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Effect of Land Configuration, Irrigation Regimes and Potassium Levels on Physiological Traits and Yield of Summer Groundnut (*Arachishypogaea* L.)

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Abstract—*The field experimentswere conducted during summer seasons of 2011 and 2012 at PGI Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri, to study the effect of land configurations, irrigation regimes and potassium levels on physiological traits of summer groundnut (Arachishypogaea L.). The experiments were carried out in split - split plot design with three replications, and 27 treatment combinations comprising of three main plot treatments of land configurations viz., Flat Bed, Broad Bed Furrow (BBF), and Broad Bed Furrow (BBF) + Polythene mulch (black), three subplot treatments of irrigation regimes viz., 0.6, 0.8 and 1.0 IW/CPE ratios and three sub-sub plot treatments of potassium levels viz.,20, 40 and 60 kg/ha* K_2O.

The photosynthetic rate, transpiration rate and stomatal conductance were recorded significantly higher in the BBF + Polythene mulch. In respect of irrigation levels, these parameters were significantly higher in 1.0 IW/CPE ratio, however, they were at par with 0.8 IW/CPE ratio. Among potassium levels, application of 60 kg/haK_2O *recorded significantlyhigher physiological parameters which were at par with 40 kg/ha* K_2O*.These values were increased upto 84 DAS and thereafter declined at harvest. The reverse trend was observed in respect of stomatal resistance.*

1. INTRODUCTION.

Groundnut (*Arachishypogaea* L.) is most important among all oilseed crops of India. More than 80 per cent of its produce is used for extraction of edible oil. The demand for vegetable oil in the country has been steadily increasing. To meet the demand, the production of oilseed has to be increased. Response of groundnut crop to the environmental factors also determines its growth performance and yield. The production and productivity of this crop in monsoon(*kharif)*season fluctuates violently. It resulted into the shift of groundnut cultivation from monsoon (*kharif*)to summer season under irrigated conditions.

The water losses from the soil due to evaporation can be reduced to a great extent by using mulches. Mulching is useful for moderating soil temperature, conserving soil moisture and for controlling weed growth. This method enables good initial crop growth and later helps in checking weed growth and evaporation of water. Application of mulch not only helps in realizing higher yields but also contributes in reducing water requirement by 40 per cent eliminating crop weed competition minimum incidence of sucking pests and reducing crop duration by7-10 days (Basu, 2008). With this view altogether, the present investigation was undertaken during summer season of 2011 and 2012 at the PGI farm, Mahatma Phule Krishi Vidyapeeth, Rahuri 413 722 (M.S.) with objectives to study the effect of polythene mulch, irrigation regimes and potassium application on growth and physiological parameters in summer groundnut.

2. MATERIALS AND METHODS.

The field experiments were conducted during the summer seasons of 2011 and 2012 at Post Graduate Institute Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmed Nagar (M.S.). The experiment was laid out in split - split plot design with three replications. There were 27 treatment combinations comprising of three main plot treatments of land configurations *viz.*, Flat Bed, Broad Bed Furrow (BBF) and Broad Bed Furrow (BBF) + Polythene mulch (black), three sub plot treatments of irrigation regimes *viz.*, 0.6 , 0.8 and 1.0 IW/CPE ratios and three sub-sub plot treatments of potassium levels *viz.*,20, 40 and 60 kg/ha K_2O. The gross and net plot sizes were 5.10 x 3.60 $m^2$and 4.50 x 3.00 m^2respectively for flat bed and 4.50 x 2.40 m^2 for BBF and BBF + polythene mulch. Recommended dose of fertilizer (25:50 N:P:0kg/ha) was applied to all the treatments and K as per treatments. The variety used for experimentation was 'RHRG 6083'. The Broad bed furrows and furrows were opened with ridger at 1.20 m distance. The width of furrow was 30 cm and the top of bed was 90 cm.. Three rows of holes were prepared on the plywood at a distance of 30 cm starting at centre keeping 20 cm on either side of the plywood. The distance between two holes was 7.5 cm.. The perforated polythene sheets were placed on the BBF having 90 cm top before sowing. The seeds were sown in the holes prepared in the polythene mulch. The observations of physiological traits were recorded with the help of Portable Photosynthetic machine (LICOR 6400). The observations were recorded during 11.00 to 13.00 hrs. at clear sunshine hours.

