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Effect of micro sprinkler and surface irrigation on growth and yield of groundnut crop under raichur agro climatic conditions

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Abstract
Field experiment was conducted during December 2011 to April 2012 under Raichur climatic conditions. The performance of micro sprinkler irrigation for groundnut at 60%, 80%, 100% and 120% ET_C was compared with surface irrigation. The study revealed that irrigating through micro sprinkler at 100% ET (23.86 q ha^{-1}) recorded the highest yield followed by 80% ET (21.60 q ha^{-1}) and 120% ET (20.09 q ha^{-1}) which was superior over surface irrigation yielded (19.75 q ha^{-1}). The highest B: C ratio (3.42) was found in micro sprinkler irrigation 100 % ET followed by surface irrigation (3.32) respectively.

Keywords: Irrigation, Micro sprinkler, Groundnut, Yield, Economics.

Introduction
Land and water are the most precious natural resources, the importance of which in human civilization needs no elaboration. The total available land area in the State sets the limits within which the competing human needs have to be met. The needs of agricultural, industrial, domestic and others often result in diversion from one use to the other. Diversion of land from agriculture to non-agriculture uses adversely affects the growth in agriculture sector. Water supports all forms of life on this mother earth. It plays a vital role in agriculture. Irrigation is the basic input for enhancing reliability and productivity of agriculture. Water being a scarce resource, its efficient and economic use is of utmost importance in agriculture. Pressurized irrigation system has been found to be quite effective under limited water availability not only in achieving higher productivity but also economizing other inputs such as fertilizers, pesticides, labor etc. compared to traditional irrigation methods. Micro irrigation is convenient and effective means of supplying water directly to soil and nearer to the plant without much loss of water resulting in higher water productivity.

For water to be available to the plant root zone only is required to be wet and this can be efficiently achieved through this system. Micro irrigation system avoids unnecessary wetting of soil zones not having roots and minimizes the losses due to surface and deep percolation from such areas.

Groundnut (*Arachis hypogaea* L.) "King of oilseed crops", is believed to be native of Brazil (South America). In India, groundnut is grown in an area of 5.95 million ha with a production of 7.54 million tonnes with the yield of 1268 kg ha^{-1} (Anon, 2011) [1]. Six major groundnut growing states *viz.*, Gujarat, Andhra Pradesh, Tamil Nadu, Rajasthan, Karnataka and Maharashtra contribute 90 per cent of total groundnut area of India.

Micro sprinkler system can be very well used for close growing crops which require less pressure compare to sprinkler system. For judicious water supply and also to maintain optimum moisture condition during the critical stage it is assumed that micro sprinkler would be more advantageous for getting higher yield. Hence it is necessary to formulate a suitable micro sprinkler irrigation design with simple and efficient scheduling of irrigation to groundnut crop.

Material 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˚15' North latitude and 77˚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 650 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 of 360 l hr^{-1} discharge with a throw of 9 m diameter each at 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.

$$ET_c = E_p \times K_p \times K_c$$

Where,

ET_c = Evapotranspiration (mm)
E_p = Pan evaporation (mm)
K_p = Pan factor (0.70)
K_c = Crop Coefficient

Economics of micro sprinkler irrigation and surface irrigation method was worked out to compute the net returns and benefit-cost ratio. For this purpose, the life period of poly vinyl chloride (PVC) items was considered as 10 years (Safanotas and Dipoala, 1985) and that of the submersible pump set was taken as 15 years (Sahay, 1986). Considering one ha area of groundnut. The fixed cost, operation cost and total cost were worked out. Fixed cost consisted of interest on initial cost and depreciation on the system. The interest calculated on the capital was at the rate of 12 percent per annum as per the prevailing bank rates. The depreciation on the system was worked out as follows, D= (I –S/ L) where as D is depreciation per annum (Rs.), I is initial cost of system (Rs.), S is Salvage value (10% of initial cost, Rs.) and L is economic life period, years (economic life of PVC-10 years and pump-15 years). Operating cost is the amount which is actually paid by the cultivator in cash throughout the crop period for carrying various agricultural operations. Total operational cost of the system is the operating cost plus interest on operational cost at the rate of 12 percent. The total cost is calculated as follows, Total cost = Fixed cost + Operating cost.

Results and Discussion

Growth parameters

The results revealed that there was significant difference in growth and yield of groundnut under different irrigation methods. The crop under micro sprinkler irrigation had better growth as compared to surface irrigation (Table 1). Plants receiving water at 120 per cent ET recorded the maximum height (24.05 cm) followed by control treatment, 100 per cent ET and 80 per cent ET. The minimum height was found at 60 per cent ET (18.73 cm). The plants receiving water at 100 per cent ET recorded maximum number of primary branches (8.75) which is significant over control treatment followed by 80 per cent ET, 120 per cent ET and it was lower in 60 per cent ET (6.50). The plants receiving water at 100 per cent ET recorded maximum Leaf Area Index (1.78) followed by 80 per cent ET, 120 per cent ET, control treatment and it was lower in 60 per cent ET (1.59) Table 1. Better plant growth led to higher yield in micro sprinkler irrigation treatments as against surface irrigation. The increase in plant height, number of primary branches and Leaf Area Index (LAI) in micro sprinkler irrigation over surface irrigation may be due to frequent application of irrigation water at lower rates, resulting in even distribution of soil moisture in the root zone of the crop. Because of this reason in micro sprinkler irrigated plots, soil moisture was maintained fairly close to the field capacity throughout the crop season, which resulted in high level of plant water use. This shows that adequate supply of soil moisture to groundnut plant resulted in the development of the required efficient photosynthesis and also due to increasing the available nutrient status of the soil due to mineralization and transformation of nutrients in soil. The results are in accordance with the findings of Kale *et al.*, (1992) [2] and Manjunatha *et al*., (2001) [3, 4].

