DOI: 10.15740/HAS/AU/12.TECHSEAR(3)2017/697-702 *Agriculture Update*
Volume **12** | TECHSEAR-3 | 2017 | 697-702
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RESEARCH ARTICLE :

Response of summer groundnut (*Arachis hypogaea* L.) to different irrigation level and mulches under drip irrigation

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ARTICLE CHRONICLE :
Received :
10.07.2017;
Accepted :
25.07.2017

SUMMARY : A field experiment was conducted during 2013-14 to study the response of summer groundnut (*Arachis hypogaea* L.) to different irrigation level and mulches under drip irrigation at the AICRP on Irrigation Water Management, VNMKV, Parbhani (M.S.). Soil of the experimental plot was clayey in texture and slightly alkaline in reaction. It was medium in total nitrogen and available phosphorus and fairly high in exchangeable potassium (K_2O). The experiment was framed out in Split Plot Design with four irrigation level (I_1 - Irrigation at 0.6 PE, I_2 - Irrigation at 0.8 PE, I_3 - Irrigation at 1.0 PE and I_4 - Irrigation at 1.2 PE) in main plots whereas four mulches [M_1 - Black polythene mulch with drip, M_2 - Transparent polythene mulch with drip, M_3 - Soybean straw mulch with drip and M_4 - Control (drip)] were assigned in sub plots. Results of the experiments revealed that the irrigation at 1.0 PE provided congenial conditions for better growth resulting in to significantly higher number of pods per plant, dry pod yield and haulm yield per hectare under 1.0 PE than 0.6, 0.8 and 1.2 PE.The yield attributing characters like number of pods per plant, dry pod yield, haulm yield, biological yield kg per hectare was maximum under transparent polythene mulch as compared to rest of the mulches.

KEY WORDS :
Groundnut, Drip irrigation, Mulches

How to cite this article : Kamble, D.R., Gokhale, D.N., Nagrare, I.M. and Jadhav, P.B. (2017). Response of summer groundnut (*Arachis hypogaea* L.) to different irrigation level and mulches under drip irrigation. *Agric. Update*, **12**(TECHSEAR-3) : 697-702; **DOI: 10.15740/HAS/AU/12.TECHSEAR(3)2017/697-702.**

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BACKGROUND AND OBJECTIVES

Groundnut (*Arachis hypogaea* L.) adorned as king of oilseeds is grown all over the world for its importance in food, medicine and industries. It is the world's fourth most important source of edible oil (51 %) and third most important source of high quality vegetable protein (28 %), minerals (2.5%) and carbohydrates (20%). Poor production of summer groundnut is the major problem faced by the groundnut growers due to high water requirement (800-1000 mm) of crop in summer involving 13 to14 irrigations associated with undependable water supply in major commands, limits the acreage. Moisture is the key factor of production but mismanagement of water like improper scheduling, lack of drainage etc. often leads to reduction in crop yield. For efficient utilization of applied water, scheduling of irrigation to the crop would be

on the scientific manner (Damodaram and Hegde, 2000). Thus, to economize the use of water and to bring more area under irrigation, advanced method of irrigation like drip to groundnut crop is essential. Drip irrigation saves considerable quantum of water that can be very well utilized for bringing more area under irrigation there by increasing the productivity.

As the soil and climatic conditions are suitable for groundnut cultivation, but due to insufficient moisture in summer creates more problems. To mitigate this problem mulching is very important because it prevents direct evaporation of moisture from the soil and thus limits the water losses and soil erosion over the surface. In this manner it plays a positive role in water conservation.

Groundnut grown as an irrigated crop to economize water through drip irrigation system during summer season and use of plastic film as mulch for agriculture is still at conceptual stage in Marathwada region, hence its agronomic practices are required to be standardized for realizing yield potential. Taking into consideration the above fact, the present research study was undertaken at AICRP on Irrigation Water Management, VNMKV, Parbhani during summer 2013-14.

