Original Research Article

Assessment of effect of different irrigation regimes on pod yield, water requirement & productivity and economics of groundnut varieties under Southern Telangana Zone

ABSTRACT

An experiment was conducted at 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 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, 87.36 kg ha^{-1}, respectively. The lowest pod yield of 1842 kg ha^{-1} and highest pod yield of 2278 kg ha^{-1} could be obtained at the IW/CPE of 0.6 and 1.0 respectively requiring 450.7 and 677.7 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).

Keywords: irrigation regimes, pod yield, water productivity and economics

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INTRODUCTION

Groundnut (*Arachis hypogeae.L*) belonging to the family Leguminaceae is an important source of oil and protein for large portion of population and is also considered as king of vegetable oil seed crops in India which can be grown during rainy, winter and summer seasons. Its kernel contains oil percentage ranging from 47 to 53 %, 26 per cent

protein , 11.5 % starch, 55 % oleic acid- about 25 % linoleic acid and around 10 % palmitic acid.

Groundnut has specific moisture needs due to its peculiar feature of producing pods underground. The *yasangi* (*rabi*) crop produces substantial yield as compared to the vanakalam (*kharif*) crop and requires irrigations 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 (Damodaram and Hegde, 2000). Irrigation at all the critical stages of groundnut produced maximum pod yield in summer groundnut (Baliarsingh and Mahapatra., 2015). Because of high productivity under assured irrigation, groundnut cultivation in summer season is gaining popularity (Behera *et al*., 2015).

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%. Optimum scheduling of irrigation led to increase in pod yield and water use efficiency (WUE) in groundnut (Taha and Gulati., 2001). There is a gap in 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.

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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 rainy season, cultivation of groundnut during *yasangi* season under limited irrigated conditions is assuming importance.

Groundnut being an important oilseed crop in Telangana, and the area under groundnut increased tremendously during *yasangi* season with productivity ranging from 2261-2330 kg ha^{-1}. In India, 24.4 per cent of *yasangi* season groundnut is cultivated in Telangana State and the lion share of area and production are contributed from Southern Telangana zone under medium black and sandy soils. In Telangana, groundnut has been sown in around 45.43 ha during 2020-21 (AMIC, 2021). 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 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 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.

MATERIALS AND METHODS:

The field experiment was conducted during *rabi* 2020-2021 at Regional Agricultural Research Station, Palem, Professor Jayashankar Telangana State Agricultural University (PJTSAU). Soil texture is sandy clay loam soil which was alkaline in reaction and non-saline, low in organic carbon content, nitrogen, available phosphorus and available potassium.

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Irrigation water was neutral (7.8 pH) suggesting that it suitable for irrigation purpose 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 (I1) , 0.8 IW/CPE ratio (I2) and 0.6 IW/CPE ratio (I3) 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 -1and entire dose of P2O5 and K2O, 20 kg nitrogen was applied was applied as basal and 10 kg of nitrogen was top dressed at 30 DAS. Gypsum (500 kg ha-1) was applied during end of 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 quantity of water applied was measured by water meter. The volume of water required for each irrigation treatment was calculated by applying the following formula.

$W = A \times d \times 1000$

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.

RESULTS AND DISCUSSION:

Pod Yield (kg ha^{-1})

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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 per cent at 1.0 IW/CPE ratio and 0.8 IW/CPE was 1.87 per cent 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 adequate level throughout the crop period which led to higher uptake of nutrients and there by increased the number of pods $plant^{-1}$ which in turn resulted in higher pod yield (Suresh *et al*., 2013).

Among the varieties of *yasangi* groundnut K-9 variety recorded 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 per cent 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 per cent over K-6, while 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 was 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 number of times crop was irrigated and interval between two irrigations during 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 summer season

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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 same level of irrigation regimes:			
SEm±	86	-	0.17
C.D(P=0.05)	NS	-	NS
Irrigation regimes with same or different varieties:			
SEm±	98	-	0.18
C.D(P=0.05)	NS	-	NS

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 relatively lower increase in yield with increased level of water applied. Similar results of water productivity were reported by Pervin *et al*. (2014) and Ravisankar *et al*. (2014).

