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Yield Performance of Groundnut (*Arachis hypogaea* L.) varieties under varied Soil Moisture Regimes of micro Sprinkler Irrigation

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ABSTRACT: Groundnut crop has specific moisture requirements due to its unique feature of producing underground pods.The *rabi* crop produces a significantly higher yield as compared to the *kharif* crop and requires irrigations due to limited rainfall during the winter season. Finding the right irrigation schedule can reach a production breakthrough. Thus, a research was carried to evaluate the performance of groundnut varieties under varied soil moisture regimes of microsprinkler irrigation at RARS, Palem during *rabi* 2021-2022. The experiment was laid out in strip plot design comprising of four irrigation levels as main treatments and three groundnut varieties as sub treatments with 12 treatment combinations replicated thrice. Results revealed that yield and yield attributing characters of microsprinkler irrigation at 0.8 Epan and Check basin irrigation at 0.8 IW: CPE ratio are on par though there is marginal increase in check basin irrigation. Irrigation scheduled at 0.8 IW: CPE ratio with check basin method has recorded higher dry matter production (7619 kg ha^{-1}), number of pods plant^{-1} (36.3), test weight (36.78 g), pod yield (3050 kg ha^{-1}). This improvement was mainly due to maintaining adequate soil moisture at frequent intervals during the crop growth period. Among the varieties, K-6 recorded higher yield over K-1812 and TAG-24.

Keywords: Groundnut, Microsprinkler, Soil moisture, Varieties, Pod yield.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a key oilseed and food-legume crop for both humans and livestock in tropical and subtropical regions between 40°N to 40°S and is also considered as the king of oilseed crops which can be grown during rainy, winter and summer seasons. But its production needs to be enhanced to meet the national shortage. Worlds production figure of groundnut in the year 2019 was 48.8 million tonnes with an average production of 1647 kg ha^{-1} (Abdulrahman *et al*., 2021). It occupies a predominant position in the Indian oilseed economy and during *rabi*, 2020-21, groundnut was sown in around 2.70 lakh ha in India as compared to previous year (2.15 lakh ha). Among the states, Telangana stood first in area coverage with 1.14 lakh ha followed by Karnataka with 1.01 lakh ha (*Groundnut outlook-PJTSAU, 2022*). The two key inputs in irrigated agriculture are water and fertilizer, while maximum benefits can be extracted only if the irrigation is scheduled with proper nutrient supply during its crop growth stages (Soni *et al*., 2019). Finding the right irrigation schedule can help reach a production breakthrough. Thus, the use of a micro-irrigation system comprising of micro-sprinkler systems offers a great degree of control over water and fertilizer application to meet the requirement of crops (Waseem *et al*., 2018). Irrigation scheduling by these systems is usually based on the water requirement of the crop to maintain the favorable soil moisture content in the root zone, which helps to achieve sustained growth and yield gains up to 100 percent, water savings up to 40 to 80 percent over conventional irrigation systems (Soni and Raja 2017). Timely availability of irrigation is the key factor that determine the groundnut productivity during the critical stages (Balasubramanian *et al*., 2020). Higher productivity of the groundnut crop is gaining popularity under assured irrigation (Behera *et al*., 2015). At the same time choice of varieties is also major factor to obtain maximum production under limited moisture supply (Kumar *et al.*, 2021). Among the varieties grown, K6 is the predominant variety (>90 %) followed by TAG 24 and Kadiri Lepakshi (K-1812), a newly released high yielding groundnut variety that is also becoming very popular and widely cultivated by the farmers of Telangana state. By considering the above facts, the present study was undertaken in three groundnut varieties K-6, TAG-24, and K-1812 to evaluate the yield and yield attributes of groundnut under micro-sprinkler irrigation.

MATERIALS AND METHODS

The experiment was conducted during *Rabi* 2021-22, in the C-6 block at Regional Agricultural Research Station, Palem which is geographically situated at 16°30′49.98″N latitude and 78°15′06.60″E longitude at an altitude of 478 m above the mean sea level of Telangana state. The mean weekly maximum and minimum temperatures during the crop growth period ranged from 28.2°C to 37.2°C and 15.0°C to 24.7°C, respectively. The soil was sandy loam in texture.

The experiment was laid out in a strip plot design with three replications with 12 treatment combinations consisting of 4 main treatments(Irrigation regimes) *viz.*, I_1: Micro sprinkler irrigation at 20 centibars soil moisture potential, I_2:Micro sprinkler irrigation at 40 centibars soil moisture potential, I_3: Micro sprinkler irrigation at 0.8 Epan, I_4: Check basin irrigation at 0.8 IW: CPE ratio and 3 sub treatments (Varieties of groundnut) *viz.*,V_1: K-6**,** V_2: TAG-24**,** V_3: K-1812.

