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Water Saving and Yield of Summer Groundnut as Influenced by Sowing Dates and Irrigation Regimes under Micro Sprinkler Irrigation

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Abstract: A field experiment for consecutive three years was laid out at Mahatma Phule Krishi Vidyapeeth, Rahuri in split plot design with three main plot treatments of sowing dates at 7th MW, 9th MW and 11th MW and four sub plot treatments of irrigation regimes *viz*., 0.6, 0.8, 1.0 IW/CPE through micro sprinkler irrigation and 1.0 IW/CPE (surface irrigation) with three replications. The maximum dry pod and haulm yields in 7th M.W. were significantly superior over sowing dates in 9th and 11th M.W. Irrigation regime 1.0 IW/CPE ratio with micro sprinkler irrigation system recorded highest dry pod yield of groundnut being significantly superior over 0.6 IW/CPE with micro sprinkler and 1.0 IW/CPE ratio with surface irrigation system. The water use efficiency was maximum in 7th MW and 0.8 IW/CPE treatments with micro sprinkler. The 11th MW saved water upto 21.36% in 0.8 IW/CPE treatment with 35.33% increase in yield. The net seasonal income and B:C ratio was maximum in 1.0 IW/CPE micro sprinkler irrigation system.There was no alarming change in the chemical parameters due to treatments. Hence, sowing of summer groundnut is recommended in 7th Meteorological week (12th to 18th February) under Micro sprinkler irrigation system with irrigation interval of 3-4 days (twice in a week) and 0.8 IW/CPE be followed for irrigation depth for getting higher yield and water saving with higher water use efficiency.

Key words: *Sowing dates, irrigation regimes, groundnut, micro sprinkler, yield*

Introduction

Water is a limiting factor for agricultural sector as it is utilized for diverse purposes like industry, domestic use, power *etc*. Therefore, for sustainable agriculture in future, adoption of efficient water management through advanced method like microsprinkler irrigation is of paramount importance. Micro-sprinkler system is a low volume sprinkling system which operates at low pressure and according to operating pressure system that lies between the conventional sprinkler and trickle irrigation system; moreover, it requires less energy than conventional sprinklers and are less susceptible to clogging than drip system. This method saves irrigation water up to 25-40% and increases the crop production by 20-25%.

Peg formation is the main stage in groundnut crop growth, which can be affected by stagnation of water, when surface irrigation or flood irrigation is practiced. Flood irrigation may also result in soil compaction, but due to use of micro-sprinkler, aeration in root zone of crop is maintained which helps in increasing the peg formation. Microsprinkler remains 45 cm above the soil surface and with uniform emission, microclimate required for flowering and interception of peg in the soil becomes easier. The changing climate in some tropical locations whereby minimal increase in temperature of some crops will reduce yields. The optimum temperature for groundnut growth is between 27 to 30ºC. In view of the above, efforts were made to find out appropriate sowing time and irrigation regimes alongwith water requirement and water use efficiency for summer groundnut.

Materials and methods

A field experiment during summer was carried out consecutively for three years (2008 -09 to 2010-11) at Mahatma Phule Krishi Vidyapeeth, Rahuri, (M.S.). The soil of the experimental plot had a plain topography, with clay loam texture, medium soil depth and good drainage. The soil was alkaline in nature and low in available N and P and high in available K content. The experiment was laid out in split plot design with twelve treatments and in three replications. There were three main plot treatments of sowing dates at 7th MW (12 – 18 February), 9th MW (26 Feb-4 March) and 11th MW (12 – 18 March) and four sub plot treatments of irrigation regimes *viz*., 0.6, 0.8,1.0 IW/CPE through microsprinkler irrigation and 1.0 IW/CPE (surface

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irrigation). The summer groundnut (Var. TAG-24) was sown on raised beds at 30x10 cm spacing with gross plot size - 6.00 x 3.00 m^2 (micro sprinkler) and net plot size - 5.60 x 2.40 m^2. The data on different parameters were collected, statistically analysed and interpreted according to (Panse and Sukhatme 1967).

