a way that the coefficient of uniformity is optimised.

The present study is based on the concept of conjunctive use of rainfall and groundwater with a view to design raingun sprinkler systems to evaluate the cost and performance of the systems under the concept of supplemental irrigation linked with the use of groundwater. Keeping the facts in mind, this study was comes out to evaluate the performance of raingun irrigation system with the following objectives: a) to evaluate the performance of raingun in alfisols of scarce rainfall zone. b) To study the effect of raingun irrigation method on growth and performance of groundnut. c) To study the energy and economics of raingun.

MATERIALS AND METHODS

A study on "Feasibility studies on Raingun method of irrigation system in Groundnut" was taken up at farmer's field near College of Agricultural Engineering, Madakasira in year 2018-19 to increasing the productivity of the existing farm ponds in farmer fields. The details of the experiment are presented in this chapter.

Selection of experimental field

The experiment was carried out in the farmer's filed at madakasira. Geographically the experimental site is located at latitude of 13°57'0.60°N and longitude of 77°18'13.19°E. The selected field soil is completely loamy in nature and the source of irrigation is bore well.

Design of experimental field

The total area selected for experimental field is 4290 m². This entire area of the field was divided into three experimental plots i.e., plots for raingun, sprinkler and check basin irrigation systems.

Table 1. Details of experimental field

S. No	Plot No	Type of irrigation system used	Dimensions .(m×m)	Area(m²)
1	Plot-1	Raingun	40 × 55	2200
2	Plot-2	Check basin	22 × 55	1210
3	Plot-3	Sprinkler	16 × 55	880

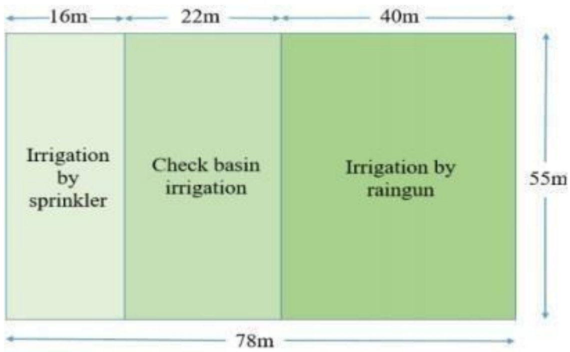

Figure 1. Lay out of the experimental field

Land preparation for sowing

The filed that was selected for the experiment was completely with weeds and stones. The primary tillage operation was carried out by using cultivator and rotavator for loosening the soil and for removal of weeds prior to sowing. Left over weeds and stones were removed manually. The Secondary tillage operations were carried out with rotavator. The soil is well pulverized, levelled, and fine seed bed is obtained for sowing of groundnut. Fertilizers of 20 kg/ha, 40 kg/ha, and 40 kg/ha were applied to soil after tillage operations and remaining quantities were applied at initial and mid stages as per recommended NPK doses (Vyavasayapanchangam) during the crop season.

Selection of groundnut variety

Groundnut of variety K6 was chosen as the test crop.

The following are the characteristics of K6 variety. Plant height: 30-40 cm Maturity: Early Leaf colour: Dark green Flowering pattern: Sequential, Pod size: medium, Leaflet shape: elliptical, Kernel nature: 1-2 seeded and occasional 3 seeded pods, Days to flower: 45 days, Oil content: 48% Duration: 110-120 days.

Seed treatment and sowing

The concept of seed treatment is the use and application of biological and chemical agents that control or contain primary soil and seed borne infestation of insects and diseases which pose devastating consequences to crop safety leading to good establishment of healthy and vigorous plants resulting better yields. Groundnut seed var. Kadiri-6 of 80 kg treated with 500 gm of TRISAF (carbendazim+mancozeb), so as to check various seed and soil borne diseases. Sowing and seeding is an art of placing seeds in the soil to have good germination in the field. The plots were thoroughly wetted before sowing.