3. RESULTS AND DISCUSSION.

Effect of land configurations on physiological traits and yield of summer groundnut

Theobald data pertaining to physiological parameters revealed that, the photosynthetic rate, transpiration rate and stomatal conductance was significantly superior in BBF + polythene mulch at all days of observations. It increased upto 84 DAS and recorded highest i.e. 25.74 µ mol/ m^2/s 12.54 mol/m^2s and 0.40 mol/m^2/s respectively. The photosynthetic rate is dependent on the stomatal conductance and transpiration rate.

This might be due to the higher soil moisture availability and optimum temperature condition under polythene mulch increased the nutrient availability. The vigorous growth of crop in BBF + polythene mulch might have increased the stomatal conductance and transpiration rate and CO_2intake throughout the growth period. The combined effect might have resulted into higher photosynthesis rate. The results are in accordance with the findings ofNautiyal*et al.* (1999), Garkal*et al.* (2005) and Nautiyal*et al.* (2012).

However, reverse trendof decline in stomatal resistance, was observed upto 84 DAS and thereafter increased at harvest of the crop in both the years. It was significantly lower in the BBF + polythene mulch 2.54mol/ m^2/s at 84 DAS in BBF + polythene mulch treatment .All the higher physiological traits in the BBF + polythene mulch, resulted into significantly higher dry pod yield i.e. 4916 kg/ haand haulm yield i.e. (9189kg/ ha)in the pooled means.

Effect of irrigation regimes on physiological traits and yield of summer groundnut

Photosynthetic rate was significantly higher throughout growth period in the irrigation at 1.0 IW/CPEratio. being at par with the 0.8 IW/CPE ratios. It was increased upto the 84 DAS (23.47µmol/ m^2/ s). The higher rate of photosynthesis at might be due to higher demand of photosynthates at this stage. The lowest photosynthetic rate was observed in 0.6 IW/CPEratio. This might be due to stress created under lower irrigation levels might have forced the stomatal closures due to drop in turgor pressure of the guard cells resulting into lower stomatal conductance. As a consequence, the entry of carbon dioxide is also reduced. The decrease in conductance of mesophyll cell due to moisture stress results in low conductance of carbon dioxide and hence reduction in photosynthetic rate (Reddy *et al.* 2003).

The irrigation levels of 1.0and 0.8 IW/CPE ratio being at per with each other have recorded significantly higher transpiration rate at all days of observations, lowest transpiration rate at 0.6 IW/CPE ratio. This might be due to moisture stress at 0.6 IW/CPE ratio, adversely affected the transpiration rate. The results corroborate with Nautiyal *et al.* (2012).

Stomata conductance was significantly influenced due to irrigation levels of 0.1 & 0.8 IW/CPE at 84 DAS on pooled basis. being significantly highest (0.37 & 0.36 mol/ m^2/s) respectively recorded at 84 DAS. The higher irrigation throughout crop growth period maintained turgidity of the cells which resulted into higher stomatal conductance. The lowest stomata conductance was recorded in the 0.6 IW/CPE ratio. Which might have lowered the stomatal conductance.

The stomatal resistance was higher in the irrigation regime at 0.6 IW/CPE ratio throughout growth period. The lowest stomatal resistance was recorded in 1.0 IW/CPE ratio at all days of observations.

The significantly higher dry pod yield (4279kg/ ha) and haulm yield(8676kg/ ha) on pooled basis was recorded with application of irrigation at 1.0 and 0.8 IW/CPE ratio being at par with each other ratios. The irrigation at 0.6 IW/CPE ratio recorded the lowest dry pod and haulm yield. This might be due to optimum moisture status at 0.8 and 1.0 IW/CPE ratio irrigation which enhanced the moisture and nutrient availability to the crop resulting into higher physiological, traits. The overall combined effect resulted into higher dry pod and haulm yield.

