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Influence of Micro Sprinkler Fertigation on Growth, Yield, Water use Efficiency and Agronomic Nutrient use Efficiency in Groundnut

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Abstract A field experiment was conducted during *kharif* 2014 at ZARS, University of agricultural Sciences, Bengaluru to study the effect of micro sprinkler fertigation on growth, yield of groundnut in red sandy loam soil. The experiment was laid out in RCBD with nine treatments and replicated thrice. Micro sprinkler fertigation of WSF at 100% RDF increased the pod yield significantly (2882 kg ha^{-1}) over all other treatments. However, it was on par with micro sprinkler fertigation of WSF at 75% RDF. Micro sprinkler fertigation of WSF at 100% RDF recorded significantly higher plant height (35.7 cm), number of branches $plant^{-1}$ (7.1), number of pods $plant^{-1}$ (34.2), pod yield (2882 kg ha^{-1}) and haulm yield (3443 kg ha^{-1}). Micro sprinkler fertigation of WSF at 100% RDF recorded significantly higher WUE (64.9 kg ha-cm^{-1}) over all other treatments. Micro sprinkler fertigation of WSF at 75% RDF recorded significantly higher agronomic nutrient use efficiency (70.3, 22.3 and 44.6 kg kg^{-1} of N, P and K, respectively). Micro sprinkler fertigation of WSF at 75% RDF recorded 25% saving in fertilizers along with higher yields of groundnut.

Keywords Micro sprinkler, Fertigation, Agronomic nutrient use efficiency.

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Introduction

Groundnut (*Arachis hypogaea* L.) is one of the principal oilseed crop of tropical and sub-tropical regions of the world belongs to the family Leguminoceae and is commonly called as poor man's almond and is also called as king of oilseeds. Water and fertilizer are the two basic inputs in irrigated agriculture, while the former is less costly than the later at present. The time is not too far off when water becomes scarce and costlier due to increased industrialisation and intensive agriculture. Micro-sprinkler irrigation applies water directly to the soil surface area allowing water to dissipate under the low pressure. Micro sprinklers operates at low pressures (20-35 psi), with wetting patterns of 10 to 30 feet, with a discharge capacity of 8-90 gph [1]. The fertilizers being used in India are granular, prills and amorphous forms which are applied by various methods such as band application, broadcasting and drilling where in the fertilizers are likely to be lost by higher rains, flood irrigation. This can be avoided by applying the fertilizers through micro irrigation called as fertigation. In this context there is a greater urge to increase the use efficiency

of applied inputs (water and nutrients) through fertigation. Thus, micro sprinkler fertigation becomes prerogative for increasing the yields most of the close growing crops like groundnut, which significantly increases use efficiency of water and fertilizer, minimize losses, supplies nutrients directly to root zone in available forms and reducing cost compared to traditional fertilizer applications [2]. With the clear vision of these facts the present study was conducted to know the performance of groundnut under micro sprinkler fertigation.

Materials and Methods

A field experiment was carried out at ZARS, University of Agricultural Sciences, Bengaluru to study the impact of micro sprinkler fertigation on growth and yield of groundnut. The experiment was laid out in randomized block design in red sandy loam with nine treatments which were replicated thric. The pH of soil was slightly acidic (6, 10), medium EC (0.43 ds m^{-1}), medium nitrogen, phosphorus and potassium content 315.3, 32.3 and 219.0 kg ha^{-1}, respectively. ICGV-91114 variety was used along with spacing of 30 cm × 15 cm at recommended seed rate. In the experiment, normal fertilizer (NF) and water soluble fertilizer (WSF) were used for the study. For soil application, normal fertilizers viz., urea, SSP and MOP were applied as source of N, P_2O_5 and K_2O, respectively. These fertilizers were applied at the time of planting as basal dose for the treatments under study. In fertigation methods, according to the treatments, required quantities of fertilizers (NF or WSF) were given in 4 equal splits at 20 days interval starting from 14 days after sowing to 74 days after sowing. The treatment details were as follows.