Sowing time

The optimum time for sowing of groundnut seed is December to January. Keeping this for the present study is rabi season the sowing operation was done on 12/12/2018. The optimum time for groundnut in different seasons in India are given in table. (Table 2)

Table 2. Groundnut sowings in India

Groundnut Sowings	Months
Winter residual	September-October
Summer season	December-January
Spring season	February-March

Spacing and seed rate

After seed treatment the selected variety of K6 seeds were sown with row to row distance of 25 cm for all three plots. The seeds are placed in soil as per the designed row to row spacing and plant to plant spacing at a depth of not more than 5 cm. The seed rate required for the summer groundnut crop is 123 kg/ha [3]. For the present study of 4290 m^2 area the requirement of seed is 80 kg/acre.

Installation of raingun

The salient parts of the raingun sprinklers are main pipe, submain, raiser pipe, tripod stand and nozzles. The selected size of nozzle was 14 mm × 5 mm diameter. The water was supplied through 63 mm diameter PVC pipes, which is connected to the raingun with a quickset brass or aluminium coupler. The water comes out of the raingun through nozzle like a jet of water, which is broken without rocker arm to form droplets similar to rain. The raingun fixed in the middle of with the help of stand and pegs as shown in figure. (Figure 2) (Table 3)

Table 3. Specifications of Jain komet R163

S. No	Particulars	Specifications
1	Model	Jain Komet R163
2	Nozzle Size	14mm
3	Trajectory angle	24°
4	Maximum pressure	4 kg/cm^2
5	Maximum discharge	4.631ps
6	Application rate	0.609 cm/hr

Figure 2. Installation of raingun in field

Crop water requirement

The crop water requirement always refers to a crop grown under optimal conditions, i.e. a uniform crop, actively growing, completely shading the ground, free of diseases, and favourable soil conditions (including fertility and water). Precise knowledge of crop water requirements is also needed for efficient use of limited irrigation water [4].

Soil moisture indicator

Monitoring soil moisture levels is required for effective irrigation water management. Irrigation water management requires timely application of the right amount of water. Competition for water, high pumping costs, and concerns for the environment are making good water management more important.

Directions for using the SMI

• Locate the place where you would like to check the soil moisture status.

• Insert the SMI vertically depending on the root zone of the crop. Press the switch and HOLD till the LED light stops on a particular coloured LED depending on the moisture status.

• Refer to the table on the SMI for the status of the soil moisture depending on the LED colour from the point number 2.

Note: Don't use the SMI just after the irrigation. Use the instrument in soil before irrigation. (Table 4)

Table 4. Specifications of Jain komet R163

Color of LED	Soil moisture status	Inference
Blue	Ample Moisture	No need for irrigation
Green	Sufficient Moisture	Immediate irrigation may not be necessary
Orange	Low Moisture	Irrigation advisable
Red	Very Low Moisture	immediate Irrigation necessary

Weed control

Before sowing spraying of pre-emergence herbicide (pendimethalin 30% EC) was carried out in the field to prevent the emergence of weeds. After 20 to 25 days of sowing weeds growth was observed and manual weeding process was initiated with hand hoes [5]. Hand weeding was carried out in the field after 25 days and 45 days of sowing. Care was taken that soil should not be disturbed at pod formation stage otherwise effects on yield.

Application of manures and fertilizers

In order to obtain better results, farm yard manure was applied at the rate of 2.4 tonnes as per standard recommendations before preparation of seed bed. DAP (Diammonium phosphate) and Urea was applied by broad casting method for better crop growth. And fertilizers applied @20 kg N/ha, 40 kg P_2O_5/ha, 40 kg K_2O/ha.

