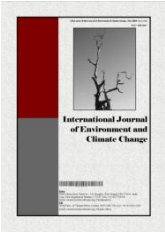

International Journal of Environment and Climate Change

12(11): 3077-3083, 2022; Article no.IJECC.91851
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Assessment of the Effect of Different Irrigation Regimes on Pod Yield, Water Requirement & Productivity and Economics of Groundnut Varieties under the Southern Telangana Zone, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2022/v12i111353

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/91851

Original Research Article

Received 20 July 2022
Accepted 26 September 2022
Published 11 October 2022

ABSTRACT

The research was conducted at the Regional Agricultural Research Station, Palem during *yasangi (rabi)* 2020-21 to assess the impact of irrigation regimes on yield, water productivity, and economics of groundnut varieties. The experiment was laid out in a split plot design and comprising of three irrigation levels viz., irrigation at IW/CPE ratios of 1.0 (I_1), 0.8 (I_2), and 0.6 (I_3), as main treatments and four groundnut varieties viz., K-6, GJG-32, KDG-128 and K-9 as sub treatments and replicated thrice. The soil was sandy clay loam having P^H 7.3, available N, P, and K of 195, 35.8, and 87.36 kg ha^{-1}, respectively. The highest pod yield of 2278 kg ha^{-1} and lowest pod yield of 1842 kg ha^{-1} could be obtained at the IW/CPE of 1.0 and 0.6 respectively requiring 677.7 ha.mm/ha and 450.7 ha.mm/ha of irrigation water respectively. There was no significant difference in gross returns, net returns, and B: C ratios recorded with irrigation at 1.0 IW/CPE ratio (Rs 126989 ha^{-1}, Rs 47607 ha^{-1}, and 1.60, respectively) and 0.8 IW/CPE and significantly lower with 0.6 IW/CPE ratio (Rs.102673 ha^{-1}, Rs. 28311 ha^{-1} and 1.38, respectively). It can be concluded that K-6 or K-9 varieties can be grown during *yasangi (rabi)* with IW/CPE ratio of 0.8 or IW/CPE ratio of 1.0 as per irrigation water availability for higher water productivity and net returns.

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Keywords: Irrigation regimes; pod yield; water productivity; economics.

1. INTRODUCTION

Groundnut (*Arachis hypogaea L.*) belonging to the family Leguminaceae is an important source of oil and protein for a large portion of the population and is also considered the king of vegetable oil seed crops in India which can be grown during rainy, winter, and summer seasons. Its kernel contains oil percentages ranging from 47 to 53%, 26 percent protein, 11.5% starch, 55% oleic acid- about 25% linoleic acid, and around 10% palmitic acid [1].

Groundnut has specific moisture needs due to its peculiar feature of producing pods underground [2]. The *yasangi* (*rabi*) crop produces a substantial yield as compared to the vanakalam (*kharif*) crop and requires irrigation due to scanty rainfall during winter. Irrigation is a critical input for groundnut production in India. Scientific scheduling of irrigation to the crop is given for the efficient utilization of applied water [3]. Irrigation at all the critical stages of groundnut produced maximum pod yield in summer groundnut [4]. Because of high productivity under assured irrigation, groundnut cultivation in the summer season is gaining popularity [5].

In irrigation scheduling, a climatologically approach based on IW/CPE ratio (IW- irrigation water, CPE- Cumulative pan evaporation) has been found most appropriate which integrates all the weather parameters that determine water use by the crop and is likely to increase production at least 15-20% [6]. Optimum scheduling of irrigation led to an increase in pod yield and water use efficiency (WUE) in groundnut [6]. There is a gap in the productivity of groundnut at our state level and national level due to the fact that the potentiality of the crop is not fully exploited by the Indian farmers due to many factors, of which proper irrigation and suitable variety for a particular season need consideration. Hence, identifying a suitable irrigation schedule and suitable variety may achieve a breakthrough in productivity.

China ranks first in groundnut production with 17.39 million tonnes followed by India 6.70 million tonnes, Nigeria 2.89 lakh tonnes, Sudan 2.88 million tonnes, and Myanmar 1.60 million tonnes accounting for 37, 14, 6, 2, and 1 percent of total world production of 46.01 million tonnes during 2018-19.

The Southwest monsoons which end by mid-September bring the region's only rainfall. With the vagaries of monsoons and the associated low productivity during the rainy season, cultivation of groundnut during the *yasangi* season under limited irrigated conditions is assuming importance.