Treatment details

T_1 : Surface irrigation with soil application of 100% RDF (NF)
T_2 : Micro sprinkler irrigation with soil application of 100% RDF (NF)
T_3 : Micro sprinkler fertigation of NF at 100% RDF
T_4 : Micro sprinkler fertigation of NF at 75% RDF
T_5 : Micro sprinkler fertigation of NF at 50% RDF
T_6 : Micro sprinkler fertigation of WSF at 100% RDF
T_7 : Micro sprinkler fertigation of WSF at 75% RDF
T_8 : Micro sprinkler fertigation of WSF at 50% RDF
T_9 : Absolute control

Results and Discussion

Significantly higher plant height (35.7 cm), number of branches (7.5), leaf area (1114 cm^2 $plant^{-1}$ and total dry matter production (51.3 g $plant^{-1}$) were recorded in micro sprinker fertigation of WSF at 100% RDF (T_6) over all other treatments except micro sprinkler fertigation of WSF at 75% RDF (T_7). Absolute control (T_1 : No application of fertilizers) recorded the lowest growth attributing parameters viz., plant height (19.1 cm), number of branches (4.9), leaf area (514 cm^2 $plant^{-1}$) and total dry matter production (20 g $plant^{-1}$). The increased growth attributes in T_6 may be attributed to availability of nutrients in root zone of plants, where in the plants were able to utilize all the nutri-

Table 1. Growth parameters viz., plant height, number of branches, leaf area and total dry matter as influenced by micro sprinkler fertigation treatments at harvest.

Treatments	Plant height (cm)	No. of branches	Leaf area (cm^2 $plant^{-1}$)	Total dry matter (g $plant^{-1}$)
T_1 : Surface irrigation with soil application of 100% RDF (NF)	22.9	5.1	625	28.6
T_2 : Micro sprinkler irrigation with soil application of 100% RDF (NF)	28.5	6.0	826	34.4
T_3 : Micro sprinkler fertigation of NF at 100 % RDF	32.6	6.8	1013	42.7
T_4 : Micro sprinkler fertigation of NF at 75% RDF	30.4	6.5	9.53	39.5
T_5 : Micro sprinkler fertigation of NF at 50% RDF	26.9	5.9	799	33.1
T_6 : Micro sprinkler fertigation of WSF at 100% RDF	35.7	7.5	1114	51.3
T_7 : Micro sprinkler fertigation of WSF at 75% RDF	34.2	7,1	1051	46.5
T_8 : Micro sprinkler fertigation of WSF at 50% RDF	29.8	6.0	874	34.7
T_9 : Absolute control	19.1	4.9	514	20.0
SEm ±	0.97	0.23	32.08	1.744
CD at 5%	2.90	0.69	96.18	5.28

Table 2. Yield and yield parameters as influenced by micro sprinkler fertigation treatments at harvest.

Treatments	No. of pods	Pod weight (g plant^{-1})	100-kernel weight (g)	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
T_1 : Surface irrigation with soil application of 100% RDF (NF)	19.4	14.8	30.3	1779	2409
T_2 : Micro sprinkler irrigation with soil application of 100% RDF (NF)	23.1	17.6	33.4	2151	2806
T_3 : Micro sprinkler fertigation of NF at 100% RDF	28.4	21.5	35.6	2517	3137
T_4 : Micro sprinkler fertigation of NF at 75% RDF	26.8	20.5	34.5	2277	2887
T_5 : Micro sprinkler fertigation of NF at 50% RDF	22.0	16.8	33.5	1933	2562
T_6 : Micro sprinkler fertigation of WSF at 100% RDF	34.2	26.1	37.9	2882	3443
T_7 : Micro sprinkler fertigation of WSF at 75% RDF	31.9	24.3	36.3	2632	3237
T_8 : Micro sprinkler fertigation of WSF at 50% RDF	24.4	18.6	33.9	2159	2837
T_9 : Absolute control	13.8	10.6	29.8	1377	2077
SEm ±	1.20	0.78	0.77	118.08	105.17
CD at 5%	3.59	2.33	2.31	354.01	315.31

ents and resulted in elongation of inter nodes, leaf area and higher dry matter accumulation. These results are similar with the findings of Vijayalakshmi [3]; Mathukia et al. [4] and Rathore et al. [5] (Table 1).