The field was uniformly levelled for micro-sprinkler and check basin treatments and the crop area sown was 22.5×10 cm. A uniform dose of NPK @40:40:50 N-P_2O_5-K_2O kg ha^{-1} respectively was applied through urea, single super phosphate (SSP) and muriate of potash (MOP). Gypsum was applied @500 kg ha^{-1} during initial pegging stage. In treatments I_1 and I_2, the microsprinkler irrigation was scheduled by monitoring soil moisture potential by installing the watermark sensors at a different depths of 0-20 cm and 20- 40 cm in the crop root zone. The irrigation was commenced whenever the soil moisture potential reached in the upper sensor at 20 cm soil depth to a pre-determined potential i.e. 20 and 40 centi bars critical soil moisture potential in treatments I_1 and I_2, respectively. The irrigation scheduling was for I_3 and I_4 at 0.8 Epan with microsprinklers and IW/CPE ratio of 0.8 with check basin method respectively.

Five plants at random from border rows leaving extreme row were destructively sampled for estimation of dry matter production. Number of pods were counted from five randomly labelled plants at harvest and averaged which is expressed as number of pods $plant^{-1}$, 100 kernels were randomly drawn from composite sample from the kernel yield from each plot, weighed and expressed in gms, one kg of sun dried pods were taken from a composite sample from each plot, shelled and weight of the kernels were recorded. Shelling percentage is calculated by dividing weight of kernels to the weight of pods which is expressed as percentage, pod yield, kernel yield, haulm yield and harvest index from each plot were calculated. Harvest index is calculated by dividing pod yield to the biological yield (pod yield + haulm yield) which is expressed in percentage.

The data generated on various parameters studied during the course of investigation were statistically analyzed by applying the standard technique of analysis of variance suggested by Gomez and Gomez (1984) for strip plot design.

RESULTS AND DISCUSSION

A. Yield and yield attributing characters

Dry matter production (DMP) of groundnut was significantly influenced by the irrigation regimes at harvest (Table 1). Highest DMP was recorded in microsprinkler irrigation at 0.8 Epan (7726 kg ha^{-1}) which was on par with check basin irrigation at 0.8 IW/CPE ratio (7259 kg ha^{-1}). This may be due to supply of optimum irrigation level and efficient nutrient uptake which resulted in better branching and increased number of leaves $plant^{-1}$ which contributed for higher DMP. Lowest DMP was recorded with microsprinkler irrigation at 40 centi bars soil moisture potential (6442 kg ha^{-1}). This might be due to less frequent irrigations. Similar results were computed by Soni and Raja (2017). Among the varieties, K-6 registered significantly higher DMP (7831 kg ha^{-1}) than K-1812 (7273 kg ha^{-1}) and TAG-24 (6181 kg ha^{-1}) respectively. This might be due to higher number of leaves $plant^{-1}$ with more number of branches in variety K-6 than TAG-24. Similar results were reported by Soumya *et al*. (2011); Priya *et al*. (2016). The interaction effect between irrigation regimes and groundnut varieties was found non-significant.

Maximum number of pods $plant^{-1}$ were observed in microsprinkler irrigation at 0.8 Epan (36.3) which was on par with check basin irrigation at 0.8 IW/CPE ratio (35.4)and microsprinkler irrigation at 20 centi bars soil moisture potential (35.3) and was significantly superior over microsprinkler irrigation at 40 centi bars soil moisture potential (32.2) (Table 1). This might be due to consistent application of water in the vicinity of crop root zone which resulted in better development of pods $plant^{-1}$. These results were in accordance with (Waseem *et al*., 2018 and Annadurai *et al*., 2012). Among the groundnut varieties, K-1812 recorded significantly greater number of pods $plant^{-1}$ (36.7) over TAG-24 (32.4) but was on par with K-6 (35.3). This may be due to compact growth with short statured nature of K-1812 resulted in reduced internodal length which finally lead to easy peg penetration. These results are in agreement with the (Priya *et al*., 2016; Prathima *et al*., 2012). Minimum number of pods $plant^{-1}$ were recorded with TAG-24 (32.4). The interaction effect between irrigation regimes and groundnut varieties was found non-significant.

Test weight was not significantly influenced by different irrigation regimes as well as the interaction effect between irrigation regimes and groundnut varieties (Table1). However, higher test weight was obtained in microsprinkler irrigation at 0.8 Epan (36.78 g). These results are in accordance with those of Behera *et al*. (2015). Among the groundnut varieties studied, significantly greater test weight was observed in variety K-6 (36.67g) over K-1812 (34.17g) and TAG-24 (32.00g). This may be due to varietal inherited characters i.e., kernel size and shape. Similar results were reported by Priya *et al*. (2016).

