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RESPONSE OF PHYSIOLOGICAL AND YIELD ATTRIBUTING PARAMETERS OF GROUNDNUT UNDER DRIP AND MICRO SPRINKLER FERTIGATION

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ABSTRACT
The study was conducted to assess the effect of drip and micro sprinkler fertigation on physiological and yield attributing parameters of groundnut. The experiment consisted of RBD with three replications having 11 treatments, with different levels of irrigation and fertilizer. Irrigation cum fertigation was scheduled at three days interval while surface irrigation at 0.8 IW/ CPE ratio. The results indicated that the drip irrigation at 100% PE with fertigation at 100% RDF as WSF recorded higher value of physiological parameters *viz.*, CGR (13.54, 8.08 and 3.88 g m^{-2} day^{-1}), RGR (33.35, 10.67 and 4.31mg g^{-1} day^{-1}) at all the growth intervals (30-60 DAS, 60-90 DAS and 90 DAS-harvest, respectively) and RWC (83.65, 84.92 and 75.68 %) at all the growth stages (30, 60 and 90 DAS, respectively). Similar trend was observed in terms of yield attributes *viz.*, number of pegs $plant^{-1}$ (32.10), number of pods $plant^{-1}$ (27.00), number of mature pods $plant^{-1}$ (22.83), peg-pod conversion (84.11%), hundred pod weight (121.00 g) and hundred kernel weight (46.80 g) in comparison with other treatments. Therefore, drip irrigation at 100% PE with fertigation at 100% RDF as WSF is very effective that responsible for higher physiological and yield attributing parameters in groundnut.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.), is the kingpin among the oilseed crops, popularly called as unpredictable legume, due to inconsistency in pod yield. In India, it is grown on an area of 5.53 m ha with an annual production of 7.4 m t and an average productivity of 1338 kg ha^{-1} (Anonymous, 2016). It occupies a predominant position in Indian oilseed economy. There are various factors that limit the productivity of groundnut, among them judicious management of available soil moisture and nutrients are crucial for improving the crop productivity. The irrigation can give maximum benefits to the crop only if the supply of nutrients during plant growth is maintained in the soil and vice-versa is also true. The use of micro irrigation offers a great degree of control over water and fertilizer application (fertigation) to meet the requirement of crops. Irrigation scheduling by micro irrigation systems is usually based on water requirement of the crop to maintain a favorable soil water content status in the root zone for precise application of water soluble fertilizers and other agricultural chemicals. It helps to achieve yield gains up to 100 %, water savings up to 40 to 80 %, and associated fertilizer, pesticide and labour savings over conventional irrigation systems (El-Habbasha *et al*., 2014).

Wane *et al*. (2009) reported that micro sprinkler system recorded significantly higher plant height, the number of leaves, leaf area, and dry matter per plant compared to other methods of irrigation in groundnut. Badr *et al*. (2010) found that the drip fertigation at 100% NPK on tomato found higher leaf area index, similarly, Yanglem and Tumbare (2014) studied that under drip fertigation of cauliflower at to 1.2 ETc irrigation regimes and 100% RDF resulted in improved physiological parameters in cauliflower at all crop growth stages. Jain and Meena (2015) revealed that drip fertigation under groundnut resulted in a higher number and weight of mature pods $plant^{-1}$, 100-kernel weight and shelling out-turn, that ultimately resulted in higher yield. Studies pertaining to physiological and yield attributing characters under different irrigation system can help to develop the relationship and understanding the dynamics of plant growth under micro irrigation system. In view of the above, an investigation was undertaken to assess the effect of drip and micro sprinkler fertigation on physiological and yield attributing parameters of groundnut.