Yield parameters

The better performance of crop in terms of number of pods, weight of pods, 100 kernel weight, shelling percentage and yield were superior in 100 per cent ET level as compared to 60 per cent ET and surface irrigation which have performed poorly (Table 2). The maximum number of pods per plant was found in case of 100 per cent ET (28.25), which was higher than control treatment followed by 80 per cent ET, 120 per cent ET and it was lower in 60 per cent ET (20.75).

The maximum average pod weight of (21.24 gm) was found in case of 100 per cent ET, followed by 80 per cent ET, 120 per cent ET, control treatment and it was lower in case of 60 per cent ET (12.81 gm). Data in respect of 100-kernel weight was found in 100 per cent ET (45.89 gm) which was maximum followed by 80 per cent ET, 120 per cent ET, control treatment and found lower in 60 per cent ET (39.40 gm). The maximum average shelling percentage was found in 100 per cent ET (68.36%) closely followed by 80 per cent ET (66.18%) which was higher than control treatment, 120 per cent ET and 60 per cent ET. The overall trend for all the growth parameters was found to be superior in case of 100 per cent ET level (Table 2). This may be attributed to the frequent and consistent application of water in the vicinity of the plants which provided better soil moisture regime in the crop root zone and the better development of kernels at optimum soil moisture condition as evidenced by increase in 100 kernel weight in turn contributed to an increased shelling percentage. The pod weight, 100 kernel weight and shelling percentage were superior in case of micro sprinkler irrigation treatments than control treatment. The results fall in line with the findings of Shinde *et al.*, (1995) [7], Varshney and Raghavaiah (2001) [8].

Significant differences were noticed in yield due to irrigation methods as well as micro sprinkler irrigation levels. The plants receiving water at 100 per cent ET recorded maximum yield (23.86 q ha^{-1}) over control treatment (19.75 q ha^{-1}) followed by 80 per cent ET (21.60 q ha^{-1}), 120 per cent ET (20.09 q ha^{-1}) and the lowest yield was recorded in case of 60 per cent (19.13 q ha^{-1}) which was on par with control treatment. The higher yield was mainly due to high frequency of irrigation which in turn maintained the soil moisture content in the active root zone at adequate level throughout the crop period (Krishnamurthi *et al.,* 2003) [2].

Economics

It is seen that among all the micro sprinkler irrigation treatments the highest net return (Rs. 81,079/- ha^{-1}) was obtained from treatment of irrigation at 100 per cent ET, followed by the treatment 80 per cent ET (Rs. 70,231/- ha^{-1}), control treatment (Rs. 66,244/- ha^{-1}) and 120 per cent ET (Rs. 62,983/- ha^{-1}) the lowest net return was obtained in 60 per cent ET (Rs. 58,375/- ha). It was seen from the (Table 3), that among all the micro sprinkler irrigation treatments the lowest

benefit: cost ratio (2.75) was obtained in 60 per cent ET and the highest benefit-cost ratio was found in 100 per cent ET (3.42) followed by control treatment (3.32), 80 per cent ET (3.10) and 120 per cent ET treatment (2.88). The results fall in line with the findings of Manjunatha *et al.*, (2001) [3, 4].

Conclusion

The maximum yield of groundnut was noticed in micro sprinkler irrigation with 100 per cent ET (23.86 q ha^{-1}) followed by 80 per cent ET (21.60 q ha^{-1}) compared to surface irrigation (19.75 q ha^{-1}). The maximum net returns were achieved in micro sprinkler irrigation at 100 per cent ET (81,079 Rs. ha^{-1}/-) and 80 per cent ET (Rs. 70,231 /- ha^{-1}) compared to surface irrigation (Rs. 66,244 /- ha^{-1}).

Table 1: Effect of irrigation methods on growth of groundnut crop

Treatment	Plant height (cm)	Number of primary branches	Leaf Area Index
T1	18.73	6.50	1.59
T2	18.85	7.75	1.72
T3	19.75	8.75	1.78
T4	24.05	7.50	1.66
T5	20.20	7.25	1.63
CD (0.05)	2.86	0.76	0.02

Table 2: Effect of irrigation methods on yield parameters of groundnut crop

Treatment	No. of pods per plant	Weight of pods (gm)	100-kernel weight (gm)	Shelling percentage (%)	Yield (q ha^{-1})
T1	20.75	12.81	39.40	61.47	19.13
T2	26.50	18.02	43.83	66.18	21.60
T3	28.25	21.24	45.89	68.36	23.86
T4	24.50	16.16	42.04	64.78	20.09
T5	22.25	14.53	40.51	63.13	19.75
CD (0.05)	1.41	1.52	0.64	2.50	1.15

Table 3: Economics of micro sprinkler and surface irrigation levels in groundnut crop

Treatment	Crop yield (q ha^{-1})	Gross returns (Rs. ha^{-1})	Total cost of cultivation (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	(B:C ratio)
T1	19.13	91,824	33,449	58,375	2.75
T2	21.60	1,03,680	33,449	70,231	3.10
T3	23.86	1,14,528	33,449	81,079	3.42
T4	20.09	96,432	33,449	62,983	2.88
T5	19.75	94,800	28,556	66,244	3.32

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