Groundnut is an important oilseed crop in Telangana, and the area under groundnut increased tremendously during *the yasangi* season with productivity ranging from 2261-2330 kg ha^{-1}. In India, 24.4 percent of *yasangi* season groundnut is cultivated in Telangana State and the lion's share of area and production are contributed from the Southern Telangana zone under medium black and sandy soils. In Telangana, groundnut has been sown in around 45.43 ha during 2020-21 [7]. Among the districts, Nagarkurnool stood first in groundnut sown area with 18.68 ha followed by Wanaparthy (7.26 ha), Gadwal (3.19 ha), Vikarabad (3.14 ha), and Narayanpet with (2.24 ha). Among varieties grown, K6 is the predominant variety (>90%) followed by TAG 24 and others. Of late, it has been observed that there was a high incidence of leaf spot diseases in these varieties. In addition to this, the subsidy on these varieties cannot be extended as they were released > 10 years earlier. The information on the performance of new varieties, to be promoted in farmers' fields and corresponding water requirement is not available. Hence there is a need to develop and promote new varieties and now the State Agricultural University (Professor Jayashankar Telangana State Agricultural University) proposes to promote new varieties viz., K-9, GJG -32, KDG-128, and others.

2. MATERIALS AND METHODS

The field experiment was conducted during *rabi* 2020-2021 at the Regional Agricultural Research Station, Palem, Professor Jayashankar Telangana State Agricultural University (PJTSAU). The soil texture was sandy clay loam soil which was alkaline in reaction and non-saline, low in organic carbon content, nitrogen, available phosphorus, and available potassium. The irrigation water was neutral (7.8 pH) suggesting that it is suitable for irrigation purposes by following good management practices. The experiment was laid out in a split-plot design consisting of 12 treatments replicated thrice. viz., irrigation regimes at 1.0 IW/CPE ratio

(I_1), 0.8 IW/CPE ratio (I_2), and 0.6 IW/CPE ratio (I_3) and four varieties K-6, GJG-32, KDG-128 and K-9 and replicated thrice. The recommended dose of fertilizers (RDF) was 30: 40: 50 kg NPK ha^{-1} and the entire dose of P_2O_5 and K_2O, 20 kg nitrogen was applied as basal and 10 kg of nitrogen was top dressed at 30 DAS. Gypsum (500 kg ha^{-1}) was applied during the end of the flowering/ initial pegging stage by band placement at 5 cm away from rows and 5 cm below the soil.

Amount of Irrigation Water Applied (mm):

The irrigation water was applied as per the treatments (IW/CPE ratios) on the basis of pan evaporation (PE) data (USWB open pan evaporimeter) obtained from RARS, Palem, and the quantity of water applied was measured by the water meter. The volume of water required for each irrigation treatment was calculated by applying the following formula.

$$W = AxdxI00$$

Where,

W= quantity of water (L)

A= plot area in m^2

d = depth of irrigation water in meters (m)

Total Irrigation Water Applied (mm):

Total irrigation water applied (mm) = water applied at each irrigation (mm) × no of irrigations + effective rainfall (mm) and total water consumed by crop was total irrigation water applied + effective rainfall during crop growth period.

3. RESULTS AND DISCUSSION

Pod Yield (kg ha^{-1}):

Significantly highest pod yield of groundnut was recorded with irrigation scheduled at 1.0 IW/CPE ratio (2278 kg ha^{-1}) which was statistically on par with irrigation scheduled at 0.8 IW/CPE (2187 kg ha^{-1}) and more over 0.6 IW/CPE ratio (1842 kg ha^{-1}). While the irrigation scheduled at 0.6 IW/CPE ratio remained significantly inferior to IW/CPE ratios of 1.0 and 0.8 treatments (Table 1). The increase in pod yield was 23.7 percent at 1.0 IW/CPE ratio and 0.8 IW/CPE was 1.87 percent over 0.6 IW/CPE might be due to frequent irrigations which in turn maintained the optimum soil moisture content in the active root zone at an adequate level throughout the crop period which led to higher uptake of nutrients and thereby increased the number of pods $plant^{-1}$ which in turn resulted in higher pod yield [8]. Also, these results were in close conformity with the findings of Naresha et al. (2017) who reported that a significantly higher pod yield of rabi groundnut was obtained with irrigation at 0.8 IW/CPE and 1.0 IW/CPE.

Among the varieties of *yasangi* groundnut, K-9 variety recorded a significantly higher mean pod yield of 2321 kg ha^{-1} which was statistically on par with K-6 (2282 kg ha^{-1}) and significantly more by 10.9 and 35.7 percent over KDG-128 and GJG-32 with pod yield of 2093 kg ha^{-1} and 1711 kg ha^{-1} respectively (Table 1). The increase in pod yield with K-9 was 1.7 percent over K-6, while the lowest pod yield was recorded with GJG-32 which remained significantly inferior to K-9, K-6 andKDM-128 varieties.