Micro sprinkler fertigation in generally increased the groundnut pod yield in all fertigation treatments. Significantly higher number of pods plant^{-1} (34.2 cm), pod weight (26.1 g plant^{-1}), 100 kernel weight (37.9 g plant^{-1}), pod yield (2882 kg ha^{-1}) and haulm yield (3443 kg ha^{-1}) recorded in micro sprinkler fertigation of WSF at 100% RDF over all other treatments except micro sprinkler fertigation of WSF at 75% RDF. The increased yield may be due to increased growth and yield parameters. The improved yield in micro sprinkler fertigation is mainly attributed to enhanced availability of nutrients in the root zone throughout growing periods, which is due to even distribution of nutrients. Since, nutrient supply through irrigation water increased solubility and availability of nutrients and higher solubility percentage of WSF which were supplied at four equal splits, thus minimizing the loss to a considerable extent. Similar results obtained by Jain et al.[6] Significantly lower yield was recorded in absolute control (1377 kg ha^{-1}) followed by surface irrigation with soil application of 100% RDF with NF (1514 kg ha^{-1}) (Table 2).

Among the different treatments, surface irrigation method recorded higher water use (631.6 mm) over micro sprinkler irrigation methods. Overall micro sprinkler fertigation treatments used 443.8 mm water which was 29.8% lower than surface irrigation with soil application of fertilizers (Table 3).Higher water use efficiency (WUE) was observed in micro sprinkler fertigation with 100% RDF through WSF (64.9 kg ha-cm^{-1}) as compared to surface irrigation with soil application of 100% RDF through NF (28.2 kg-cm^{-1}),

Table 3. Total water used and WUE as influenced by micro sprinkler fertigation in groundnut. Treatment details : T_1: Surface irrigation with soil application of 100% RDF (NF),T_2: Micro sprinkler irrigation with soil application of 100% RDF (NF), T_3 : Micro sprinkler fertigation of NF at 100% RDF, T_4 : Micro sprinkler fertigation of NF at 75% RDF, T_5 : Micro sprinkler fertigation of NF at 50% RDF, T_6 : Micro sprinkler fertigation of WSF at 100% RDF, T_7 : Micro sprinkler fertigation of WSE at 75% RDF, T_8 : Micro sprinkler fertigation of WSF at 50% RDF, T_9 : Absolute control.

Treatments	Irrigation water applied (I_w) (mm)	Total water used (I_w+E_R) (mm)	WUE (kg ha-cm^{-1})	Water saved (%)
T_1	500.0	631.6	28.2	-
T_2	312.2	443.8	48.5	29.8
T_3	312.2	443.8	56.7	29.8
T_4	312.2	443.8	51.3	29.8
T_5	312.2	443.8	43.6	29.8
T_6	312.2	443.8	64.9	29.8
T_7	312.2	443.8	59.3	29.8
T_8	312.2	443.8	48.6	29.8
T_9	312.2	443.8	31.0	29.8
SEm ±	-	-	2.78	-
CD at 5%	-	-	8.35	-

Table 4. Agronomic nutrient use efficiency (kg pod yield per kg nutrient applied) as influenced by micro sprinkler fertigation in groundnut.

Treatments	Agronomic nutrient use efficiency (kg kg^{-1}) N	P	K
T_1 : Surface irrigation with soil application of 100% RDF (NF)	16.1	5.4	10.7
T_2 : Micro sprinkler irrigation with soil application of 100% RDF (NF)	31.0	10.3	20.6
T_3 : Micro sprinkler fertigation of NF at 100% RDF	45.6	15.2	30.4
T_4 : Micro sprinkler fertigation of NF at 75% RDF	48.0	16.0	32.0
T_5 : Micro sprinkler fertigation of NF at 50% RDF	44.5	14.8	29.7
T_6 : Micro sprinkler fertigation of WSF at 100% RDF	60.2	20.1	40.1
T_7 : Micro sprinkler fertigation of WSF AT 75% RDF	70.3	22.3	44.6
T_8 : Micro sprinkler fertigation of WSF at 50% RDF	62.5	20.8	41.7
SEm ±	2.26	0.65	1.34
CD at 5%	7.86	2.3	4.07