RESOURCES AND METHODS

A field experiment was undertaken at, AICRP on IrrigationWater Management, VNMKV, Parbhani during summer 2013-14 and 2014-15to study the effect of different irrigation level and mulches on yield and economics of drip irrigated summer groundnut. Soil of the experimental fieldwas clayey (52.25%) in texture, medium in organic carbon (%), poor in nitrogen (kg ha^{-1}), medium in available phosphorus (kg ha^{-1}), high in potash (kg ha^{-1}) and slightly alkaline in reaction. The experiment was framed out in split plot design with four irrigation levels (I_1 - Irrigation at 0.6 PE, I_2 - Irrigation at 0.8 PE, I_3 - Irrigation at 1.0 PE and I_4 - Irrigation at 1.2 PE) in main plots whereas four mulches [M_1 Black polythene mulch with drip, M_2 - Transparent polythene mulch with drip, M_3 - Soybean straw mulch with drip and M_4 - Control (drip)] were assigned in sub plots and these treatment combination were randomly replicated thrice. The broad bed furrows with top width of 90 cm were laid out in the experimental plot with the help of bullock drawn ridger and thereafter one lateral was laid down in the centre of each bed. One common irrigation of 60 mm was applied to each bed to ensure good germination. Mean while holes were punched on 30 micron black and transparent polythene mulch by maintaining three rows at the spacing of 30cm × 8cm. Later on as per the treatment, different mulches viz. black polythene mulch (30 micron), transparent polythene mulch (30 micron) and straw mulch (5 ton ha^{-1}) were laid down on the bed.Sowing of groundnut was undertaken on 7th February 2014 and fertilizers were applied as per the recommended dose at the time of sowing. The pan evaporation was measured daily from the U.S.W.B. class 'A' open pan evaporimeter installed at the Agro meteorology observatory, Department of meteorology, VNMKV, Parbhani during the period of experiment. The volume of water to be applied was calculated as per the treatment of irrigation level by using the formula given below.

$$V = PE \times A$$

where,

V= Volume of water to be applied (litre/day/plot)

PE = Daily pan evaporation (mm) multiplied by irrigation level *i.e.*0.6/0.8/1.0/1.2

A = Area of the plot (m^2).

After calculating the volume of water to be applied, the operating time of drip unit (t) was calculated by using the following formula given by Pawar (2001).

$$t = \frac{V}{q \times Ne} \times 60$$

where,

t = Operation time of system, min

V = Volume of water to be applied (litre/day/plot)

q = Average emitter discharge, lph

Ne = Number of emitters, per plot

The experimental data were statistically analyzed as per the method described by Panse and Sukhatme (1985).

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads and Table 1 to 6 :

Effect of irrigation level on growthand yield :

Application of irrigation at 1.0 PE recorded significantly higher plant height, number of leaves, number of branches and dry matter production per plant over rest of the irrigation level at 45, 60, 75, 90, 105 DAS and at harvest during both the year of experimentation. The

probable reason for this might be the irrigation at 1.0 PE proved adequate to grow the plant under moisture stress free condition that helped in better cell division and cell expansion of plant and finally resulted in better plant height as compared to rest of the irrigation level. This trend is in conformity with the earlier findings reported by Thorat(2000) and Bhure (2010).

In groundnut, the increase in yield proportionately

Table 1 : Periodical mean plant height (cm) of summer groundnut as influenced by various treatments during 2013-14

Treatments	Days after sowing						AH
	30	45	60	75	90	105	
Irrigation level							
I_1- 0.6 PE	4.85	11.84	22.10	23.95	25.45	25.62	25.68
I_2- 0.8 PE	5.06	13.72	24.58	26.96	28.65	29.47	29.59
I_3- 1.0 PE	5.32	15.53	27.00	29.90	31.92	33.36	33.70
I_4- 1.2 PE	5.03	13.11	23.70	25.61	27.24	28.05	28.15
S.E. ±	0.14	0.50	0.63	0.49	0.58	0.44	0.46
C.D. (P=0.05)	NS	1.74	2.18	1.69	1.99	1.51	1.59
Mulches							
M_1- BPM	5.31	14.31	24.89	27.55	29.92	30.69	30.86
M_2- TPM	5.64	15.59	27.61	30.79	33.38	34.77	35.07
M_3- SSM	4.90	12.69	23.19	25.22	26.50	27.20	27.31
M_4- Control	4.42	11.61	21.68	22.86	23.46	23.84	23.88
S.E. ±	0.16	0.37	0.49	0.67	0.67	0.66	0.61
C.D. (P=0.05)	0.55	1.27	1.69	2.31	2.33	2.28	2.11
Interaction (I × M)							
S.E. ±	0.23	1.16	1.79	1.14	1.18	1.44	1.24
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS
G.M.	5.07	13.55	24.34	26.60	28.31	29.13	29.28

