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## Effect of irrigation levels and intervals on yield and quality of groundnut (*Arachis hypogaea* L.) cultivars

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### Abstract

A field experiment was conducted at Instructional Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner during *kharif*, 2019. The treatments consist of 2 levels of irrigation *viz.*, 0.60 and 0.80 PE and two interval levels *viz.*, alternate and 3 days in main plot and three groundnut cultivars *viz.*, HNG-69, HNG-123 and TG-37-A in sub plot. The experiment was laid out in split plot design and replicated thrice. The yield of crop evaluated as pod yield, haulm yield, biological yield and test weight and in terms of quality as oil yield, N uptake by seed and haulm and protein content. Results revealed that higher pod yield (3117 kg ha<sup>-1</sup>), kernel yield (2147 kg ha<sup>-1</sup>), haulm yield (4081 kg ha<sup>-1</sup>), biological yield (7199 kg ha<sup>-1</sup>), test weight (446.58 g), oil yield (978.32 kg ha<sup>-1</sup>), N uptake by seed (51.19 kg ha<sup>-1</sup>), N uptake by haulm (44.80 kg ha<sup>-1</sup>) with HNG-123 in comparison to other varieties under irrigation level of 0.80 PE and alternate day interval.

**Keywords:** Haulm yield, kernel yield, irrigation level, biological yield, protein content

### Introduction

Oilseeds occupy an important place in the Indian economy and contribute about 6 per cent to the gross national product and 9 per cent of the value of all agricultural commodities. Groundnut is world's largest source of edible oil and 4<sup>th</sup> most important oil seed crop of the world. Groundnut seed (kernel) contains 44–50 per cent oil, 44–56 per cent fat, 26 per cent protein and 10–20 per cent carbohydrate. The country ranks second in the groundnut production and Gujarat ranks first in India. Groundnut occupies first position among all oilseeds in regard to both area and production in India. It accounts about 22 per cent area (5.95 m ha.) and 24 per cent of production of India or of oil seed (7.07mt) with the productivity of 1268 kg ha<sup>-1</sup> (Anonymous, 2017a). In Rajasthan, groundnut is cultivated mainly in north-western region covering the districts of Bikaner, Jaipur, Jodhpur, Nagaur and Sikar. The total area of groundnut in Rajasthan is 5.90 lakh ha. with total production of 14.05 lakh tons with productivity of 2380 kg ha<sup>-1</sup> (Anonymous, 2017b) [4]. Groundnut cake contains 45–60% protein, 22–30% carbohydrate, 3.8–7.5% crude fibre, 7 to 8% N, 1.5% P<sub>2</sub>O<sub>5</sub> and 1.2% K<sub>2</sub>O (Desai, *et al.* 1999) [8] and can be used as manure. Owing to various reasons the demand for water for different purposes has been continuously increasing in India, but the potential water available for future use has been declining at a faster rate. The agricultural sector (irrigation), which currently consumes over 80 per cent of the available water in India, continues to be the major water-consuming sector due to the intensification of agriculture. Though India has the largest irrigated area in the world, the coverage of irrigation is only about 40 per cent of the gross cropped area in present time. Reason for the low coverage of irrigation is the use of flood (conventional) method of irrigation, where water use efficiency is very low due to various reasons. Available estimates indicate that water use efficiency under flood method of irrigation is only about 35 to 40 per cent because of huge conveyance and distribution losses (EI-Habbasha, *et al.* 2015) [9]. For efficient utilization of irrigation water proper scheduling of irrigation increasing. Irrigation scheduling based on climatologically approach (Etc.) is considered as most scientific approach as it integrates all the weather parameters giving them natural weight age in a given climate-plant continuum (Parihar *et al.*, 1976) [14].

### Materials and Methods

The field experiment was conducted at Instructional Farm, S.K. Rajasthan Agricultural University, Bikaner during *Kharif* 2019. Bikaner is situated at 28.01°N latitude and 73.22°E longitude at an altitude of 234.70 meters above mean sea level. According to "Agro-ecological region map" brought out by the National Bureau of Soil Survey and Land Use Planning

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(NBSS&LUP), Bikaner falls under Agro-ecological region No. 2 (MgE1) in arid ecosystem (Hot arid eco-region with desert and saline soil), which is characterized by deep, sandy and coarse loamy, desert soils with low water holding capacity and hot and arid climate. According to the average meteorological data of 2019 (June to October), the maximum temperature ranged between 35.0°C and 42.3°C during the crop growing season in the 27<sup>th</sup> and 25<sup>th</sup> standard meteorological weeks, respectively. Likewise, the values of minimum temperature *i.e.*, 15.8°C and 20.6°C was recorded in the 44<sup>th</sup> and 40<sup>th</sup> standard meteorological weeks, respectively. Crop received 235 mm of rainfall with 13 rainy days in the growing season. Pan evaporation ranged from 6.1 to 12.0 mm day<sup>-1</sup> during the crop growing period. The average relative humidity during experiment fluctuated in the range of 32.4 to 93.6 per cent.