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Among the groundnut varieties, significantly higher water productivity was recorded with K6 (4.59 kg m^{-3}) than 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 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.121917ha^{-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 Figure 1).This indicates that gross returns increased with increasing irrigation levels. These results were in similarity with Behera *et al*. (2015) and Dash et al. (2013) 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 was 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 the Murugan and Nisha, (2016)

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 Figure 1. The results are in conformity with the results reported by Behera et al. (2015) and Dash et al. (2013) who found that highest net returns were obtained with irrigation scheduled at 0.8 IW/CPE and lowest with 0.6 IW/CPE ratio. Among the different groundnut varieties, highest net returns were

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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 rest of the treatments (Table 2 and Figure 1).

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

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 significantly lower B:C ratio than rest of the treatments. Findings of Arif *et al*. (2016) and Kamble *et al.* (2018) were in similar agreement with the present investigation findings. (Table 2. and Figure 1). K-6 (1.68) and K-9 (1.65) recorded on par B: C ratio and were significantly superior over

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GJG-32 (1.24) and KDG-128 (1.53). Significantly lower B:C ratio was recorded with GJG-32 than rest of the other varieties. This may be due to relatively lower gross returns with increased cost of cultivation. These findings corroborate findings of Meena and Yadav. (2014).

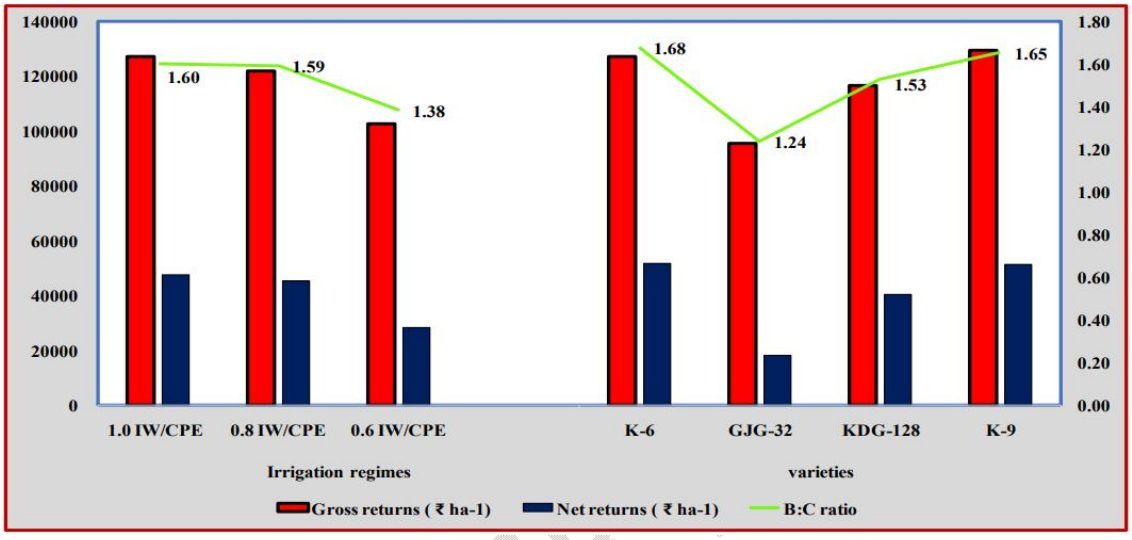

Figure 1. Gross returns (₹. ha^{-1}), Net returns (₹. ha^{-1}) and B: C ratio of groundnut varieties as influenced by different irrigation regimes during *yasangi*

CONCLUSION:

- From the study it can be concluded that 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. Water requirement of K-9 and GJG-32 was higher over K-6 and KDG-128.
- Gross returns, Net returns and B: C ratio did not differ significantly when groundnut varieties 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.

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