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RESEARCH ARTICLE :

Comparsion of micro sprinkler irrigation and surface irrigation methods on growth and yield for groundnut under Raichur region

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SUMMARY : Field experiment was carried out during December 2011 to April 2012 under Raichur climatic conditions. The performance of micro sprinkler irrigation for groundnut crop at 60%, 80%, 100% and 120% ET_C was compared with surface irrigation. The results indicated that there was saving of 66.41% and 57.29 % in 60 per cent ET and 80 per cent ET in micro sprinkler irrigation over surface irrigation. Maximum water use efficiency registered in micro sprinkler irrigation at 60 per cent ET (1.42 kg m^{-3}) and 80 per cent ET (1.26 kg m^{-3}) with the application efficiency of 82.80 % and 82.05 % in 60 per cent and 80 per cent ET. Uniformity in single micro sprinkler was 89.91 % and 87.69 % in 100 per cent over lapping at 1.4 kg cm^{-2}pressure, respectively.

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KEY WORDS :
Irrigation, Micro sprinkler, Water saving, Water efficiency, Uniformity co-efficient

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BACKGROUND AND OBJECTIVES

Water is one of the most critical inputs for agriculture which consumes more than 70 per cent of the water resources of the country. Availability of adequate quantity and quality of water are, therefore, key factors for achieving higher productivity levels. Investments in conservation of water, improved techniques to ensure its timely supply, and improve its efficient use are some of the imperatives, which the country needs to enhance. Poor irrigation efficiency of conventional irrigation system has not only reduced the anticipated outcome of investments made towards water resource development, but has also resulted inenvironmental problems like water logging and soil salinity thereby affecting crop yields. Thus, are calls for massive investments in adoption of improved methods of irrigation such as drip and sprinkler, including fertigation. Water being a scarce resource, its efficient and economic use is of utmost importance in agriculture.

The water users of agriculture now started realizing the importance of water management. To meet the growing demand under different categories such as domestic and industries, the necessity has arised for the optimum use of available water. Economic use of water for agriculture is the utmost necessity to bring more area under increased production. Sprinkler irrigation system is one of the water saving technique which can be adopted for the suitable crops in almost all the soils (Michael, 1989).

The micro sprinkler with easier operation and automation that, in addition, have the capacity to attain highly uniform and efficient irrigation, results in water saving and farm profitability. It is known that the water distribution pattern depends on many factors, such as, type of micro sprinklers, nozzles sizes, operating pressure, nozzle modification (Tarjuelo, 1995). In field conditions it also depends on the temperature, humidity and wind presented an interesting extensive summary of drop size distribution data for a wide range of sprinkler types that can be used complementing the information informed from evaluate data. Field evaluation is an excellent procedure for determining the actual water distribution at field level.

Micro sprinkler system can be very well used for close growing crops which requires less pressure compared to sprinkler system. Among the oil seed crops, groundnut (*Arachis hypogaea* L.) is one of the most important crop for the rice eating peoples of India, southeast Asia and Indonesia. Groundnut is grown mostly in India and is the largest producer and exporter of groundnut.

RESOURCES AND METHODS

A field study was conducted from December 2011 to April 2012 in farmer's field at Yeragera village, Raichur which is located at $16^0 15'$ North latitude and $77^0 20'$ East longitude and is at an elevation of 389 m above mean sea level (MSL).The climate is semi-arid and average annual rainfall is 722 mm. The experiment was laid out with groundnut variety R-2001-2 in a Randomized Block Design with five treatments *i.e.* 60, 80, 100, 120 per cent ET once in two days in micro sprinkler irrigation and surface irrigation replicated four times with net plot size of 9 x 9 m with 100 per cent over lapping. The soil of experimental field was sandy loam. Groundnut is a close spaced crop with the spacing 30 x 10 cm. The irrigation water was analyzed for its suitability for irrigation. The pH was 7.30 and electrical conductivity (EC) was 1.055 dSm^{-1}. Suitability of micro sprinklers interms of discharge, pressure and wetting area were tested before selection. Micro sprinklers having discharge 360 l hr^{-1} with a throw of 9 m diameter each with 1.4 kg cm^{-2} pressure at the height of 45 cm from the ground surface were selected for micro sprinkler irrigation treatments. Surface irrigation scheduled at 0.80 IW/CPE ratio and the micro sprinkler irrigation was scheduled based on Evapotranspiration of crop (ET_c) once in two days.

The daily water requirement for micro sprinkler irrigation was computed using pan evaporation data from USDA Class-A open pan evaporimeter.