Infiltration characteristics

Two representative sites selected with the 5 sides of the each experiment field were for measuring infiltration rate using the double ring infiltrometer as described by Micheal. The infiltrometer consists of two cylinders made of 2 mm rolled steel. Each cylinder was 25 cm high. The inner cylinder from which the infiltration rate was measured was 30 cm in diameter. The outer cylinder, which acted as a buffer pond was 60 cm in diameter. The cylinders were installed about 10 cm deep in the soil. The cylinders were driven into the ground by a hammer and a wooden plank to prevent damage to edges of the cylinder [6]. Plastic sheet was used to cover the soil surface confined by inner cylinder before filling with water and starting reading. Reading was taken every five minutes until a constant infiltration rate was reached. Then the data was tabulated and the average infiltration rate in cm/h was determined. The infiltration rate is calculated by the following formula Infiltration rate (cm/h)= (intial water depth(cm)-final water depth(cm))/(time required,h)

$$\frac{intial\ water\ depth\ (cm) - final\ water\ depth\ (cm)}{timerequired\ ,\ h}$$

Hydraulic performance of rain gun sprinkler irrigation

Hydraulic performance is done to determine the efficiency of the whole system whether it or to reject it. To determine hydraulic performance of rain gun parameters required are measurement of discharge, radius of coverage, uniformity co-efficient, water distribution curve, nozzle size *vs.* co-efficient of uniformity. The rain gun was fixed in the middle of a field with the help of stand and pegs. The rain gun was tested with 14 mm diameter nozzle at a selected procedure (Figure 3).

Figure 3. Installation of Double Ring Infiltrometer

Measurement of discharge by using water meter

A water meter calibrated in litres was installed near the bore well to measure the discharge at the head section (Figure 4).

Figure 4. Installation of Water meter

Measurement of pressure

A pressure gauge calibrated in kg/cm^2, which was fixed to the riser pipe having a range of 0 to 7 kg/cm^2 and regulate the pressure with help of control valve. When the required pressure was obtained, the rain gun system was started.

Measurement of distribution of water

Before the start of the rain gun operation, catch cans were properly cleaned and placed in the field with 5 m spacing for 30 min. at the end of the operation, the water collected in each catch can was measured using a measuring cylinder.

The distribution of water with 14 mm diameter size nozzle was measured [7].

Measurement of radius of coverage

The rain gun was operated for duration of 30 min under various pressures. The distances from rain gun to last catch can receive the water under a specific pressure. The radius of coverage of the rain gun with 14 mm diameter nozzle was computed.

Determination of application rate

The application rate of the rain gun was determined using the following relationship (James, 1988): $A = \frac{K \times Q}{a}$ …..(1)

Where, A- application rate of the rain gun, mm/h K- constant, 60; Q- discharge of the rain gun, lit/min and a-Wetted area, m^2.

The discharge in litres per minute and area in square meters were computed using the measured data of discharge and radius of coverage, respectively.

Determination of coefficient of uniformity

Raingun was installed at the centre of the field and catch cans were placed in grid pattern with separation of 5 m longitudinally and laterally. The depth of water collected in each catch-can, placed in four quadrants, was measured with a measuring cylinder, for determination ofcoefficient of uniformity. The coefficient of uniformityofrain gun was determined using the following relationship developed by Christiansen (1942): $Cu = (1 - \frac{\Sigma x}{m \times n}) \times 100$ .... (2)

Where, Cu-Coefficient of uniformity, %; M-Average of all the observations, X-Absolute numerical deviation of individual observations from the average application, and n-Total number of observations [8].

The radius of coverage of rain gun under various pressures was divided into four equal parts called quarters.

Crop parameters

Plant sampling was done at 40, 60, 80 and 100 days after sowing, which correspond to plant height, no. of leaves and no. of leaflets. Five representative plants from each plot were selected and counted no. of leaves and no. of leaflets and also measured plant height.

Plant dry matter

Five plants selected in each plot were noticed at 40, 60, 80 and 100 days after sowing. Measure the initial weight of the plants and these are kept in hot air oven at temperature of 105°C for 24 hours and measure final weight of the sample. And determined the moisture content on wet basis and dry basis at different days of interval (Figure 5).