Effect of potassium levels on physiological traits and yield of summer groundnut

The photosynthetic rate and transpiration rate was significantly higher at all days of observations with the application of 40 &60 kg/ha K_2O being at per with each other for both the years which increased upto 84 DAS and then declined upto harvest due to accumulation of photosynthates in this levels and decline in chlorophyll content towards maturity. This might be due to role of potassium in water balance and higher vigour of crop at 60 kg/ha K_2O application might have resulted into higher transpiration rate. The stomatal conductance was recorded higher with application of 40&60 kg/ha K_2O. being higher at 84 DAS (0.34&0.37 mol/m^2/s) respectively However, this might be due to the characteristics of potassium for water balance. The reverse trend was observed in stomatal resistance. The application of potassium40& 60 kg/ha K_2O recorded the lower stomatal resistance at all days of observations,being at par with each other.

This might be due to higher stomatal conductance and transpiration rate in application of 40&60 kg/ha K_2O. The potassium is involved in enzyme activities in photosynthesis and water balance. which regulated the moisture stress. All these factors together resulted into higher photosynthetic rate and stomatalconductance. These results are in conformity with Nautiyal*et al.* (2012).

The higher dry pod yield, (4123kg/ ha) and haulm yield and (8441 kg/ha)on pooled mean basis was obtained with potassium application @ 60 kg/ha K_2O. However, it was at par with application of 40 kg/ha K_2O. This might be due to the involvement of potassium in physiological and biochemical functions of plant growth i.e. enzyme activation, water balance, protein synthesis, starch synthesis, etc. Its application in legumes improves nitrogen fixation capacity of plants. These favorable effects might have resulted in increased physiological parameters *viz.*, photosynthetic rate, stomatal conductance and transpiration rate in this treatment. Altogether, combined effect of these factors resulted into higher dry pod yield and haulm yield.

Interaction effect between land configurations and irrigation regimes.

The BBF + polythene mulch in combination with 1.0 IW/CPE ratio produced higher dry pod yield (4954 kg/ha) and haulm yield (9239 kg/ha which was at par with BBF+polythene mulch in combination with 0.8 and 0.6 IW/CPE ratio irrigation(Tables 2 & 3). This might be due to higher soil moisture and nutrient availability under the BBF + polythene mulch due to low rate of evaporation which might have favoured positive physiological response.

Table 2: Interaction effect between land configurations and irrigation regimes on dry pod yield (pooled data of two years)

Land configuration / Irrigation regimes	Dry pod yield (kg/ha)		
	Flat Bed	**BBF**	**BBF + Polymulch**
0.6 IW/CPE	2836	2963	4878
0.8 IW/CPE	3599	4214	4916
1.0 IW/CPE	3632	4251	4954
		SE (m) ±	**CD (P:0.05)**
Between I means at same level of P means		28.42	98.37
Between P means at same level of I means		29.04	114.02

Table 3: Interaction effect between land configurations and irrigation regimes on haulm yield (pooled data of two years)

Land configuration / Irrigation Regimes	Haulm yield (kg/ha)		
	Flat Bed	**BBF**	**BBF + Polymulch**
0.6 IW/CPE	6591	6824	9118
0.8 IW/CPE	7823	8459	9211
1.0 IW/CPE	8198	8591	9239
		SE (m) ±	**CD** (P:0.05)
Between I means at same level of P means		67.22	232.62
Between P means at same level of I means		65.03	255.32

4. CONCLUSION

From the two years pooled data it can be concluded that BBF + polythene mulch in combination with 1.0 IW/CPE ratio produced higher dry pod yield (4954 kg/ha) and haulm yield (9239 kg/ha) which was at par with BBF + polythene mulch in combination with 0.8 and 0.6 IW/CPE ratio irrigation. Therefore, BBF + polythene mulch in combination with 0.6 IW/CPE ratio is suitable for higher productivity of summer groundnut.

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Table 1: Periodical physiologicaltraits and yield of summer groundnutas influenced by land configurations, irrigation regimes and potassium levels (pooled data of two years)