MATERIALS AND METHODS

A field experiment was carried out at Tamil Nadu Agricultural University, Coimbatore, India, during 2015. The soil was sandy clay loam in texture with slightly alkaline in pH (7.24), low organic carbon (0.23 per cent), medium available N (305 kg ha^{-1}), available P_2O_5 (20.12 kg ha^{-1}) and available K_2O (169.27 kg ha^{-1}). A total rainfall of 4.3 mm was received during the cropping period. The daily mean maximum and minimum temperatures were 32.7ºC and 21.3ºC, respectively with mean pan evaporation per day were 5.6 mm having the average

relative humidity of 60.8 % during the cropping period. The experiment was laid out with groundnut variety TMV13 in a randomized block design (RBD) and replicated thrice comprised 11 treatments *viz.*,

T_1-DI at 100% PE + fertigation at 100% RDF with WSF

T_2- DI at 75% PE + fertigation at 100% RDF with WSF

T_3- DI at 100% PE + fertigation at 75% RDF with WSF

T_4- DI at 75% PE + fertigation at 75% RDF with WSF

T_5- DI at 100% PE + fertigation at 100% RDF with NF

T_6- Micro sprinkler at 100% PE + fertigation at 100% RDF with WSF

T_7- Micro sprinkler at 75% PE + fertigation at 100% RDF with WSF

T_8- Micro sprinkler at 100% PE + fertigation at 75% RDF with WSF

T_9- Micro sprinkler at 75% PE + fertigation at 75% RDF with WSF

T_{10}- Micro sprinkler at 100% PE + fertigation at 100% RDF with NF

T_{11}- Surface irrigation (5 cm depth) + soil application at 100% RDF with NF

(Note- DI: Drip irrigation, PE: Pan Evaporation, RDF: Recommended dose of fertilizers, WSF: Water soluble fertilizers, NF: Normal fertilizers)

The experimental field was ploughed with tractor drawn disc plough followed by two ploughings with cultivator and the clods were broken with rotavator. The field was uniformly leveled and formed the raised bed of 120 cm bed width and 30 cm furrow width for drip irrigation treatments, 360 cm bed width with 30 cm furrow for micro sprinkler treatments and check basin was formed for control plot so as to have uniform population. The recommended dose of fertilizer (RDF) at 25: 50: 75 kg NPK ha^{-1} with row spacing of 30 x 10 cm was maintained, with bed size 28.8 m^2 (drip: 24 x 1.2 m, micro sprinkler: 8 x 3.6 m). Drip and micro sprinkler irrigation were based on daily pan evaporation (PE) and fertigation was based on nutrient uptake pattern at the different growth stage of groundnut as suggested by Loganathan and Krishnamoorthy (1977), at once in three days interval and the volume of irrigation water was calculated by using following formula:

Volume of irrigation (V) = 3 days CPE × Kp × Kc × Area (m^2) × Wp - ER

Where,

CPE - Cumulative pan evaporation for three days (mm); Kp - Pan factor (0.8);

Kc - Crop coefficient; Wp - Wetted percentage (80 %) for drip; 100% for micro sprinkler (As over lapping was 100%); Area - 28.8 m^2; ER - Effective rainfall

The surface irrigation was given at 0.8 IW/CPE ratio with 5 cm depth of water. The required quantity of water soluble fertilizers (WSF) *viz.*, N, P_2O_5 and K_2O were applied as urea (46:0:0), all 19 (19:19:19), MAP (12:61:0) and SOP (0:0:52) and normal fertilizers (NF) as urea, MAP and MOP (0:0:60) were used under drip and micro sprinkler whereas, for surface application urea, MOP and SSP (0:16:0) were used. Drip laterals of 16 mm outer diameter (OD) having 40 cm emitter spacing was fixed in the sub mains with a lateral spacing of 60 cm having two laterals per bed with a discharge rate of 4 lph at 1 kg cm^{-2} and each plot consists of two laterals for irrigating 4 rows of crops whereas, under micro sprinkler system plane laterals of 16 mm OD was fixed in the sub mains with a lateral spacing of 3.2 m having one plane lateral per bed. On along the laterals, micro sprinkler had spaced at 1.5 m apart with a discharge rate of 44 lph at 1 kg cm^{-2} with diameter throw 3 m, each plot consists of one lateral for irrigating 12 rows of crops.