Figure 5. Determination of plant dry matter

Harvesting and threshing

It is necessary to dig the pods at the right time for obtaining higher yields of pods and oil. Nut takes two months to attain full development. A fully mature pod will be difficult to spill easily with finger pressure. This stage is achieved when vine begins to turn yellow and leaves start shedding. Harvesting should be done when good percentage of nuts is fully developed and fairly intact. In case of bunch type groundnut, the plants are harvested by pulling [9]. The harvesting was started from 5/05/2019 to 10/05/2019. Pods were threshed manually. The weight of the produce in each picking for each sub-plot was recorded and the total yield for each plot was calculated.

Determination of final yield

The groundnuts of each experimental plot are manually harvested and the biological yield and the pod yield corresponding to each plot are recorded in kgs.

In plot-1, plot-2, and plot-3, 2 sub plots each of area 1 m were plotted randomly and biological yield and pod yield were separately measured.

Calculation of water use efficiency

The water use efficiency is ratio of total yield obtained to that of amount of water used. The term water use efficiency denotes the production per unit of water applied. It is expressed as the weight of crop produce per unit depth of water over a unit area, i.e., kg/cm per hectare.

For calculating the water use efficiency, the yield obtained from each experimental site and amount of water used for each site was recorded.

$$\text{Water use efficiency} = \frac{\text{crop yield}}{\text{amount of water applied}} \quad \ldots\ldots\ldots(3)$$

RESULTS AND DISCUSSION

The discharge, pressure, water distribution pattern and radius of coverage of the raingun (Jain Komet R163) with 16 mm diameter nozzle were measured under various pressures. The application rate and coefficient of uniformity were determined. The relationships of pressure with discharge, radius of coverage and application rate were also determined.

Measurement of coefficient of uniformity of the raingun at different pressure

Raingun was installed at the centre of the field and catch cans were placed in grid pattern with separation of 5 m longitudinally and laterally. Raingun sprinkler was operated at pressures of 2 kg/cm^2 and 3 kg/cm^2 with two trails for each, to check the variation in uniformity coefficient. It was found that the water distribution pattern more uniform in later case (Table 5).

Table 5. Comparison of uniformity of coefficient of raingun

Pressure(kg/cm²)	**2 kg/cm²**		**3 kg/cm²**	
Uniformity coefficient (%)	60.65	62.36	70.19	71.43

Statistical analysis of uniformity coefficient of raingun method of irrigation

As the calculated value of F <=f)>0.05 there is no significant difference between the uniformity coefficient under the pressure 2 kg/cm² and 3 kg/cm² at 5% LOS. If P<0.05, then there is a significant difference, otherwise there is no significant difference (Table 6).

Table 6. Statistical analysis of Uniformity coefficient of raingun

F-test two-sample for variances	**2 kg/cm²**	**3 kg/cm²**
Mean	61.5	70.81
Variance	1.46	0.7688
Observation’s	2	2
Df	1	1
F-Test Two-Sample for variances	1.9	
P(F<=f) one-tail	0.399	
F Critical one-tail	161.44	

Relationship between pressure and discharge

The discharge of the raingun was measured under various pressures. The discharge increased with the increase with the increase in pressure. The discharge of the raingun ranged from 2.39 lit/sec to 3.37 lit/sec for a pressure range of 1.5 to 3.0 kg/cm², respectively. Different statistical techniques such as linear regression. The data were analysed by using pressure as independent variable and discharge as dependent variable. So this function was used to describe the relationship between pressure and discharge of the raingun with 14 mm diameter nozzle [10]. The relationship can be described mathematically as under:

Q=2.348 H+5.337 With R_2=.9636 Where, Q=Discharge of the raingun, m^3 /h, H= pressure, kg/cm^2 (Table 7) (Figure 6).