Shelling percentage was not significantly influenced by different irrigation regimes (Table 1). However, maximum shelling percentage was observed inmicrosprinkler irrigation at 0.8 Epan (64.7 %)

followed by check basin irrigation at 0.8 IW/CPE ratio (63.0 %), microsprinkler irrigation at 20 centibars soil moisture potential (62.8 %) and minimum shelling percentage was recorded with microsprinkler irrigation at 40 centibars soil moisture potential (59.8 %). These results are in conformity with those of Naresha *et al*. (2016); Behera *et al*. (2015); Bure *et al*. (2011). Among the groundnut varieties studied, significantly higher shelling percentage was recorded in variety K-6 (66.0 %) over K-1812 (61.2 %) and TAG-24 (60.5 %). These results are having similarity with Priya *et al*. (2016) and Soumya *et al*. (2011). The interaction effect between irrigation regimes and groundnut varieties was found non-significant.

Table 1: Dry matter production at harvest and yield attributes of groundnut varieties as influenced by different irrigation regimes.

Treatments	Dry matter production (kg ha^{-1})	No. of pods $plant^{-1}$	Test weight(g)	Shelling percentage (%)
Main plot–(Irrigation regimes)				
I_1: Microsprinkler irrigation at 20 centibars soil moisture potential	6950	35.3	33.44	62.8
I_2: Microsprinkler irrigation at 40 centibars soil moisture potential	6442	32.2	32.00	59.8
I_3: Microsprinkler irrigation at 0.8 Epan	7726	36.3	36.78	64.7
I_4 : Check basin irrigation at 0.8 IW: CPE ratio	7259	35.4	34.89	63.0
SEm±	188	0.8	1.01	2.2
C.D(P=0.05)	653	2.8	NS	NS
Subplot– (Varieties)				
V_1: K-6	7831	35.3	36.67	66.0
V_2: TAG-24	6181	32.4	32.00	60.5
V_3:K-1812	7273	36.7	34.17	61.2
SEm±	177	1.0	0.87	1.1
C.D(P=0.05)	459	4.0	3.43	4.4
Interaction:				
Effect of different varieties at same level of irrigation regimes:				
SEm±	234	2.0	1.75	2.2
C.D(P=0.05)	NS	NS	NS	NS
Effect of irrigation regimes with same or different varieties:				
SEm±	268	1.8	1.74	2.9
C.D(P=0.05)	NS	NS	NS	NS

There is a significant difference in the pod yield of groundnut with the irrigation levels and highest pod yield was recorded when irrigation scheduled with microsprinkler irrigation at 0.8 Epan (3050 kg ha^{-1}) which was statistically on par with check basin irrigation at 0.8 IW/CPE ratio (2915 kg ha^{-1}) and microsprinkler irrigation at 20 centi bar soil moisture potential (2703 kg ha^{-1}) and lowest was recorded in microsprinkler irrigation at 40 centibar soil moisture potential (2331 kg ha^{-1}). This might due to the maintenance of adequate soil moisture at frequent intervals during the crop growth period and high nutrient availability leading to better nutrient uptake and higher number of pods which ultimately resulted in higher yield. These results are in accordance with Vijayalakshmi *et al*. (2011) and similar findings were reported by Suresh *et al*. (2013) who concluded that higher pod yield in groundnut at 1.0 and 0.8 IW/CPE ratio. Among the groundnut varieties, K-6 (2950 kg ha^{-1}) recorded significantly higher pod yield which was on par with K-1812 (2833 kg ha^{-1}) and lowest pod yield was recorded in TAG-24 (2467kg ha^{-1}) (Table 2). This might be due to genetic potential of those varieties in terms of higher test weight, shelling percentage. The interaction effect between the irrigation levels and groundnut varieties was not significant.

The kernel yield of groundnut was significantly influenced by different irrigation regimes as well as groundnut varieties (Table 2). Maximum kernel yield of groundnut was obtainedwhen microsprinkler irrigation was scheduled at 0.8 Epan (1977 kg ha^{-1}) which was statistically superior over all the treatments *viz.*,check basin irrigation at 0.8 IW/CPE ratio (1802 kg ha^{-1}), microsprinkler irrigation at 20 centibars soil moisture potential (1695kg ha^{-1}) and minimum kernel yield was registered with microsprinkler irrigation at 40 centibars soil moisture potential (1390kg ha^{-1}). This might be due to frequent irrigations which created favorable environment for the crop growth and all the yield promoting characters were significantly higher with microsprinkler irrigation at 0.8 Epan. These results are in conformity with Vaghasia *et al*. (2017); Pawar *et al*. (2013). Among the groundnut varieties, K-6 recorded significantly higher kernel yield (1949kg ha^{-1}) over K-1812 (1722 kg ha^{-1}) and TAG-24 (1477kg ha^{-1}). This may be due to genetic potential of the varieties *viz.*, test weight, shelling percentage Meena *et al*. (2015). The interaction effect between the irrigation levels and groundnut varieties was found non-significant.