The soils of experimental unit was poor in organic carbon (0.10%) having available nitrogen of 86.4 kg ha<sup>-1</sup>, phosphorus of 33 kg ha<sup>-1</sup>, potassium of 331 kg ha<sup>-1</sup>. Electrical Conductivity (1:2) of the soil was 0.2 dS per m with pH 8.4. The treatment comprised of irrigation levels *viz.*, 0.60 and 0.80 PE and two irrigation intervals *viz.*, alternate and 3 days assigned to main plot and three groundnut cultivars *viz.*, HNG-69, HNG-123 and TG-37-A in sub plot. The experiment was laid out in split plot design and replicated thrice. The nitrogen and phosphorus were applied through urea and SSP. Full dose of phosphorus and half dose of nitrogen were applied at the time of sowing by drilling and remaining nitrogen was applied in two split doses.

The crops were harvested from each net plot area individually, tagged and weighed. Weight was recorded and expressed in kg ha<sup>-1</sup>. At harvest five representative samples of each plot were collected and biometrical data were recorded and computed for seed yield, haulm yield and biological yield. Similarly 100-seed weight was also computed. Dried matter was used for analysing the nutritive value in term of crude protein (CP) using standard method (A.O.A.C, 1990).

## Result and Discussion

### Yield and yield attributes

#### Irrigation levels

Irrigation at 0.80 PE had recorded higher Kernal yield (2147 kg ha<sup>-1</sup>), haulm yield (4081 kg ha<sup>-1</sup>) and biological yield (7199 kg ha<sup>-1</sup>) of groundnut as compared to irrigation level 0.60 PE. Harvest index and shelling index were not influenced by applied treatment. It might be due to the reason that at 0.60 PE water availability was meagre which caused poor growth of plant due to extreme hot climate during summer months which resulted in poor yield. Similar results found by Sorensen and Butts (2014) [17], Sripunitha *et al.*, (2011) [18].

#### Irrigation intervals

Alternate day irrigation interval gave higher kernal yield, haulm and biological yield (2044 3986 and 6980 kg ha<sup>-1</sup> respectively) of groundnut as compared to 3 days interval. Harvest index and shelling index have no significant difference in applied irrigation interval treatment. Further irrigation schedules significantly influenced the yield of groundnut. All these parameters increased with decreasing irrigation intervals from 3 days to alternate day. It might be due to the reason that at 3 days interval water availability was less which caused plant mortality as well as poor growth of plant due to extreme hot climate during summer months

which resulted in poor yield. Similar kinds of result have been reported by Sharma *et al.*, (2012) [16], Bagali *et. al* (2012) [6] and (Aryanci and Altunlu, 2016) [5].

**Table 1:** Effect of irrigation levels and Intervals on yield attributes

Treatments	Kernel yield (kg ha <sup>-1</sup> )	Haulm yield (kg ha <sup>-1</sup> )	Biological yield (kg ha <sup>-1</sup> )
<b>Irrigation levels</b>			
0.60 PE	1741	3666	6153
0.80 PE	2147	4081	7199
SEM±	23	51	63
CD (P=0.05)	79	178	217
<b>Irrigation intervals</b>			
Alternate day	2044	3986	6980
3 days	1843	3661	6372
SEM±	41	91	75
CD (P=0.05)	142	315	258
<b>Cultivars</b>			
HNG-69	1893	3764	6678

### Cultivars

Maximum pod, haulm and biological yield (2097, 3977 and 6902 kg ha<sup>-1</sup>) was recorded under HNG 123 groundnut cultivars, followed by was recorded under HNG 69 (1893 3764 and 6678 kg ha<sup>-1</sup>), respectively. Cultivars have significant effect on harvest index and shelling percentage. Maximum test weight was recorded under HNG-123 which was statistically at par with HNG-69. Superior yield attributing characters in variety HNG-123 as compared to other varieties were also recorded in experiments conducted under All India Co-ordinated Research Project on groundnut at ARSS, Hanumangarh, (Anonymous, 2010) [2]. The higher yield could be attributed to higher dry matter production and cumulative effect of yield attributes. These results are in close conformity with those reported in Co-ordinated advance varietal trials conducted at different locations wherein the variety HNG-123 proved superior to other varieties (Anonymous, 2010) [2].