Amount of Water Applied (mm):

The amount of irrigation water applied (including sowing and harvesting irrigation) in 1.0 IW/CPE, 0.8 IW/CPE, and 0.6 IW/CPE ratios were 661.3 mm, 535.3 mm, and 434.3 mm, respectively. Total irrigation water applied including effective rainfall of 16.4 mm was 677.7 mm, 551.7 mm, and 450.7 mm in 1.0, 0.8, and 0.6 IW/CPE ratios, respectively. The variation in the total irrigation water applied was due to variation in the number of times the crop was irrigated and the interval between two irrigations during the crop growth period. These results validate the findings of Rank, 2007, who reported that irrigation water applied varied between 523 mm and 1047 mm with 0.6 to 1.2 IW/CPE ratios during the summer season.

Water Productivity (WP):

Water productivity of *yasangi* groundnut varied among different irrigation treatments and significantly higher water productivity (4.11 kg m^{-3}) was recorded with irrigation scheduled at 0.6 IW/CPE than 1.0 IW/CPE ratio (3.40 kg m^{-3}) and was statistically on par with irrigation scheduled at 0.8 IW/CPE (4.0 kg m^{-3}) as given in Table 1. Significantly lower water productivity was observed with irrigation scheduled at 1.0 IW/CPE ratio, as a result of the relatively lower increase in yield with an increased level of water applied.

Similar results of water productivity were reported by Pervin et al. [9] and Ravisankar et al. [10].

Among the groundnut varieties, significantly higher water productivity was recorded with K6 (4.59 kg m^{-3}) than the rest of the varieties and was followed by K9 (3.96 kg m^{-3}) which was on par with KDG-128 (3.85 kg m^{-3}). Significantly lowest water productivity was observed with GJG-32 (2.94 kg m^{-3}). This may be resulted due to lower pod yields obtained with the application of increased irrigation water.

Gross Returns:

Significantly greater (Rs.126989 ha^{-1}) gross returns were recorded with irrigation scheduled at 1.0 IW/CPE ratio which was on par with irrigation at 0.8 IW/CPE ratio (Rs.121917 ha^{-1}). Significantly lower gross returns (Rs.102673 ha^{-1}) were recorded with irrigation at 0.6 IW/CPE ratio than irrigation at 1.0 and 0.8 IW/CPE ratio (Table 2 and Fig. 1). This indicates that gross returns increased with increasing irrigation levels. These results were in similarity to Behera et al. [5] and Dash et al. [11] who reported higher gross returns with higher irrigation levels.

Significantly higher gross returns were recorded with K9 (Rs.129440 ha^{-1}) compared with GJG-32 (Rs.95390 ha^{-1}) & KDG-128 (Rs.116696 ha^{-1}) and were on par with K6 (Rs.127246 ha^{-1}). The variation in the gross returns was due to the variation in pod yields with different varieties selected for the study. Similar results of higher gross returns with different varieties were reported by Murugan and Nisha [12].

Net Returns:

The mean net returns obtained with the irrigation scheduled at 1.0IW/CPE ratio (Rs.47607 ha^{-1}) and IW/CPE ratio of 0.8 IW/CPE (Rs.45295 ha^{-1}) were significantly superior to 0.6 IW/CPE ratio (Rs.28311 ha^{-1}) as given in Table 2 and Fig. 1. The results are in conformity with the results reported by Behera et al. [5] and Dash et al. [11] who found that the highest net returns were obtained with irrigation scheduled at 0.8 IW/CPE and the lowest with 0.6 IW/CPE ratio. Among the different groundnut varieties, the highest net returns were recorded with K- 6(Rs.51553 ha^{-1}) than net returns recorded with GJG-32 (Rs.18291 ha^{-1}) and KDG-128 (Rs. 40534 ha^{-1}) and was on par with K9 (Rs. 51241 ha^{-1}). Significantly lower net returns were recorded by GJG-32 than the rest of the treatments (Table 2 and Fig. 1).