NS=Non-significant

Table 2 : Periodical mean number of branches per plant of summer groundnut as influenced by different treatments during 2013-14

Treatments	Days after sowing				
	45	60	75	90	105
Irrigation level					
I_1- 0.6 PE	1.78	3.16	3.96	4.58	5.01
I_2- 0.8 PE	2.24	4.23	5.27	6.06	6.73
I_3- 1.0 PE	3.04	6.06	7.28	8.33	9.31
I_4- 1.2 PE	2.12	4.03	4.95	5.60	6.17
S.E. ±	0.08	0.13	0.12	0.27	0.26
C.D. (P=0.05)	0.26	0.44	0.40	0.92	0.91
Mulches					
M_1- BPM	2.61	5.01	6.08	6.88	7.62
M_2- TPM	2.74	5.40	6.59	7.53	8.30
M_3- SSM	2.11	4.17	5.10	5.84	6.52
M_4- Control	1.72	2.91	3.69	4.32	4.77
S.E. ±	0.10	0.16	0.17	0.21	0.23
C.D. (P=0.05)	0.35	0.56	0.58	0.72	0.80
Interaction (I × M)					
S.E. ±	0.19	0.34	0.35	0.45	0.42
C.D. (P=0.05)	NS	NS	NS	NS	NS
G.M.	2.29	4.37	5.36	6.14	6.80

NS=Non-significant

with the increased in irrigation level upto 1.0 PE. Irrigation level 1.0 PE (I_3) gave significantly highest number of pod per plant, dry pod yield (kg ha^{-1}), dry haulm yield (kg ha^{-1}) and biological yield (kg ha^{-1}) as compared to rest of the irrigation level. It was attributed to the fact that in case of groundnut pegging and early pod formation as

Table 3 : Periodical mean number of functional leaves per plant of summer groundnut as influenced by different treatments during 2013-14

Treatments	Days after sowing						AH
	30	45	60	75	90	105	
Irrigation level							
I_1- 0.6 PE	4.47	12.57	34.63	45.25	53.98	59.04	56.50
I_2- 0.8 PE	5.38	14.79	41.53	55.67	68.58	74.59	72.69
I_3- 1.0 PE	6.07	16.83	50.81	68.95	82.25	90.17	89.17
I_4- 1.2 PE	4.95	14.09	37.68	51.61	62.28	67.76	65.71
S.E. ±	0.16	0.55	1.60	1.28	1.87	3.16	3.11
C.D. (P=0.05)	0.56	1.91	5.55	4.42	6.48	10.93	10.77
Mulches							
M_1- BPM	5.27	15.15	42.17	55.88	67.26	75.79	73.96
M_2- TPM	6.52	17.23	48.23	70.08	87.69	96.60	94.73
M_3- SSM	4.76	13.88	38.80	51.87	62.54	66.65	64.93
M_4- Control	4.31	12.02	35.45	43.65	49.60	52.52	50.45
S.E. ±	0.16	0.38	1.68	1.17	2.38	3.26	3.09
C.D. (P=0.05)	0.54	1.30	5.82	4.04	8.25	11.27	10.70
Interaction (I × M)							
S.E. ±	0.40	1.21	2.27	2.73	4.04	5.90	5.84
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS
G.M.	5.22	14.57	41.16	55.37	66.77	72.89	71.02

NS=Non-significant

Table 4 : Mean total dry matter accumulation (g $plant^{-1}$) of summer groundnut as influenced by various treatments at different stages during 2013-14