Table 7. Relationship between pressure and discharge of the raingun

Pressure (kg/cm²)	Discharge (m³/h)
1.5	8.6
2	10.3
2.5	11.45
3	12.13

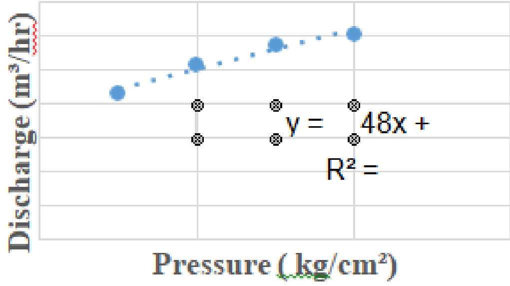

Figure 6. Regression analysis for best fit trend data

Relationship between pressure and radius of coverage

The radius of coverage of the raingun was measured under various pressures. The radius of coverage increased with the increase in pressure but the increase in radius of coverage was not uniform and regular. The radius of coverage ranged from 15.6 to 20.35 m at a pressure range of 1.5 to 3.0 kg/cm^2, respectively.

The relationship between pressure and radius of coverage of the raingun was determined by using different statistical techniques such as linear regression. The data were analysed by using pressure and independent variable and radius of coverage as dependent variable. So this function was used to describe the relationship between pressure and radius of coverage of the raingun.

The relationship can be described mathematically as under. R=3.09 H+11.035.

Where, R=Radius of coverage of the raingun, m P=pressure, kg/cm^2 (Figure 7).

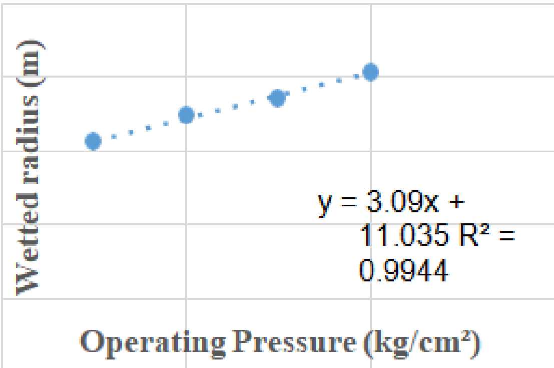

Figure 7. Regression analysis for best fit trend data

Relationship between pressure and water application rate

The application rate of the raingun was determined under various pressures. The maximum application rate of 45.015 mm/hr was found at 1.5 kg/cm^2 pressure while the minimum application rate of 37.3 mm/hr was found at 3.0 kg/cm^2 pressure.

The relationship between pressure and application rate of the raingun was determined by using different statistical techniques such as linear regression. The data were analysed by using pressure as independent variable and application rate as dependent variable. The relationship can be described mathematically as under:

A=-1.21 Q+13.23 R2=0.8739

Where, A= application rate of the raingun, mm/h P=pressure, kg/cm^2 (Figure 8).

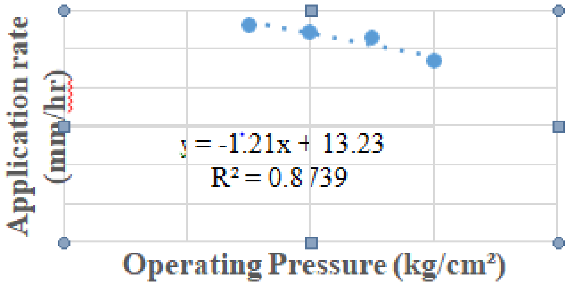

Figure 8. Regression analysis for best fit trend data

Crop parameters

Our experiment results revealed that 40, 60, 80 and 100 days after sowing, higher plant dry matter in raingun plot as compared to other treatments. And also plant height is more in raingun irrigation system but no. of leaves and no. of leaflets are more in check Basin compared to sprinkler and raingun irrigation system (Figures 9-11).

No. of pods per plant

The number of pods per plant varied with different types of irrigation systems. Among all three irrigation systems found that no. of pods per plant higher in raingun irrigation system. And no. of seeds per plant also higher in raingun irrigation system as compared to other irrigation systems (Figure 12).