micro sprinkler irrigation with soil application of 100% RDF through NF (48.5 kg ha-cm^{-1}) and absolute control (31.0 kg ha-cm^{-1}). Water saving was up to the tune of 29.8% by using micro sprinkler fertigation as compared to surface method of irrigation (Table 3). The increased water use efficiency in all micro sprinkler fertigation treatmentS over surface irrigation was mainly due to considerable saving of irrigation water, higher nutrient uptake and higher yield of crop (Table 3). Further, this was also due to need based application of water at regular intervals resulted in efficient utilisation of applied irrigation water and nutrients. These results are in concordance with Sukeshni et al. [7] in groundnut.

Micro sprinkler fertigation of WSF at 75% RDF registered significantly higher nitrogen use efficiency (70.3 kg kg^{-1}) over all other treatments except micro sprinkler fertigation of WSF at 50% RDF (62.5 kg kg^{-1}). Significantly higher phosphorus and potassium use efficiency was noticed in micro sprinkler fertigation of WSF at 75% RDF (22.3 and 4.6, respectively) over all other treatments except micro sprinkler fertigation of WSF at 50% RDF and 100% RDF. Higher solubility percentage of WSF have led to the efficient utilization of nutrients leading to higher uptake of nutrients which was positively correlated with the yield. So, the proportionate increase in the yield to the nutrients applied led to the increased ANUE. These results are in conformity with Jayadeva [8].

Micro sprinkler fertigation of WSF at 100% RDF recorded significantly higher growth parameters, yield parameters and water use efficiency. However, it was on par with micro sprinkler fertigation of WSF at 75% RDF. Higher agronomic nutrient use efficiency was noticed in micro sprinkler fertigation of WSF at 75% RDF. Thus 25% saving on fertilizers without much reduction in the yield.

References

1. Anonymous (2006) Promoting micro-irrigation technologies that reduce poverty. Water policy briefing. Int Water Manag Inst (IWMI) 23 : 2—4.
2. Sanju HR (2013) Precision effect of precision water and nutrient management with different sources and levels of fertilizer on yield of groundnut, MSc (Agric) thesis. Univ of Agric Sci, Bengaluru.
3. Vijayalakshmi R, Veerabadran V, Shanmugasundram K, Kumar V (2011) Micro-sprinkler irrigation and fustigation and land configuration as a best management technology package for groundnut. In: 8th Int Micro Irrig Cong Innovation in Tech and Manag of Micro-irrig for Crop Prod Enhancement. 21 Oct 2011, Tehran, Iran, pp 200-207.
4. Mathukia RK, Sagarka BK, Davaria BL (2014) Evaluation of micro-irrigation, fertigation and weed management insummer groundnut. Innovare J Agric Sci 2 : 221—227.
5. Rathore SS, Shekhawat K, Premi OP, Kandpal BK, Chauhan JS (2014) Comparative effect of irrigation systems and nitrogen fertigation on growth, productivity and water-use efficiency of Indian mustard (Brasssica juncea) under semi-arid conditions of Rajasthan. Ind J Agron 59 : 112—118.
6. Jain NK, Meena HN, Bhaduri D, Pal KK (2012) Effect of irrigation intervals and fertigation on groundnut productivity under drip irrigation. Annual report, Directorate of groundnut research, pp 47—48.

7. Sukeshni W, Harshana B, Bhuyar RC (2009) Effect of different micro-irrigation methods on growth, yield and quality of summer groundnut in Vidharbha. Green Farming 2 : 351—353.

8. Jayadeva HM (2008) Studies on nitrogen losses, methane emission and productivity of rice under crop establishment techniques. PhD thesis. Univ Agric Sci, Bengaluru.