Results and Discussion

The data of three years experimentation has been pooled for various parameters and presented under sub headings

Groundnut pod and Haulm yields

The maximum dry pod and haulm yields obtained in 7thM.W. (35.90 and 52.72 q ha^{-1}, respectively) which were significantly superior over sowing in 9th and 11th M.W. (Table 1). This can be attributed to the optimum temperature during physiological maturity which brought about variation in yield (Patra *et al*. 1999). In irrigation regimes; 1.0 IW/CPE with micro sprinkler irrigation system recorded highest dry pod yield of groundnut (36.46 q ha^{-1}) being significantly superior over 0.6 IW/CPE with micro sprinkler (25.84q ha^{-1}) and 1.0 IW/CPE ratio with surface irrigation system (29.19 q ha^{-1}). However, it was at par with 0.8 IW/CPE with micro sprinkler irrigation (34.97 qha^{-1}), this may be attributed to the higher photosynthetic surface. Similar results were obtained by Dutta and Mondal (2006). Haulm yield in 9th MW was significantly superior over 11th M.W (38.57 q ha^{-1}) and highest (51.74 q ha^{-1}) in 1.0 IW/CPE treatment followed by 0.8 IW/CPE (49.27 q ha^{-1}), both these treatments were at par but significantly superior over 0.6 IW/CPE micro sprinkler (39.41 q ha^{-1}) and 1.0 IW/CPE treatment with surface irrigation (42.14 q ha^{-1}).This might be due to optimum moisture and aerated conditions in the soil which reflected in good physiological activity and increase in yield. Irrigation scheduled at alternate days maintained soil moisture near to the field capacity and crop did not experience moisture stress during the crop growth. Lowest yield was obtained in surface irrigation due to moisture stress during crop growth period. Similar results were reported by Kabra (1994), Bade (1995), Powar (1999) and Nikam (2000).

Shelling percentage

The shelling percentage was non significant in pooled data and for individual years, while it was found significantly superior for 1.0 IW/CPE ratio treatment over all the treatments followed by 0.8 IW/CPE which was significantly superior over 0.6 IW/CPE with micro sprinkler and 1.0 IW/CPE surface irrigation. The above findings are in conformity with those of (Khadtare 2014).

Oil percentage

The pooled data (Table 1) was non significant for sowing dates and was significant for irrigation regimes where highest oil content was recorded under 0.6 IW/CPE treatment being at par with all the treatments. The oil content in groundnut is largely governed by the genetic characteristics of that genotype (Mahesh, 2007). However, increased oil content was attributed to significant higher yield (Dhanvijay, 1995).

Table 1. Dry pod yield (qha^{-1}), haulm yield (qha^{-1}) and shelling per cent of Groundnut as influenced by different treatments (Pooled results)

Sr. No	Treatment	Dry pod yield (qha^{-1})	Haulm yield (qha^{-1})	Shelling (%)	100 kernel weight (g)	Oil content (%)
A. Sowing Dates						
1	7th MW	35.90	52.72	68.30	42.50	46.23
2	9th MW	33.06	45.63	68.35	41.75	45.73
3	11th MW	25.93	38.57	67.50	38.96	45.86
	SE - +	0.90	1.46	0.53	1.49	0.61
	CD at 5%	2.74	4.37	NS	NS	NS
B. Irrigation Regimes						
1	0.6 IW /CPE Ratio	25.84	39.41	66.24	37.65	46.45
2	0.8 IW /CPE Ratio	34.97	49.27	68.77	44.45	45.62
3	1.0 IW /CPE Ratio	36.46	51.74	70.18	45.04	46.02
4	1.0 IW /CPE surface	29.19	42.14	66.99	36.85	45.65
	SE - +	1.16	0.84	0.34	0.48	0.36
	CD at 5%	3.28	2.38	0.98	1.36	1.02
	Interaction	NS	NS	NS	NS	NS

Total water applied, Water use efficiency and water saving

The total water applied (Table 2) was maximum in 7th MW (91.85 cm) followed by 9th MW (91.82 cm) and minimum in 11th MW (87.74cm). Minimum water was applied in 0.6 CPE treatments (61.44 cm) and maximum was in 1.0 IW/CPE ratio with surface irrigation treatment (101.72 cm). The water use efficiency was maximum in 7th MW (39.08 kg/ha-cm) followed by 9th MW (36.00 kg/ha-cm) and 11th MW (29.55 kg/ha-cm). In irrigation regimes, water applied was maximum (43.61 kg/ha-cm) for 0.8 IW/CPE treatment followed by 0.6 IW/CPE treatment (41.95 kg/ha-cm) and 1.0 IW/CPE treatment (36.93 kg ha-cm-^{1}) with micro sprinkler. It was lowest in 1.0 IW/CPE ratio treatment with surface irrigation (28.79 kg/ha-cm). Though, 0.6 IW/CPE treatment had good water use efficiency, however, there was decrease in yield. Maximum yield increase (38.45%) was observed in 7th MW followed by 9th MW (27.50%). It was found maximum (41.1%) in 1.0 IW/CPE treatment with microsprinkler followed by 0.8 IW/CPE ratio treatment with micro sprinkler (35.33%) and 1.0 IW/CPE ratio treatment with surface irrigation (12.96%). The 11th MW sowing treatment has 4.47% water saving over 7th MW. It was maximum 39.60% in 0.6 IW/CPE treatment with micro sprinkler irrigation system but it has lowest yield. However, it was found 21.36% in 0.8 IW/CPE treatment with 35.33% increase in yield and was lowest in 1.0 IW/CPE ratio with surface irrigation treatment *i.e*. 3.18%. The overall use efficiency of water can be improved by reducing the evaporation, particularly in areas where the evaporation is quite high. This can be achieved by selection of appropriate – specific cropping system where crop growth matches with the available water supply system