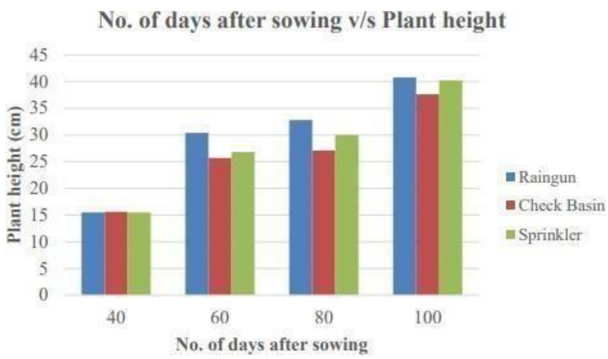

Figure 9. Comparison of plant height in different treatments

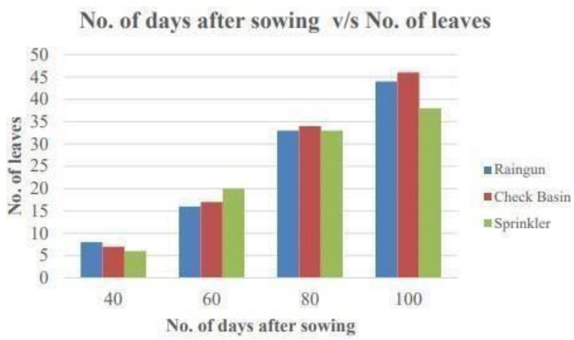

Figure 10. Comparison of no.of leaves in different treatments

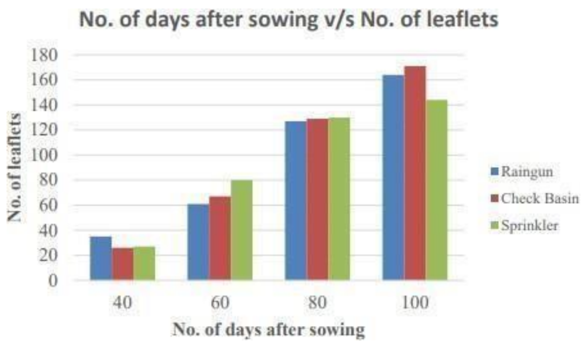

Figure 11. Comparison of no.of leaflets in different treatments

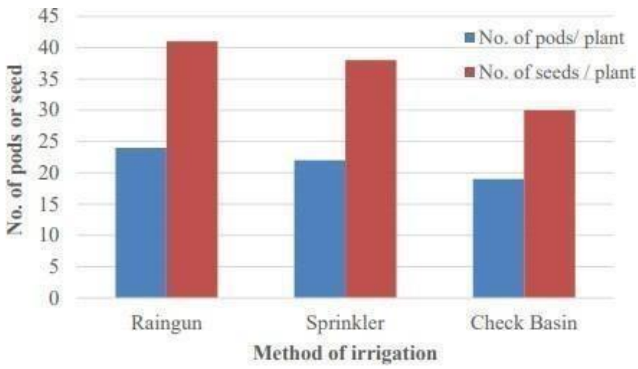

Figure 12. Comparison of no. pods and no.of seeds per plant

Crop yield

Groundnut crop was harvested by manually in three methods (rain gun, check basin, and sprinkler irrigation) and the yield was calculated (Figure 13).

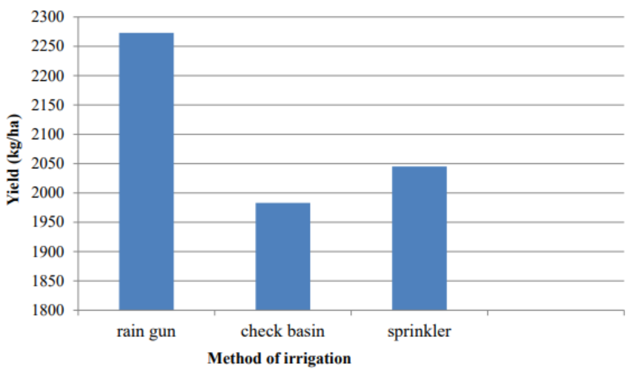

Figure 13. Comparison of yield of groundnut crop between different irrigation methods