Observation on physiological parameters *viz.*, crop growth rate (CGR), relative growth rate (RGR) as suggested by Enyi (1962) at 30-60, 60-90 and 90 DAS-harvest, and relative water content (RWC) by Barrs and Weatherly (1962) 30, 60, 90 DAS were taken whereas, The yield attributing parameters *viz.*, number of pegs $plant^{-1}$, number of pods $plant^{-1}$, number of matured pods $plant^{-1}$, peg to pod conversion, hundred pod weight and hundred kernel weight were recorded on five randomly selected plants from each replication at harvest. All the data obtained were statistically analyzed using the F test procedure given by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Physiological parameters

The results from the present investigation clearly indicate that physiological parameters *viz.*, CGR, RGR and RWC of groundnut were significantly influenced by drip and micro sprinkler fertigation with different sources and levels of fertilizer during cropping period compared to surface irrigation (Table 1).

The CGR was positively influenced at 30-60 DAS stage. Drip irrigation at 100% PE with fertigation at 100% RDF as WSF (T_1) recorded significantly higher CGR of 13.54, 8.08 and 3.88 g m^{-2} day^{-1}, followed by drip irrigation at 75% PE with fertigation at 100% RDF as WSF (T_2) with 12.72, 7.55 and 3.58 g m^{-2} day^{-1} at 30-60 DAS, 60-90 DAS and 90 DAS-harvest, respectively. The least CGR was noticed in surface irrigation (5 cm depth) at 0.8 IW/ CPE with soil application at 100% RDF as NF (T_{11}) at all the stages. This may be due to effectively utilization of water and nutrient resources in the process of cell division and elongation for every incremental increase in crop growth leading to increased leaf area, which might have led to increased photosynthesis and ultimately higher CGR (Krishnamoorthy *et al.*, 2013). Higher RGR values were recorded at the initial stage of the crop and then it decreased gradually up to harvest stage. At 30-60 DAS drip irrigation at 100% PE with fertigation at 100% RDF as WSF (T_1) recorded highest RGR of 33.35 mg g^{-1} day^{-1} which was closely followed by micro sprinkler at 100% PE with fertigation at 100% RDF as WSF (T_6: 33.22 mg g^{-1} day^{-1}). At 60-90 DAS and 90 DAS-harvest, the higher value of 10.67 and 4.31 mg g^{-1} day^{-1} was recorded in drip irrigation at 100% PE with fertigation at 100% RDF as WSF (T_1), which was followed by drip irrigation at 75% PE with fertigation at 100% RDF as WSF (T_2) with 10.47 and 4.19 mg g^{-1} day^{-1}, respectively. This is because of frequent application of irrigation with WSF fertilizers through drip that provided well-aerated condition at root zone with adequate soil moisture content and sufficient concentration of nutrients

Table1: Physiological parameters as influenced by drip and micro sprinkler fertigation with different levels of irrigation and fertigation in groundnut

Treatments	CGR (g m^{-2} day^{-1})			RGR (mg $g^{-1}day^{-1}$)			RWC (%)		
	30-60 DAS	60-90 DAS	90 DAS -harvest	30-60 DAS	60-90 DAS	90 DAS -harvest	30 DAS	60 DAS	90 DAS
T_1	13.54	8.08	3.88	33.35	10.67	4.31	83.65	84.92	75.68
T_2	12.72	7.55	3.58	32.42	10.47	4.19	79.9	80.23	72.16
T_3	11.37	6.76	3.02	32.22	10.45	3.95	78.03	79.32	70.05
T_4	9.92	5.23	2.13	31.93	9.38	3.29	75.74	75.12	66.55
T_5	11.22	6.61	2.92	32.39	10.40	3.88	78.56	79.02	69.25
T_6	12.59	7.35	3.46	33.22	10.45	4.15	80.92	82.10	73.50
T_7	11.25	6.65	3.06	32.34	10.42	4.05	78.32	78.60	68.72
T_8	10.8	6.33	2.83	32.18	10.32	3.91	76.8	77.96	68.12
T_9	9.56	5.05	2.00	31.72	9.36	3.19	74.2	74.00	65.82
T_{10}	10.74	6.22	2.67	32.76	10.31	3.75	76.35	76.54	67.85
T_{11}	8.34	4.28	1.42	30.77	8.98	2.58	70.86	72.96	63.23
SEd	0.35	0.22	0.09	0.59	0.33	0.12	2.51	2.46	2.22
CD (P = 0.5)	0.76	0.46	0.19	1.27	0.70	0.25	5.38	5.28	4.76