The water requirement of groundnut crop per day under micro sprinkler irrigation was computed using the following equation (Anonymous, 2008).

$$Q = \frac{A \times B \times C}{E} \quad (1)$$

where,

Q = Quantity of water required mm/day

A = Daily evapotranspiration, mm/day

= Pan evaporation x pan co-efficient

B = Amount of area covered with foliage (canopy factor), fraction

C = Crop co-efficient, fraction

E = Efficiency of micro sprinkler irrigation system, per cent (80 %)

The amount of water to be delivered in check basin method was computed using the following equation.

$$d = \frac{M_{fc} - M_{bi}}{100} \times As \times ds \quad (2)$$

where,

d = Net amount of water to be applied during irrigation, cm

M_{fc} = Moisture content at field capacity, per cent

M_{bi} = Moisture content before irrigation, per cent

A_s = Bulk density of soil, g cc^{-1}

d_s = Effecive root zone depth, cm

The application efficiency of micro sprinkler irrigation and surface irrigation was computed by using the following eq.

$$e_a = \frac{W_s}{W_f} \times 100 \quad (3)$$

where,

e_a = Application efficiency (%)

W_s = Water stored in root zone of crop, Litre

W_f = Water delivered to the field, Litre

The water use efficiency of each treatment was computed using the following formula for both micro sprinkler and surface irrigation methods.

$$e_u = \frac{Y}{WR} \quad (4)$$

where

e_u=Water use efficiency, kg m^{-3}

Y = Crop yield, kg

WR = Total amount of water used in the field, m^3.

The uniformity co-efficient was calculated by collecting water in the catch cans placed at grid points of the overlapped area and then by using Christiansen's equation of uniformity co-efficient was calculated.

$$Cu = 100[1.0 - \frac{X}{MN}] \quad (5)$$

where,

Cu – Co-efficient of uniformity in per cent

X – Numerical deviation of individual observations from the average application rate, mm

M – Average value of all observations, mm

N – Total number of observation points

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Water requirement and water saving:

The results revealed that water requirement of groundnut crop during its crop period showed that the water requirement was maximum in the month of February and March. This may be attributed to the growth stage of the crop, higher temperature during this month. The total water consumed was very in micro sprinkler irrigation treatments (134.37 mm) in 60 per cent ET compared to surface irrigation (400 mm) Table 1. The water saving over surface irrigation was maximum for 60 per cent ET treatment (66.41 %), followed by 80 per cent ET (57.29 %), 100 per cent ET (48.18 %) and 120 per cent ET (39.07 %) treatments. And there is a saving of water about (9.11 %) among all the micro sprinkler irrigation treatments compared to each of the individual micro sprinkler irrigation treatments among themselves. From these results it may be concluded that there is a substantial amount of water saving by micro sprinkler irrigation system as compared to surface irrigation. This may be attributed to the fact that maximum amount of water applied will be stored in the root zone in case of micro sprinkler irrigation treatments and the deep percolation losses are eliminated. Further it could be observed that the water loss in surface irrigation is more because deep percolation losses are more due to the fact that water front does not spread instantaneously over the entire area. Invariably it takes certain time to spread the water and to build up certain water depth. During this time certain quantity of water might have percolated below the crop root zone. These results are in agreement with the earlier findings of Krishnamurthi *et al.* (2003) and Vijayalakshmi *et al*. (2004).

Irrigation efficiencies :

The irrigation efficiencies are very important factors in deciding the efficiency of micro sprinkler systems and status of availability of water to plants. In the present study the application efficiency was higher in micro sprinkler irrigation treatments than that of surface irrigation (Table 2). The higher application efficiency in micro sprinkler irrigation as compared to surface irrigation system was due to controlled application of require quantity of water to replenish the crop root zone. In micro sprinkler irrigation water will be applied as per plant water requirement over the entire area at a rate less than the

Table 1 : Monthly amount of water applied to groundnut under different levels of micro sprinkler and surface irrigation methods

Months	Amount water applied through micro sprinkler irrigation at different irrigation levels, mm				Surface irrigation
	T_1	T_2	T_3	T_4	T_5
6^{th} December	25	25	25	25	25.00
December	2.73	3.63	4.54	5.45	50.00
January	20.64	27.52	34.41	41.29	75.00
February	39.94	53.25	66.56	79.87	100.00
March	36.88	49.17	61.46	73.76	100.00
April 7^{th}	9.19	12.25	15.31	18.37	50.00
Total	134.37	170.83	207.28	243.74	400.00
% saving water over surface	66.41	57.29	48.18	39.07	

Table 2 : Effect of irrigation methods and different levels of irrigation on irrigation efficiencies

Treatments	Application efficiency (%)	Water use efficiency (kg m^{-3})
T_1	82.80	1.42
T_2	82.05	1.26
T_3	81.87	1.15
T_4	80.90	0.82
T_5	72.70	0.49

infiltration rate. In general, water application efficiency decreases as the amount of water applied during each irrigation increases. This eliminates the deep percolation losses, as water was conveyed through pipes which results in higher application efficiency.These results are in agreement with the findings of Koumanov *et al.* (1997).

