International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(3): 3008-3011

Received: 25-03-2019
Accepted: 27-04-2019

N Karthika
Ph.D. Scholar, Department of Agronomy, TNAU, Coimbatore, Tamil Nadu, India

SP Ramanathan
Professor and Head, Agro Climate Research Centre, TNAU, Coimbatore, Tamil Nadu, India

Correspondence
SP Ramanathan
Professor and Head, Agro Climate Research Centre, TNAU, Coimbatore, Tamil Nadu, India

Influence of drip fertigation on the physiological and yield parameters of groundnut (*Arachis hypogaea* L.) in light textured soils of Cauvery command in Tamil Nadu

N Karthika and SP Ramanathan

Abstract
Field experiment was conducted during *kharif* 2017 at Soil and Water Management Research Institute, Kattuthottam, Thanjavur with the objectives of studying the effect of varied irrigation and nutrient regimes on the physiological and yield parameters of groundnut grown in sandy loam soils of Cauvery command. Ten treatments comprising of three irrigation regimes (75%, 100% and 125% PE) with three fertigation levels (75%, 100% and 125% RDF) were tested. The surface irrigation method with soil application of 100% RDF was included as check. The results revealed that drip fertigation at 125% PE with 125% RDF recorded higher plant height (52.2cm), leaf area index (3.47), dry matter production (7848 kg ha^{-1}), pod yield(3636 kg ha^{-1}) and haulm yield (6690 kg ha^{-1}) resulting in a yield increment of 45% over surface irrigation with soil application of 100% RDF. However, the above fertigation treatment was found to be on a par with drip fertigation at 125% PE with100% RDF in groundnut.

Keywords: Groundnut, drip fertigation, surface irrigation, yield

Introduction

Groundnut (*Arachis hypogaea* L.) is an important oilseed crop which satisfies a considerable proportion of the demand for edible oils in the country and in Tamil Nadu. The oil content varies from 44 to 52%. It is not only a major source of edible oil but its kernel and oilcake serve as a good source of digestible protein and nitrogen. The haulms are fed as green, dried or silage form to livestock. Groundnut shell is used as fuel for manufacturing coarse boards, cork substitutes, etc. Groundnut is also value as a rotation crop. In India, it is grown on an area of 5.53 m ha with an annual production of 7.46 mt with average productivity of 1398 kg ha^{-1}. In Tamil Nadu, it occupies 0.28 m ha producing 0.58 mt with average productivity of 2084 kg ha^{-1} (Indiastat, 2019) [8]. Tamil Nadu is one among the top four groundnut producing states in the country contributing about 20% of the groundnut production. Groundnut is widely cultivated as rainfed but it also grown well under irrigated condition. Inadequate water supply during growth period may reduce germination, normal root expansion and pod development. However, excessive supply of water can cause excessive vegetative growth but restrict root growth and development, resulting in decreased pod yield (Boote *et al*., 1982) [1]. Furthermore, Groundnut is an unpredictable legume, since its response to nutrient application is always not optimistic. Excessive application of nitrogen and potassium often resulted in excessive vegetative growth. Considering the availability of the major elements in the soil and quantum of losses due to leaching and fixation of the individual elements expected, a proper method and the time of nutrient application are needs of the hour (Veeramani *et al*., 2011) [12]. Though groundnut was being grown as rainfed crop under nutrient limiting environments, the productivity had been declining in view of vagaries of monsoon and non availability of nutrients. As groundnut is a crop responding to moisture and nutrients, it is imperative to increase its yield through micro irrigation with fertigation. Drip fertigation provides new possibilities for controlling water and nutrient supplies to crops besides maintaining the desired concentration and distribution of nutrients and water into the soil. Hence, an experiment was designed in the light soil tract of Cauvery command of Tamil Nadu where groundnut was a predominant crop in earlier days to evolve a standard drip fertigation technology which would enhance the groundnut productivity.