Table 1. Pod yield, water requirement, and water productivity of groundnut varieties as influenced by irrigation regimes during *yasangi (rabi)*

Treatments	Pod yield (kg ha^{-1})	Water requirement (mm)	Water productivity (kg m^{-3})
Main plot–Irrigation regimes:			
I_1 : IW/CPE ratio of 1.0	2278	677.7	3.40
I_2 : IW/CPE ratio of 0.8	2187	551.7	4.00
I_3 : IW/CPE ratio of 0.6	1842	450.7	4.11
SEm±	63	-	0.10
C.D(P=0.05)	246	-	0.40
Subplot– Varieties:			
V_1: K-6	2282	501.3	4.59
V_2: GJG-32	1711	595.3	2.94
V_3: KDG-128	2093	548.3	3.85
V_4: K-9	2321	595.3	3.96
SEm±	50	-	0.10
C.D(P=0.05)	148	-	0.28
Interaction:			
Different varieties at the same level of irrigation regimes:			
SEm±	86	-	0.17
C.D(P=0.05)	NS	-	NS
Irrigation regimes with the same or different varieties:			
SEm±	98	-	0.18
C.D(P=0.05)	NS	-	NS

Table 2. Gross & Net returns (Rs. ha^{-1}) and B: C ratio of groundnut varieties as influenced by different levels of different irrigation regimes during *yasangi (rabi)*

Treatments	Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	B:C ratio
Main plot - Irrigation regimes:			
I_1 :IW/CPE ratio of 1.0	126989	47607	1.60
I_2 :IW/CPE ratio of 0.8	121917	45295	1.59
I_3 :IW/CPE ratio of 0.6	102673	28311	1.38
SEm±	3493	3493	0.04
C.D(P=0.05)	13175	13175	0.18
Subplot–Varieties:			
V_1:K-6	127246	51553	1.68
V_2:GJG-32	95390	18291	1.24
V_3: KDG-128	116696	40534	1.53
V_4: K-9	129440	51241	1.65
SEm±	2780	2780	0.04
C.D(P=0.05)	8259	8259	0.11
Interaction:			
Different varieties at same level of irrigation regimes:			
SEm±	4814	4814	0.06
C.D(P=0.05)	NS	NS	NS
Irrigation regimes with same or different varieties:			
SEm±	5439	5439	0.07
C.D(P=0.05)	NS	NS	NS

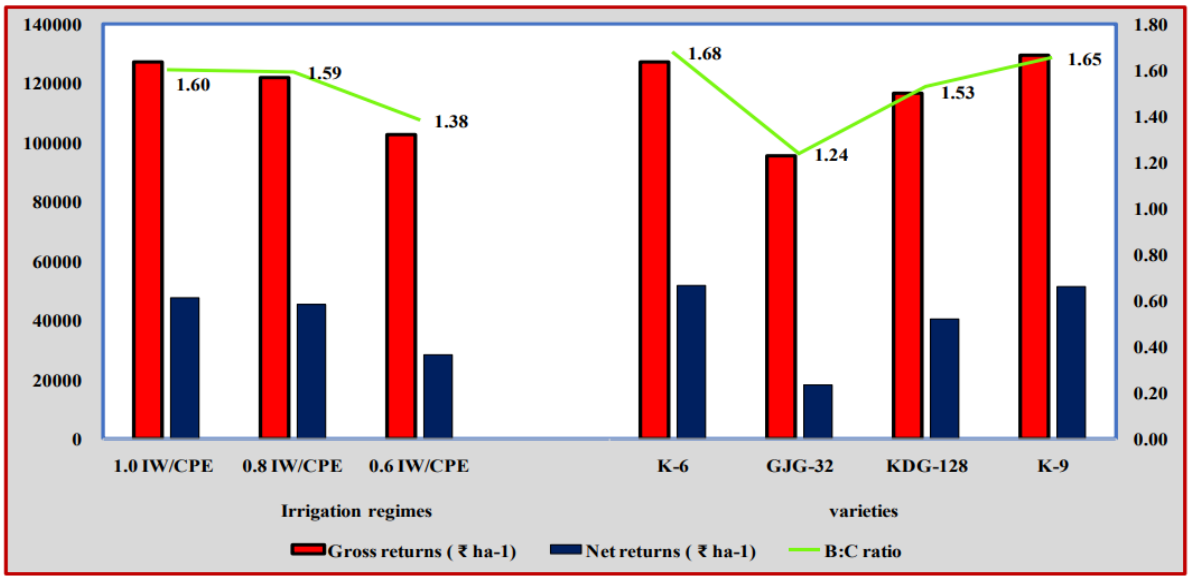

Fig. 1. Gross returns (₹. ha^{-1}), Net returns (₹. ha^{-1}) and B: C ratio of groundnut varieties as influenced by different irrigation regimes during *yasangi*

B:C Ratio (Benefit: Cost Ratio):