Among the micro sprinkler irrigation levels higher water use efficiency was found in 60 per cent ET treatment (1.42 kg m^{-3}) indicating more efficient use of irrigation water, closely followed by 80 per cent ET level (1.26 kg m^{-3}). The higher water use efficiency at 60 and 80 per cent ET level was mainly due to higher pod yield and maximum saving in irrigation water (Table 2). The lowest water use efficiency in surface irrigation (0.49 kg m^{-3}) might be the result of higher irrigation water use with comparatively less yield. The above discussion suggests that higher groundnut yields could be achieved by adopting micro sprinkler irrigation scheduled at 60 and 80 per cent ET levels. The present investigations fall in line with that of the findings of Krishnamurthi *et al.* (2003).

Uniformity co-efficient:

It was observed by the performance of single micro sprinkler that the less discharge was noticed upto 1.5 m from the stake and the discharge was less, it varied from 1.2 mm to 2 mm, whereas the high and uniform discharge was observed from 1.5 m distance from the stake and it varied from 2 mm to 4.2 mm as shown in Fig. 1. The maximum uniformity of 89.91 per cent was achieved at 1.4 kg cm^{-2} pressure for single micro sprinkler at the stake height of 45cm from the ground surface.

By observing the pattern of throw and wetting diameter of single micro sprinkler, 100 per cent over lapping was tested to overcome the dry patches and for the uniform distribution. The micro sprinklers were placed

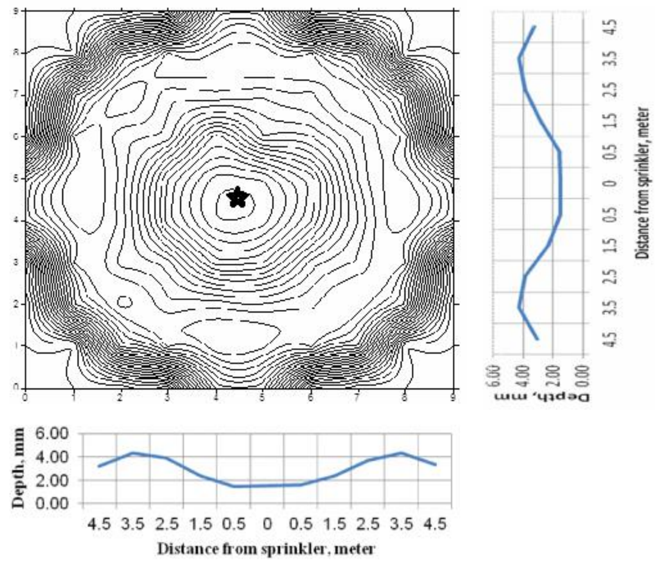

Fig. 1 : Moisture distribution pattern of single micro sprinkler

in single line. The distance between micro sprinkler was 4.5 meter apart. It was observed that the uniform and high discharge was found in 7m x 7m area and the discharge varied from 6 mm to 8.5 mm.The maximum uniformity of 87.69 per centwas obtained at 1.4 kg cm^{-2} pressure for over lapping micro sprinklers at the stake height of 45 cm from the ground surface. Though the uniformity of single micro sprinkler is higher, the 100 per cent over lapping was selected. Because in single micro sprinkler water requirement of the plants will not meet. Hence, 100 per cent over lapping was selected. These

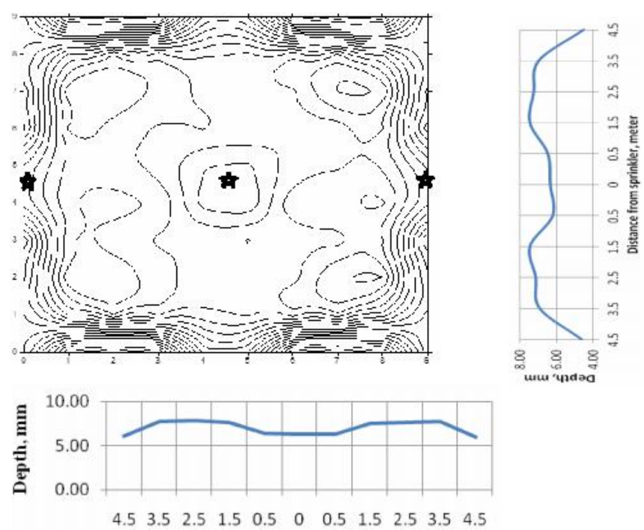

Fig. 2 : Moisture distribution pattern of overlapped micro sprinkle

results are in agreement with the findings of (Mukund and Kumar, 2002). A view of distribution pattern of 100 per cent over lapping was shown in Fig. 2.

Conclusion :

Results obtained from the experiment revealed that irrigating through micro sprinkler once in two days at 60 and 80 per cent ET recorded the maximum water saving of 66.41 % and 57.29% over surface irrigation with the highest water use efficiency in 60 per cent ET (1.42 kg m^{-3}) and 80 per cent ET (1.26 kg m^{-3}). The uniformity attained at field level is acceptable with a maximum Cu value of 87.69 % with 100 per cent over lapping. The uniformity increases when variable wind is present. Uniformity is affected by additional factors such as distance between micro sprinklers, wind etc.

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