Water use efficiency

The results of water use efficiency for the raingun, check basin and sprinkler irrigation systems are given below. The results indicated that highest water use efficiency i.e., 0.79 kg/m^3 was obtained in case of raingun sprinkler irrigation system as compared to 0.76 and 0.46 kg/m^3 for sprinkler and check basin irrigation systems respectively. 1800 1850 1900 1950 2000 2050 2100 2150 2200 2250 2300 rain gun check basin sprinkler Yield (kg/ha) Method of irrigation 41 It was observed that raingun sprinkler irrigation system used the water more efficiently as compared to other two irrigation systems. Furthermore, the selection of sprinkler or surface irrigation system depends upon the suitability of the system to socio- economic conditions of the farmer, his technical skills and availability of servicing facilities and spare parts [11]. The benefit-cost ratio of the raingun sprinkler irrigation was found as 1.19, which indicated that the raingun sprinkler irrigation system was economically feasible (Figure 14).

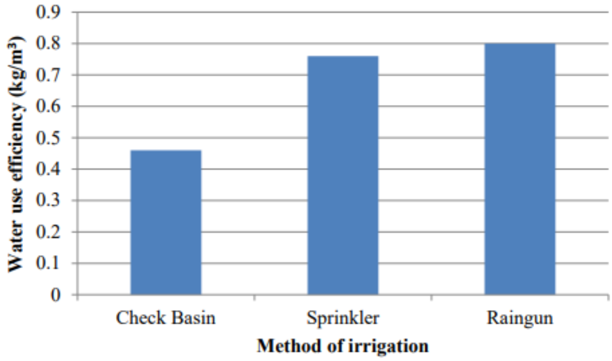

Figure 14. Comparison of water use efficiency in different treatments

Determination of infiltration rate

This test method describe a procedure for measuring the infiltration rate of water through in place soils using a double ring inflictor- meter using a sealed inner ring. Rate of infiltration study by using the water at different time of interval and measured depth of water infiltrated. The infiltration rate of the area we got as 1.2 cm/h. Type of soil=Red loamy (Figure 15).

Figure 15. Determination of infiltration rate of soil

Cost of cultivation

Cost of cultivation refers to the total expenses incurred in cultivating one hectare of groundnut. The cost of cultivation is worked out by input wise and operation wise together with their percentage to the total. A detailed cost of cultivation is worked out. All types of appropriations and imputations of various costs are taken as per the guidelines given in the manual [12].

Cost measures

The measures of costs and their components are given below.

Cost

Cost consists of all actual expenses in cash and kind, incurred in cultivation. In the present study, it includes the cost of hired human labour, cost of machine labour, cost of planting materials, cost of manures and fertilizers, cost of plant protection chemicals and weedicides, irrigation and hormone charges, interest on working capital and loan, land revenue, depreciation and other expenses. From the above analysis, one can find that the major share in input cost is the cost of labour. The other major input costs are machine cost and chemical fertilizer cost, other than other expenses

(Tables 8 and 9).

Table 8. Cost of groundnut cultivation for three classes of test plots

Inputs	Raingun (Rs/acre)	Check basin (Rs/acre)	Sprinkler (Rs/acre)
Land preparation	3800	3800	3800
Seed	6800	6800	6800
Irrigation	2700	4050	2700
Sowing	2500	2500	2500
Fertilizer	1850	1850	1850
Weeding	3500	3500	3500
Pesticides	1000	1000	1000
Weedicides	500	500	500
Harvesting & Threshing	3930	3930	3930
Cost/acre	26580	27930	26580

Table 9. Income measures of groundnut cultivation (Rs/acre)

Income measures	Raingun (Rs/acre)	Check basin (Rs/acre)	Sprinkler (Rs/acre)
Gross income	41390	41808	39090
By-products income	13000	13000	13000
Net Income	27810	26878	25510

Benefit Cost Ratio (BCR)

Benefit Cost Ratio (BCR) is the ratio of present value of benefits to present value of costs, and may be given

$BCR=I\div C$

Where, I=Income, Rs/acre, C=cost of cultivation Rs/acre

Note: Project is viable and worth taking up when the BC ratio is more than 1 (Table 10).