	Photosynthetic rate (μ mol/m^2/ s)					**Transpiration rate (mol/ m^2/ s)**					**Stomatal conductance (mol/m2/s)**					**Resistance (mol/m2/s)**					**Dry pod yield (kg/ ha)**	**Haulm yield (kg/ ha)**
	28 DAS	**56 DAS**	**84 DAS**	**112 DAS**	**At harvest**	**28 DAS**	**56 DAS**	**84 DAS**	**112 DAS**	**At harvest**	**28 DAS**	**56 DAS**	**84 DAS**	**112 DAS**	**At harvest**	**28 DAS**	**56 DAS**	**84 DAS**	**112 DAS**	**At harvest**		
A. Land configurations (P)																						
Flat Bed	13.50	14.86	18.45	14.28	8.93	3.50	3.56	10.57	9.02	6.06	0.16	0.18	0.30	0.16	0.10	6.56	6.06	3.55	6.55	11.10	3356	7537
Broad Bed Furrow (BBF)	15.27	16.11	20.22	15.80	9.55	3.85	4.22	10.96	9.48	6.67	0.17	0.22	0.33	0.17	0.11	6.05	4.98	3.21	6.10	9.86	3810	7958
BBF + Poly mulch	18.62	19.13	25.74	17.99	11.15	4.26	5.68	12.54	10.69	8.05	0.18	0.27	0.40	0.20	0.14	5.62	3.93	2.54	5.13	7.41	4916	9189
SE (m) ±	0.50	0.21	0.19	0.19	0.18	0.05	0.13	0.10	0.13	0.09	0.01	0.01	0.02	0.00	0.00	0.28	0.26	0.14	0.09	0.20	17.46	34.89
CD at (P:0.05)	3.01	1.27	1.16	1.17	1.07	0.33	0.79	0.62	0.82	0.57	NS	0.06	0.06	0.02	0.02	NS	NS	0.42	0.54	1.21	106.24	212.29
B. Irrigation regimes (I)																						
0.6 IW/CPE	14.39	15.46	18.33	14.83	8.98	3.44	3.69	10.50	9.11	6.16	0.16	0.20	0.32	0.16	0.10	6.34	5.48	3.36	6.33	10.43	3559	7511
0.8 IW/CPE	16.06	16.94	22.61	16.13	9.98	3.84	4.44	11.38	9.67	6.89	0.17	0.23	0.36	0.18	0.12	6.01	4.97	3.01	5.87	9.38	4243	8497
1.0 IW/CPE	16.94	17.70	23.47	17.11	10.67	4.34	5.33	12.20	10.41	7.73	0.18	0.25	0.37	0.18	0.12	5.87	4.52	2.93	5.59	8.56	4279	8676
SE (m) ±	0.09	0.23	0.19	0.23	0.09	0.17	0.30	0.22	0.34	0.31	0.00	0.01	0.01	0.00	0.01	0.16	0.22	0.06	0.16	0.45	16.41	38.81
CD at (P:0.05)	0.27	0.79	0.66	0.78	0.27	0.51	1.04	0.76	1.17	1.07	NS	0.03	0.03	NS	NS	NS	NS	0.08	NS	1.57	56.80	134.31
C. Potassium (K_2O) levels (F)																						
20 kg ha^{-1}	14.87	15.58	20.46	14.54	9.03	3.35	3.91	10.69	9.12	6.38	0.16	0.19	0.32	0.16	0.10	6.53	6.06	3.34	6.36	10.30	3842	7946
40 kg ha^{-1}	16.02	16.83	21.62	16.29	10.08	3.95	4.60	11.49	9.80	7.01	0.17	0.23	0.34	0.17	0.11	6.08	4.85	3.12	5.98	9.47	4115	8298
60 kg ha^{-1}	16.50	17.70	22.33	17.24	10.52	4.33	4.95	11.90	10.27	7.39	0.18	0.26	0.37	0.19	0.13	5.61	4.06	2.84	5.45	8.60	4123	8441
SE (m) ±	0.08	0.11	0.18	0.14	0.08	0.14	0.15	0.17	0.12	0.16	0.01	0.01	0.01	0.00	0.00	0.11	0.19	0.10	0.07	0.26	15.89	26.39

CD at (P:0.05)	0.22	0.32	0.51	0.40	0.22	0.40	0.42	0.48	0.34	0.45	NS	0.02	0.02	0.072	0.01	0.32	0.54	0.28	0.19	0.75	45.62	75.74
Interaction -																						
P x I	NS	NS	Sig	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	Sig	Sig.
P x F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
I x F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
P x I x F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
General mean	**15.80**	**16.70**	**21.47**	**16.02**	**9.88**	**3.87**	**4.49**	**11.36**	**9.73**	**6.93**	**0.17**	**0.23**	**0.35**	**0.17**	**0.11**	**6.08**	**4.99**	**3.10**	**5.93**	**9.46**	**4027**	**8228**