(Acharya and Hati, 2002). The above findings are in line with those of (Raskar and Bhoi 2003) and (Khadtare 2014).

Table 2. Total water applied (cm), Water use efficiency, water saving and yield increase due to various treatments (Pooled results)

Treatment	Yield of dry pod (q/ha)	Total water applied (cm)	Water use efficiency (Kg/ha-cm)	Yield increase (%)	Water saving (%)
A. Sowing Dates					
7th MW	35.90	91.85	39.08	38.45	-
9th MW	33.06	91.82	36.00	27.50	0.03
11th MW	25.93	87.74	29.55	-	4.47
SE - +	0.90				
CD at 5%	2.74				
B. Irrigation Regimes					
0.6 IW /CPE Ratio	25.84	61.44	41.95	-	39.60
0.8 IW /CPE Ratio	34.97	79.99	43.61	35.33	21.36
1.0 IW /CPE Ratio	36.46	98.49	36.93	41.10	3.18
1.0 IW /CPE surface	29.19	101.72	28.79	12.96	-
SE - +	1.16				
CD at 5%	3.28				

Net Seasonal Income and B:C ratio

The net seasonal income (Table 3) was maximum in 1.0 IW/CPE ratio treatment of micro sprinkler irrigation system (Rs. 45871) followed by 0.8 IW/CPE ratio treatment (Rs. 43418) and 1.0 IW/CPE ratio surface irrigation treatment (Rs. 36279) and lowest in 0.6 IW/CPE ratio micro sprinkler irrigation treatment (Rs.22586). B:C ratio was highest in 1.0 IW/CPE ratio microsprinkler irrigation treatment (2.15) followed by 0.8 IW/CPE ratio microsprinkler irrigation treatment (2.12) and was lowest in 0.6 IW/CPE ratio treatment (1.59). Similar results were also reported by (Rank 2007) and (Khadtare 2014).

Table 3. Economics of summer groundnut under micro sprinkler irrigation system with different irrigation regimes (Pooled results)

Sr. No.	Particulars	IW/CPE 0.6 Micro sprinkler	IW/CPE 0.8 Micro sprinkler	IW/CPE 1.0 Micro sprinkler	IW/CPE 1.0 Surface
1	a) Fixed cost of system Rs.	64886/-	64886/-	64886	-
	b)Life of the system years	7	7	7	-
	c) Depreciation/year (a/b)	9269/-	9269/-	9269	-
2	Repairs & Maintenance @ 2%	1298/-	1298/-	1298/-	-
3	Interest @ 10% on (a)	6489/-	6489/-	6489	-
4	Total operational cost/ season Rs .= (1c +2+3)/2	8528/-	8528/-	8528	-
5	Cost of cultivation Rs.	29782	30135	31252	32399
6	Total cost of cultivation Rs.	38310	38663	39780	32399
7	Yield of pods q ha^{-1}	25.84	34.97	36.46	29.19
8	Yield of haulm q ha^{-1}	39.41	49.27	51.74	42.14
9	a) Avg. Market price Rs . q^{-1} for pod	2233	2233	2233	2233
	b) Avg. Market price Rs . t^{-1} for haulm	800	800	800	800
10	Income generated Rs. ha^{-1}	60895	82081	85651	68678
11	Net profit (10-6)	22586	43418	45871	36279
12	B: C Ratio (10/6)	1.59	2.12	2.15	2.11

Chemical Properties

The pooled data of three years (Table 4) revealed that there was slight increase in pH (8.48 to 8.56), EC (0.32 to 0.38 dSm^{-1}), organic carbon (0.48 to 0.55%), available N (215 to 239 kg ha^{-1}), available P (12.68 to 13.28 kg ha^{-1}) but decrease in available K content from 425 to 419 kg ha^{-1}. There was increase in all the chemical parameters as the sowing dates are advanced as well as increase in the irrigation regimes irrespective of the sowing dates. There was no alarming change in the chemical parameters as far as the sowing dates and irrigation regimes are concerned. Similar results were reported by (Anonymous 2012).