### Quality parameters

**Irrigation levels:** Quality parameters are significantly influenced by different irrigation levels. The increasing irrigation levels increased the oil yield. Irrigation at 0.80 PE was recorded highest oil content (47.70%), oil yield (978.32 Kg ha<sup>-1</sup>), protein content (15.60%), nitrogen uptake by seed (51.19 kg ha<sup>-1</sup>) and nitrogen uptake by haulm (44.80 kg ha<sup>-1</sup>) of groundnut as compared to irrigation level at 0.60 PE. Nitrogen content in seed and haulm were not influenced by different irrigation levels. Similar kind of results have been reported by Kumawat, *et al.* (2000) [12], Khajouei *et al.* (2004) [11] and Patel and Patel (2013) [15].

### Irrigation intervals

Quality parameters are significantly influenced by different irrigation intervals. Alternate day irrigation interval gave higher oil content (48.24%), oil yield (987.51Kg ha<sup>-1</sup>), protein content (15.75%), nitrogen content in seed (2.52%) and nitrogen content in haulm (1.13%), nitrogen uptake by seed (51.59 kg ha<sup>-1</sup>) and nitrogen uptake by haulm (45.26 kg ha<sup>-1</sup>) of groundnut which was significantly superior to 3 day interval of irrigation. Similar kinds of result have been reported by Bhunia *et al.* (2006), Suresh *et al.* (2013) [19] and Jain *et al.* (2018) [10].

### Cultivars

Data showed that highest oil content (47.89%), oil yield (1005.58 kg ha<sup>-1</sup>), protein content (15.65%), nitrogen content in seed (2.50%) and nitrogen content in haulm (1.12%), nitrogen uptake by seed (52.59 kg ha<sup>-1</sup>) and nitrogen uptake

by haulm (44.92 kg ha<sup>-1</sup>) were recorded under HNG 123 groundnut cultivars followed by TG-37-A and HNG 69. Similar kinds of results have been reported by Meena and yadav (2014) [13].

**Table 2:** Effect of irrigation levels and Intervals on quality parameters

Treatments	Oil content (%)	Oil yield (kg ha <sup>-1</sup> )	Total chlorophyll at 45 days (mg g <sup>-1</sup> )	Protein content in seed (%)
<b>Irrigation levels</b>				
0.60 PE	47.67	877.88	2.399	15.59
0.80 PE	47.70	978.32	2.613	15.60
SEm±	0.27	12.08	0.028	0.07
CD (P=0.05)	NS	41.81	0.098	NS
<b>Irrigation intervals</b>				
Alternate day	48.24	987.51	2.652	15.75
3 days	47.13	868.69	2.360	15.44
SEm±	0.32	26.35	0.034	0.09
CD (P=0.05)	NS	91.20	0.116	NS
<b>Cultivars</b>				
HNG-69	47.48	899.44	2.599	15.54
HNG-123	47.89	1005.58	2.396	15.65
TG-37-A	47.69	879.27	2.523	15.60
SEm±	0.34	14.79	0.035	0.09
CD (P= 0.05)	NS	NS	0.104	NS

**Table 3:** Effect of irrigation levels and Intervals on Nitrogen content and uptake by seed and haulm

Treatments	N content (%) in seed	N content (%) in haulm	N uptake (kg/ha) by seed	N uptake (kg/ha) by haulm
<b>Irrigation levels</b>				
0.60 PE	2.49	1.12	45.95	41.22
0.80 PE	2.49	1.12	51.19	44.80
SEm±	0.01	0.00	0.61	0.60
CD (P=0.05)	NS	NS	2.13	2.07
<b>Irrigation intervals</b>				
Alternate day	2.52	1.13	51.59	45.26
3 days	2.47	1.11	45.54	40.76
SEm±	0.01	0.00	1.32	0.89
CD (P=0.05)	NS	NS	4.59	3.10
<b>Cultivars</b>				
HNG-69	2.48	1.1	47.10	42.15
HNG-123	2.50	1.12	52.59	44.92
TG-37-A	2.49	1.12	46.01	41.96
SEm±	0.01	0.01	0.75	0.73
CD (P= 0.05)	NS	NS	NS	NS

### Conclusion

The variety HNG-123 gave significantly higher Karnal, haulm yield and biological yield with irrigation at 0.80 PE at alternate day irrigation interval.

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