DAS: days after sowing

Table 2: Yield attributing parameters as influenced by drip and micro sprinkler fertigation with different levels of irrigation and fertigation in groundnut

Treatments	Number of pegs $plant^{-1}$	Number of pods $plant^{-1}$	No of mature pods $plant^{-1}$	Peg-pod conversion (%)	Hundred pod wt (g)	Hundred kernel wt (g)
T_1	32.10	27.00	22.83	84.11	121.00	46.80
T_2	29.50	23.97	19.90	81.25	118.10	45.90
T_3	28.10	21.98	17.21	78.23	111.90	42.95
T_4	25.17	18.97	14.05	75.36	104.80	40.93
T_5	27.14	21.06	16.40	77.59	111.52	42.52
T_6	29.17	23.63	18.97	81.03	115.91	44.29
T_7	26.06	20.07	15.28	76.99	109.30	42.20
T_8	26.00	19.97	15.01	76.79	106.40	41.60
T_9	24.85	18.19	13.33	73.18	103.60	39.80
T_{10}	25.40	19.47	14.48	76.63	105.40	40.12
T_{11}	23.90	17.09	12.03	71.50	98.68	37.50
SEd	1.09	0.88	0.71	2.52	4.18	1.73
CD (P = 0.5)	2.34	1.89	1.51	5.41	8.96	3.70

that did not fluctuate between wet and dry extremes contributes to optimum growth (Badr *et al.,* 2010). The highest RWC was recorded under drip irrigation at 100% PE with fertigation at 100% RDF as WSF (T_1) of 83.65, 84.92 and 75.68% which is at par with micro sprinkler at 100% PE with fertigation at 100% RDF as WSF (T_6) at 30, 60 and 90 DAS, respectively and least under surface irrigation. Sufficient moisture under drip and micro sprinkler led to increasing in cell turgor and cell expansions along with solutes help in maintain the optimum osmotic potential (Nautiyal *et al*., 2002; Reddy *et al*., 2003).

Yield attributes

The yield attributes at harvest stage of groundnut were analyzed to identify different dimensions of the variations in pod yield due to drip and micro sprinkler fertigation with different sources and levels of fertilizer during cropping period compared to surface irrigation (table 2). The groundnut yield attributing characters *viz*., number of pegs $plant^{-1}$, number of pods $plant^{-1}$ and number of mature pods $plant^{-1}$ were recorded significantly highest under drip irrigation at 100% PE with fertigation at 100% RDF as WSF (T_1) with 32.10, 27.00 and 22.83 respectively, followed by drip irrigation at 75% PE with fertigation at 100% RDF as WSF (T_2) with 29.50, 23.97 and 19.90 respectively, whereas peg-pod conversion (%), hundred pod weight (g) and hundred kernel weight (g) were recorded highest under drip irrigation at 100% PE with fertigation at 100% RDF as WSF (T_1) with 84.11%, 121.00 g and 46.80 g respectively, closely followed by drip irrigation at 75% PE with fertigation at 100% RDF as WSF (T_2) with 81.25%, 118.10 g and 45.90 g respectively and significantly lower under surface irrigation (5 cm depth) at 0.8 IW/ CPE with soil application at 100% RDF as NF (T_{11}). The marked improvement in yield attributes could be due to overall improvement in vigour and crop growth, reflected by improved dry matter accumulation, CGR, RGR and LAI (Brahma Bhatt, 2012; Rekha *et al*., 2015), the optimum availability of moisture and nutrients in the root zone throughout the crop growth which would have favoured better pegging and pod development in the presence of increased N fixation and effective uptake of required quantity of N, P and K and other micro-nutrients also resulting in higher translocation of photosynthates from source to sink (Wane *et al*., 2009; Suresh *et al*., 2013).

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