Table 10. Benefit cost ratio of different treatments

	T-1	T-2	T-3
BCR	1.05	0.96	0.96

Energy input-output analysis

A preforms questionnaire was designed in order to collect the required information related to the land possessed by the farmers and the utilization pattern, crop yield, operation time, fuel consumptions, electricity consumption and seed, fertilizer and chemical inputs. The energy use values were determined by multiplying by the associated energy equivalents/coefficients. Energy equivalents of the input and output used in groundnut production [13].

CONCLUSIONS

(a) The uniformity coefficient is found to be higher (70.81%) for raingun at pressures of 3 kg/cm² whereas uniformity coefficient is lower (61.50%) at pressure at 2 kg/cm² with nozzle diameter of 14 mm.

(b) Radius of coverage of rain gun at operating pressures of 1.5 kg/cm², 2.0 kg/cm², 2.5 kg/cm² and 3.0 kg/cm² with 14 mm nozzle size are 15.6 m, 17.4 m, 18.6 m and 20.35 m respectively. The radius of coverage of the raingun increased with the increase in pressure but the increase in radius of coverage was not uniform & regular.

(c) Discharge of rain gun at operating pressures of 1.5 kg/cm², 2.0 kg/cm², 2.5 kg/cm² and 3.0 kg/cm² with 14 mm nozzle size are 8.60 m^3/h, 10.30 m^3/h, 11.45 m^3/h and 12.13 m^3/h respectively. The discharge of the raingun increased with the increase in pressure.

(d) At operating pressures of 1.5 kg/cm², 2.0 kg/cm², 2.5 kg/cm² and 3.0 kg/cm², got water application rate of raingun with 14 mm nozzle of 11.25 mm/hr, 10.86 mm/hr, 10.6 mm/hr and 9.32 mm/hr respectively. Application rate is maximum at operating pressure of 1.5 kg/cm².

(e) The yield obtained in rain gun, sprinkler and check Basin irrigation were 2046 kg/ha, 1932 kg/ha and 2066 kg/ha respectively.

(f) Water use efficiency is more in raingun method of irrigation system (0.79 kg/m^3) as compared to check basin (0.46 kg/m^3) and sprinkler (0.76 kg/m^3).

(g) By applying less amount of water in raingun method of irrigation, it can get almost same yield.

(h) The benefit-cost ratio of the raingun sprinkler irrigation was found as 1.05, which indicated that the raingun sprinkler irrigation system was economically feasible.

REFERENCES

[1] Chennakesavulu. Int. J Food Agri. **2014**;4(1):127-129.

[2] Solmon, RP., Farukh., Sita, R., JASEd. **2012**;2(6):74-78.

[3] Shruthi., Dayakar, R., Latika, D., Jolly, M., Agric. Sci. Digest. **2017**;37(2):151-153.

[4] Thiyagarajan., Ranghaswami., Rajakumar., Kumaraperumal., Madras Agric J. **2010**; 97(1-3):40-42.

[5] Haleh SS., Ebrahim A., Biol Forum Int J. **2015**;7(1):617-620.

[6] Madhusudhana., IOSR-JEF. **2013**;1(3):1-7.

[7] Mohammad, A., Saeed, BN., AbdAli, N., Siroos, J., Agric Water Manag. **2010**;97(7):131-135.

[8] Jadhav., Nikam., Sinha., Kate., J Agric Eng. **2011**;4(1):97-99.

[9] Muhammad, Y.,, Shahid, A., Badruddin., Asif, AB., National Agricultural Research Centre. 1-18.

[10] Saeed, F., Hashem, A., Ann Biol Res. **2012**;3(8):3994-3997.

[11] Shafiq, A., Abdul, K., Ghulam, Nabi., et al., Pak j life soc sci. **2004**;2(2):174-177.

[12] Mungla, G., Chooneea, M., Scholars j agric vet. **2016**;3(1):9-19.