Materials and methods
Field experiment was conducted during *kharif* 2017 at Soil and Water Management Research Institute, Kattuthottam, Thanjavur District, Tamil Nadu. The experimental field was situated in Cauvery Delta Zone of Tamil Nadu geographically located at 10°45' N latitude, 79°E longitude with an altitude of 50 m above mean sea level. The soil of the experimental site was sandy loam in texture having neutral pH (6.8), EC (0.1 dS m^{-1}) and medium in organic carbon (0.60%). With regard to nutrient status, the soil was low in available nitrogen (263.4 kg ha^{-1}), high in phosphorus (25 kg ha^{-1}) and medium in potassium (168.0 kg ha^{-1}). The experiment comprised often treatments of Drip fertigation at 75 % PE + 75% RDF (T_1), Drip fertigation at 75 % PE + 100% RDF (T_2), Drip fertigation at 75 % PE + 125% RDF(T_3), Drip fertigation at 100% PE + 75% RDF(T_4), Drip fertigation at 100% PE + 100% RDF(T_5), Drip fertigation at 100% PE + 125% RDF(T_6), Drip fertigation at 125% PE + 75% RDF(T_7), Drip fertigation at 125% PE + 100% RDF(T_8), Drip fertigation at 125% PE + 125% RDF(T_9), and surface irrigation with soil application 100% RDF(T_{10}) as check were tested in randomized block design and replicated thrice. The surface irrigation was adopted at IW/CPE of 0.8 with soil application of 100% RDF. Recommended dose of fertilizer (RDF) for groundnut is 25: 50: 75 kg NPK ha^{-1}. In groundnut, the entire P_2O_5 was applied as basal in the form of single super phosphate for surface and drip fertigation method. For manual application, 50% N and K_2O as basal and remaining 50% N and K_2O in two top dressing @ 25% N and K_2O at 20 DAS and 25% N and K_2O at 45 DAS. Under drip fertigation, N and K_2O supplied through water soluble fertilizer urea (N- 46%) and SOP (K-50%) at 75% (T_1, T_4, T_7), 100% (T_2, T_5, T_6) and 125%(T_3, T_6, T_9) once in three days. Raised beds were formed with a top bed width of 3.6 m and furrows with width of 30 cm. Groundnut variety VRI 8taken as a test variety with spacing of 30cm x 10cm. Six laterals were laid out per bed with spacing of 60cm. Laterals had emitting point spaced at 30 cm apart with a discharge rate of 4 lph at 1 kg cm^{-2}. Proper weed management and plant protection measures were carried out at the appropriate time as per the recommendation. Growth and yield parameters were recorded as per the standard methodology. In order to evaluate the effect of different drip fertigation on growth and yield of groundnut, the data were statistically analyzed using "Analysis of variance test". The critical difference at 5% level of significance was calculated to find out the significance of different treatments over each other (Gomez and Gomez, 1984) [6].

Results and discussions
Plant height (cm)
There was a linear response between drip fertigation levels and plants height. Taller plants (55.4 cm) were recorded under drip fertigation at 125% PE + 125% RDF and this was at par with drip fertigation at 125% PE + 100% RDF (52.2cm) (Table 1). Shorter plant height of 42.0 cm was recorded with drip fertigation at 75% PE + 75% RDF. Increased plant height was due to optimal maintenance of soil and plant water status and also supply of sufficient quantity of nutrients in a readily available form through water soluble fertilizers. This will increased the activity of meristematic cells and cell elongation of internodes resulting in higher growth rate of stem in turn promoting higher plant height. The above results are in agreement with Gardner *et al*. (1985) [5] and Fanish *et al*. (2011) [4].

Leaf area index (LAI)
Leaf Area Index (LAI) is an important indicator of total photosynthetic surface area available to the plant for the production of photosynthates which accumulate in the developing sink. The variation in LAI is an important biophysical parameter that eventually determines crop productivity because it influences the light interception and transpiration by the crop canopy (Fageria *et al*., 2006) [3]. LAI was influenced by different level of drip fertigation (Table 1). Drip fertigation at 125% PE + 125% RDF registered higher LAI of 3.61, which was statistically on par with drip fertigation at 125% PE + 100% RDF (3.47). The lowest LAI was registered under surface irrigation (5 cm depth) at 0.8 IW/ CPE ratio with soil application of 100% RDF (2.48). In the present study, the LAI was enhanced with increase of water and constant availability of nutrients which resulted in better translocation of photosynthates and more carbohydrate synthesis contributing to favourable plant water balance. This was perhaps due to the higher production of number of leaves with more number of branches, which was in conformity with the findings of Kumar *et al*. (2009) [10].

Dry matter production (DMP)
Dry matter production of a crop reflects its efficiency to utilize the available resources such as solar radiation, moisture, nutrients and other niches of the existing environmental conditions.Varies drip fertigation levels showed its significant effect on DMP (Table 1). The higher plant dry matter production recorded under drip irrigation at 125% PE + 125% RDF (7848 kg ha^{-1}). This treatment was at par with drip irrigation at 125% PE + 100% RDF and Drip fertigation at 100% PE + 125% RDF. Significantly lower DMP (4783 kg ha^{-1}) was recorded in surface irrigation (5 cm depth) at 0.8 IW/ CPE ratio with soil application of 100% RDF. This was mainly due to optimum moisture supply and timely nutrient application which could have enhanced the assimilatory efficiency resulting in increased size and number of leaves per plant, number of branches per plant and LAI which contributed for higher dry matter production as well as promoted the activity of photosynthesis and simultaneous accumulation of dry matter. These results are in the agreement with Hebbar *et al*. (2004) [7].