B: C ratio was significantly higher with irrigation scheduled at 1.0IW/CPE (1.60) than irrigation at 0.6IW/CPE (1.38) and there was no significant variation in B:C ratio between 1.0 and 0.8 IW/CPE ratio (1.59). Irrigation scheduled at 0.6IW/CPE ratio recorded a significantly lower

B:C ratio than rest of the treatments. The findings of Arif et al. [13] and Kamble et al. [14] were in similar agreement with the present investigation findings (Table 2 and Fig. 1). K-6 (1.68) and K-9 (1.65) were recorded on par B: C ratio and were significantly superior over GJG-32 (1.24) and KDG-128 (1.53). Significantly lower B:C ratio was recorded with GJG- 32 than in the rest of the other varieties. This may be due to relatively lower gross returns with an increased cost of cultivation. These findings corroborate the findings of Meena and Yadav [15].

4. CONCLUSION

- From the study, it can be concluded that the water requirement of different groundnut varieties was higher with irrigation scheduled at 1.0 IW/CPE ratio and lower with that at 0.6 IW/CPE ratio. The water requirement of K-9 and GJG-32 was higher than K-6 and KDG-128.
- Gross returns, Net returns, and B: C ratio did not differ significantly when groundnut varieties were irrigated either with 1.0 IW/CPE ratio or with 0.8 IW/CPE ratio and were significantly superior to 0.6 IW/CPE ratio.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Available:https://www.thehindu.com/sci-tech/agriculture/india-develops-new-groundnut-line-with-desirable-oil-quality/article27107499; 2019.
2. Banik CN, Nath R, Chakraborty PK. Effect of dates of sowing on growth and yield of groundnut crop. Journal of Crop and Weed. 2009;5(2):59-62.
3. Damodaram T, Hegde DM. Oilseed situation: A statistical compendium. Directorate of Oilseed Research, Rajendranagar, Hyderabad; 2000.
4. Baliarsingh A, Mahapatra PK. Effect of dates of sowing and irrigation on growth and yield of summer groundnut (*Arachis hypogaea* L.). Environment and Ecology. 2015;33(1):167-170.
5. Behera BS, Mohit Das, Behera AC, Behera RA. Weather based irrigation scheduling in summer groundnut in Odisha condition. International Journal of Agricultural Science and Research. 2015; 5(5):247-260.
6. Taha M, Gulati JML. Influence of irrigation on yield and moisture utilization of groundnut (*Arachis hypogaea*). Indian Journal of Agronomy. 2001;46(3):523-527.
7. AMIC, PJTSAU; 2021. Available:http://www.agritelangana.gov.in/. pp-2
8. Suresh K, Balaguravaiah D, Ramulu V, Sujani Rao CH. Comparative efficiency of sprinkler irrigation over check basin irrigation in groundnut at different irrigation schedules. International Journal of Plant, Animal and Environmental Sciences. 2013;3(2):9-13.
9. Pervin S, Islam M, Akanda A, Rahman M, Mila A. Effect of irrigation levels on the yield of groundnut. International Journal of Experimental Agriculture. 2014; 4(1):17-21.
10. Ravisankar N, Balakrishnan M, Ambast SK, Srivastava RC, Bommayasamy N, Subramani T. Influence of irrigation and crop residue mulching on yield and water productivity of table purpose groundnut (*Arachis hypogaea*) in humid tropical island. Legume Research-An International Journal. 2014;37(2):195-200.
11. Dash AK, Nayak BR, Panigrahy N, Mohapatra S, Samant PK. Performance of groundnut (*Arachis hypogaea L*) under different levels of sulphr and irrigation. Indian Journal of Agronomy. 2013;58(4):578-582.
12. Murugan P, Nisha PR. Evaluation of high yielding groundnut varieties for North for North Eastern Zone of Tamil Nadu. Journal of Krishi Vigyan. 2016; 5(1):64-66.
13. Arif M, Bhunia SR, Verma IM, Khinchi V. Effect of crop geometry and drip irrigation on growth, yield and economics of groundnut (*Arachis hypogaea* L.). Environment and Ecology. 2016;34(4): 2274-2278.
14. Kamble DR, Gokhale DN, Gadade GD, Jadhav PB. Yield and economics of summer groundnut as influenced by different irrigation level and mulches. International Journal of Current Microbiology and Applied Sciences. 2018;6:135-139.

15. Meena RS, Yadav RS. Phenological performance of groundnut varieties under sowing environments in hyper arid zone of Rajasthan, India. Journal of Applied and Natural Science. 2014;6(2): 344-348.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/91851