The haulm yield of groundnut was significantly influenced by different irrigation regimes as well as groundnut varieties (Table 2). Significantly higher haulm yield was noticed in microsprinkler irrigation at 0.8 Epan(5534 kg ha^{-1}) compared to microsprinkler irrigation at 20 centi bars soil moisture potential (5020 kg ha^{-1}) and microsprinkler irrigation at 40 centi bars soil moisture potential (4827 kg ha^{-1}) and was on par with check basin irrigation at 0.8 IW/CPE ratio (5150 kg ha^{-1}). This may be due to greater soil moisture availability with increased nutrient uptake which in turn led to more vegetative growth resulting in higher haulm yield. These results are also lined with (Behera *et al*., 2015; Vaghasia *et al*., 2017). Among the varieties, K-6 registered significantly greater haulm yield (5750 kg ha^{-1}) than K-1812 (5248 kg ha^{-1}) and TAG-24 (4401 kg ha^{-1}). This could be mainly due to the genetic potential of the varieties and nutrient uptake by the plants. The interaction effect between the irrigation levels and groundnut varieties was found non-significant. The results validate the findings of Priya *et al*. (2016); Bhargavi *et al*. (2017).

Harvest index was not significantly differed among the irrigation regimes (Table 2). However, it was reported higher in check basin irrigation at 0.8 IW/CPE ratio (36.5 %) and lowest was recorded in microsprinkler irrigation at 40 centi bars soil moisture potential (33.3 %). These results are in accordance with (Rathore *et al*., 2014; Soni *et al*., 2019). Among the groundnut varieties, significantly greater harvest index was registered in variety TAG-24 (36.2 %) compared to K-6 (33.8 %) and was on par with K-1812 (35.4 %). This might be due to short statured nature of TAG-24 which led to reduced haulm yield (Priya *et al*., 2016). The interaction effect between the irrigation levels and groundnut varieties was found non-significant.

Table 2: Yield and Harvest index of groundnut varieties as influenced by different irrigation regimes.

Treatments	Pod yield (kg ha^{-1})	Kernel yield (kg ha^{-1})	Haulm Yield (kg ha^{-1})	Harvest index(%)
Mainplot–(Irrigation regimes)				
I_1: Microsprinkler irrigation at 20 centibars soil moisture potential	2703	1695	5020	35.4
I_2: Microsprinkler irrigation at 40 centibars soil moisture potential	2331	1390	4827	33.3
I_3: Microsprinkler irrigation at 0.8 Epan	3050	1977	5534	35.4
I_4 : Check basin irrigation at 0.8 IW: CPE ratio	2915	1802	5150	36.5
SEm±	108	47	188	1.0
C.D(P=0.05)	376	164	461	NS
Subplot–(Varieties)				
V_1: K-6	2950	1949	5750	33.8
V_2: TAG-24	2467	1477	4401	36.2
V_3:K-1812	2833	1722	5248	35.4
SEm±	75	42	108	0.4
C.D(P=0.05)	296	167	425	1.7
Interaction:				
Effect of different varieties at same level of irrigation regimes:				
SEm±	150	85	216	0.9
C.D(P=0.05)47	NS	NS	NS	NS
Effect of irrigation regimes with same or different varieties:				
SEm±	164	84	221	1.3
C.D(P=0.05)	NS	NS	NS	NS

Fig. 1. Author taking soil moisture potential readings.

CONCLUSION

Results of the present investigation revealed that irrigation scheduled with check basin irrigation at 0.8 IW/CPE ratio recorded significantly higher yield attributing characters i.e., numbers of pods $plant^{-1}$, test weight and shelling percentage, pod yield, kernel yield, haulm yield which was statistically on par with microsprinkler irrigation at 0.8 Epan. Among the groundnut varieties studied greater yield was obtained from variety K-6 over K-1812 and TAG-24, respectively.

FUTURE SCOPE

This investigation will help to understand farmers the best suitable irrigation method for the particular variety. Furthermore, advancements in micro sprinkler irrigation have a greater impact on water saving through easy and precise application.

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Conflict of Interest. None.

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