Table 4. Chemical properties of soil as influenced by sowing dates and irrigation regimes for summer groundnut after harvest. (Pooled results)

Treatment	pH	Ec (dSm^{-1})	Organic carbon (%)	Available N	Available P ($Kg\ ha^{-1}$)	Available K
A. Sowing Dates						
7^{th} MW	8.56	0.35	0.53	235	13.03	420
9^{th} MW	8.59	0.37	0.55	240	13.77	413
11^{th} MW	8.65	0.41	0.56	243	14.92	427
SE ±	0.88	1.22	1.53	2.60	0.50	7.86
CD at 5%	NS	NS	NS	7.78	NS	NS
B. Irrigation Regimes						
0.6 IW /CPE	8.55	0.35	0.51	239	13.09	425
0.8 IW /CPE	8.57	0.37	0.53	244	13.13	434
1.0 IW /CPE	8.61	0.39	0.56	245	13.88	438
1.0 IW /CPE surface	8.63	0. 40	0.58	244	14.27	431
SE ±	0.011	1.43	0.012	1.49	0.13	1.99
CD at 5%	0.031	NS	NS	4.22	0.37	5.62
Interaction	NS	NS	NS	NS	NS	NS
Mean	8.59	0.38	0.55	239	13.28	419
Initial status	8.48	0.32	0.48	215	12.68	425

Conclusions

Sowing of summer groundnut is recommended in 7th meteorological week (12th to 18th February) under micro sprinkler irrigation system with irrigation interval of 3-4 days (twice in a week) and 0.8 IW/CPE ratio be followed for irrigation depth for getting higher yield and water saving with higher water use efficiency.

References

Acharya, C.L. and Hati, K. M. (2002). Efficient water management for sustainable crop production in vertisols of India. *Journal of Water Management.* Vol. 10 (1 and 2): 30-38

Anonymous, (2012). Research review Committee meeting report of Irrigation and Drainage Engineering, MPKV, Rahuri, for 2011-12:pp 3-19

Bade, D.M. (1995). Effect of irrigation scheduling and interval in drip method on summer groundnut (*Arachishypogaea* L.) cv. ICGS-11.M.Sc. (Agri.) Thesis. Mahatma Phule Krishi Vidyapeeth, Rahuri (M.S.) India.

Dhanvijay, R.P. (1995). Performance of different planting techniques for economic design of micro-irrigation systems in summer groundnut cv. ICGS-II. M.Sc. (Agri.) Thesis submitted to MPKV, Rahuri (M.S.) India.

Dutta, D. and Mondal, S.S. (2006).Response of summer groundnut to moisture stress, organic manure and fertilizer with and without gypsum under lateritic soil of West Bengal. *Indian Journal of Agronomy* **51(2):145-148**

Kabra, S.H. (1994). Performance of different planting techniques for economic design of micro irrigation system in *kharif* groundnut cv SB-XI. M.Sc. (Agri.) Thesis submitted to MPKV, Rahuri, (M.S.) India.

Khadtare, S. V. (2014). Crop weather relationship under different sowing windows and irrigation regimes in summer groundnut. Ph.D. Thesis, M.P.K.V., Rahuri

Mahesh, C. G. (2007). Effect of irrigation, growing period and genotypes and seed yield and quality in groundnut. M.Sc. (Agri) Thesis, U.A.S., Dharwad

Nikam, D.R. (2000). Effect of planting layouts and micro-irrigation systems on growth and yield of summer groundnut (*Arachishypogaea* L.) M.Sc. (Agri.) Thesis submitted to MPKV, Rahuri (M.S.) India.

Panse, V. G. and Sukhatme, P.V. (1967).Statistical methods for agricultural workers. ICAR, New Delhi, pp. 359.

Patra, A. K., Tripathy, S.K. and Samui, R.C. (1999). Effect of sowing dates, irrigation and spacing on nodulation, dry matter and yield of summer groundnut. *Indian Journal of Agronomy* **44(4):800-804**

Powar, A.S. (1999). Use of micro-irrigation systems for summer groundnut cv. TAG-24. M.Sc. (Agri.) Thesis Mahatma Phule Krishi Vidyapeeth, Rahuri.

Rank, H.D. (2007). Summer groundnut crop performance and economics under micro sprinkler irrigation at various water application levels. *Legumes Res.* **30(4):261-265**

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