Pod yield (kg ha^{-1})
Groundnut dry pod yield results revealed that among the all treatments, under drip irrigation at 125% PE + 125% RDF was recorded significantly higher pod yield of 3636 kg ha^{-1} (Table 2). Which was statistically at par with drip irrigation at 125% PE + 100% RDF and drip fertigation at 100% PE + 125% RDF. Significantly lower pod yield (1998 kg ha^{-1}) was recorded under surface irrigation (5 cm depth) at 0.8 IW/ CPE ratio with soil application of 100% RDF. The increased yield might be due to nutrient supply through irrigation water increased solubility and availability of nutrients, as they were supplied at splits, thus minimizing the loss to a considerable extent. The higher pod yield further related to high frequency irrigation which in turn maintained the soil moisture content in the active root zone at adequate level throughout the crop growth period is an important and advantageous feature of drip irrigation. These results are agreement with the finding of Bresler (1977) [2] and Sri Ranjitha *et al*. (2018) [11].

Haulm yield (kg ha^{-1})
Among the fertigation treatments, drip fertigation at 125% PE + 125% RDF was recorded significantly higher haulm yield

of 6690 kg ha^{-1} (Table 2).Which was statistically at par with drip irrigation at 125% PE + 100% RDF and drip fertigation at 100% PE + 125% RDF. Surface irrigation (5 cm depth) at 0.8 IW/ CPE ratio with soil application of 100% RDF recorded significantly lower haulm yield (4296 kg ha^{-1}). The increased haulm yield of groundnut was mainly due to the higher production of dry matter, leaf area and all the yield attributing components of the crop and provides adequate soil moisture at field capacity and better availability of nutrients which facilitated easy uptake of the required plant nutrients and thereby increased the performance of the crop with increase in photosynthetic rate. This increased photosynthetic rate naturally leads to increased crop growth and resulted in higher haulm yield. This was confirmed by the findings of Jain *et al*. (2012) [9].

Harvest index

No significant difference was noticed in harvest index among different drip fertigtion treatments. Whereas, drip fertigation at 125% PE + 125% RDF recorded relatively higher harvest index (0.352) and lower harvest index was registered under surface irrigation (5 cm depth) at 0.8 IW/ CPE ratio with soil application of 100% RDF (0.317).

Table 1: Effect of drip fertigation on Plant height (cm), LAI and DMP (kg ha^{-1}) of *kharif* groundnut in Cauvery command of Tamil Nadu

Treatment	Plant height (cm)	LAI	DMP (kg ha^{-1})
T_1- DF at 75% PE + 75% RDF	42.0	2.65	5714
T_2- DF at 75% PE + 100% RDF	46.2	2.82	6320
T_3- DF at 75% PE + 125% RDF	45.4	2.99	7005
T_4- DF at 100% PE + 75% RDF	43.0	2.70	6119
T_5- DF at 100% PE + 100% RDF	48.7	2.88	6757
T_6- DF at 100% PE + 125% RDF	43.5	3.52	7712
T_7- DF at 125% PE + 75% RDF	45.3	2.73	6242
T_8- DF at 125% PE + 100% RDF	52.2	3.47	7732
T_9- DF at 125% PE + 125% RDF	55.4	3.61	7848
T_{10}- Surface irrigation with soil application 100% RDF	48.1	2.48	4783
SEd	1.7	0.10	337
CD (p=0.05)	3.5	0.22	708

DF: Drip Fertigation ; RDF : Recommended Dose of fertilizers

Table 2: Effect of drip fertigation on Pod yield (kg ha^{-1}), haulm yield (kg ha^{-1}) and harvest index of *kharif* groundnut in Cauvery command of Tamil Nadu

Treatment	Pod Yield (kg ha^{-1})	Haulm Yield (kg ha^{-1})	Harvest index
T_1- DF at 75% PE + 75% RDF	2402	5116	0.319
T_2- DF at 75% PE + 100% RDF	2700	5616	0.325
T_3- DF at 75% PE + 125% RDF	3012	6205	0.327
T_4- DF at 100% PE + 75% RDF	2589	5463	0.322
T_5- DF at 100% PE + 100% RDF	2896	5995	0.326
T_6- DF at 100% PE + 125% RDF	3548	6599	0.350
T_7- DF at 125% PE + 75% RDF	2658	5555	0.324
T_8- DF at 125% PE + 100% RDF	3496	6677	0.344
T_9- DF at 125% PE + 125% RDF	3636	6690	0.352
T_{10}- Surface irrigation with soil application 100% RDF	1998	4296	0.317
SEd	147	297	0.017
CD (p=0.05)	308	624	NS

DF: Drip Fertigation; RDF: Recommended Dose of fertilizers

Conclusion

The results of the experiment revealed that the growth and physiological parameters viz., plant height, LAI and dry matter productionwere influenced positively by the drip fertigation levels and higher pod yields were obtained with drip fertigation at 125% PE + 125% RDF.which was on a par with drip irrigation at 125% PE + 100% RDF and drip fertigation at 100% PE + 125% RDF in groundnut grown in light soil tracts of Cauvery command during *kharif* season

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