Treatments	Days after sowing						AH
	30	45	60	75	90	105	
Irrigation level							
I_1- 0.6 PE	0.97	4.03	12.95	22.40	29.78	33.77	43.81
I_2- 0.8 PE	1.48	5.15	16.12	28.35	35.95	41.67	55.46
I_3- 1.0 PE	2.28	6.40	18.69	33.44	42.08	50.21	68.18
I_4- 1.2 PE	1.43	4.88	15.57	26.70	34.11	39.80	52.22
S.E. ±	0.03	0.16	0.45	0.63	0.71	0.58	1.10
C.D. (P=0.05)	0.10	0.48	1.54	2.18	2.47	2.02	3.82
Mulches							
M_1- BPM	1.86	5.75	16.75	29.30	37.72	44.93	59.67
M_2- TPM	2.13	6.55	18.55	33.07	42.39	51.02	70.32
M_3- SSM	1.36	4.55	14.64	25.38	32.56	37.27	48.10
M_4- Control	0.81	3.62	13.38	23.14	29.25	32.21	41.58
S.E. ±	0.05	0.14	0.35	0.69	0.63	0.42	1.11
C.D. (P=0.05)	0.18	0.42	1.20	2.37	2.19	1.46	3.85
Interaction (I × M)							
S.E. ±	0.11	0.29	0.93	1.56	1.65	1.60	2.26
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	6.70
G.M.	1.54	5.12	15.83	27.72	35.48	41.36	54.92

NS=Non-significant

well as pod formation to maturity stages are most sensitive to moisture stress and during these stages the crop obtained sufficient moisture at irrigation level 1.0 PE and hence it has produced higher yield. Similar results were reported by Suresh *et al*. (2013) and Saha and Gunri (2014).

Table 5 : Mean number of developing pods per plant of summer groundnut as influenced by various treatments at different stages during 2013-14

Treatments	Days after sowing				AH
	60	75	90	105	
Irrigation level					
I_1- 0.6 PE	12.42	18.92	25.04	28.79	31.28
I_2- 0.8 PE	15.83	23.50	30.21	35.02	38.71
I_3- 1.0 PE	18.08	26.83	33.92	39.65	44.09
I_4- 1.2 PE	14.67	22.08	28.17	32.98	36.20
S.E. ±	0.51	0.70	0.88	0.95	0.87
C.D. (P=0.05)	1.78	2.41	3.03	3.30	3.01
Mulches					
M_1- BPM	16.17	23.42	31.12	35.95	39.70
M_2- TPM	18.00	29.00	36.87	42.53	46.77
M_3- SSM	14.00	20.33	25.69	30.30	33.40
M_4- Control	12.83	18.58	23.66	27.66	30.41
S.E. ±	0.52	0.86	0.43	0.42	0.58
C.D. (P=0.05)	1.79	2.96	1.49	1.45	1.99
Interaction (I × M)					
S.E. ±	0.97	1.72	1.87	1.83	1.70
C.D. (P=0.05)	NS	NS	NS	NS	NS
G.M.	15.25	22.83	29.34	34.11	37.57

NS=Non-significant

Table 6 : Effect of irrigation level and mulches on dry pod yield and dry haulm yield, biological yield (kg ha^{-1}) of summer groundnut during 2013-14

Treatments	Dry pod yield (kg ha^{-1})	Dry haulm yield (kg ha^{-1})	Biological yield (kg ha^{-1})
Irrigation level			
I_1- 0.6 PE	3342	3726	7068
I_2- 0.8 PE	3713	3968	7680
I_3- 1.0 PE	4211	4534	8745
I_4- 1.2 PE	3508	3904	7412
S.E. ±	102	119	206
C.D. (P=0.05)	354	412	712
Mulches			
M_1- BPM	3932	4282	8214
M_2- TPM	4370	4647	9017
M_3- SSM	3492	3823	7315
M_4- Control	2979	3380	6359
S.E. ±	105	134	228
C.D. (P=0.05)	364	463	790
Interaction			
S.E. ±	191	261	417
C.D. (P=0.05)	NS	NS	NS
G.M.	3693	4033	7726

NS=Non-significant

Effect of mulches on growth and yield :

Transparent polythene mulch (M_2) recorded significantly highest plant height, number of leaves, number of branches, dry matter production per plant andtotal number of pod per plant as compared to rest of the mulches.Regarding the dry pod yield transparent polythene mulch recorded significantly superior dry pod yield over rest of the treatments. The higher availability of available soil moisture, better temperature conditions under transparent polythene mulch has resulted into superior nutrient uptake, more vegetative growth, thereby creating more source, which has resulted into creation of more sink in the form of yield attributes and finally significantly superior dry pod yield, dry haulm yield, biological yield in transparent polythene mulch than rest of mulches treatments. These findings are on similar line with findings of Bhure (2010) and Saha and Gunri (2014).

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