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Effect of irrigation regimes and land configurations on growth and yield of summer groundnut (*Arachis hypogaea* L) in submontane zone of Maharashtra

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Abstract

A field experiment entitled, on "Studies on irrigation regimes and land configurations on growth and yield of summer groundnut (*Arachis hypogaea* L.)" was conducted at Agronomy Farm, Rajarshee Chhatrapati Shahu Maharaj College of Agriculture, Kolhapur (M.S.), India during summer, 2020. The experiment was laid out in split plot design with three replications and twelve treatment combinations consist of main plot with four irrigation regimes *viz.,* I_1- 0.6 IW/CPE, I_2- 0.8 IW/CPE, I_3- 1.0 IW/CPE, I_4- 1.2 IW/CPE, and sub plot with three land configurations *viz.,* L_1- Broad Bed Furrow, L_2- Ridges and furrow, L_3- Flat bed. In context with growth the irrigation regime 1.0 IW/CPE was found significantly superior over 0.6 IW/CPE, and it was found at par with 0.8 IW/CPE and 1.2 IW/CPE in respect of the growth attributes *viz*., plant height (cm), plant spread (cm), number of branches plant^{-1}, dry matter plant^{-1} (g), number of nodules plant^{-1} and weight of nodules plant^{-1} (g) and for dry pod yield and dry haulm yield. The land configuration of broad bed furrow was at par with ridges and furrow and significantly superior to flat bed in respect the of the growth attributes viz., plant height (cm), plant spread (cm), number of branches plant^{-1}, dry matter plant^{-1} (g), number of nodules plant^{-1} and weight of nodules plant^{-1} (g). The analyzed results indicated that application of water at 1.0 IW/CPE was at par with 0.8 IW/CPE and 1.2 IW/CPE significantly superior over 0.6 IW/CPE in respect the yield *viz*., dry pod yield (q ha^{-1}) and dry haulm yield, biological yield (q ha^{-1}) and harvest index. For land configurations broad bed furrow recorded significantly superior dry pod yield (q ha^{-1}) and dry haulm yield, biological yield (q ha^{-1}) and harvest index over flat bed and found at par with ridges and furrows.

Keywords: irrigation regimes, land configurations, attributes, summer, *Arachis hypogaea* L.

Introduction

Among the oilseeds crop groundnut (*Arachis hypogaea* L) is major cash crops for the farmers of semi-arid and arid regions. Due it's to importance for oil, protein, food, medicine, and industrial use groundnut is grown all over the world. During 2019-2020 it was sown 50.95 lakh hectares as compared in 2018-2019 was 39.12 lakh ha. Adoption of improved technology is most important to meet the ever-increasing demand of vegetable oil, production improvement of major oilseed crops through area expansion and productivity enhancement. Productivity of groundnut is low in the *kharif* season due to monsoon uncertainties and disease epidemics, which limits its cultivation in the rainy season. Higher and stable yields can be obtained in summer mainly because of bright sunshine, least incidence of insects, pests, and diseases. Consumption of water by irrigation sector is 83% and it can be decreased up to 72% by 2025(Mo WR, 2014) [4]. As a result, in a restricted water environment, the need of the future age is to raise yields and water use efficiency. Therefore, various water conservation strategies such as irrigation timing based on consumptive pan evaporation, land configurations and others must be prioritized. In the present day of water scarcity, optimum method of irrigation plays a vital role in economizing irrigation water and enhancing crop yield. Various approaches have been advocated for scheduling irrigation to groundnut crop in different seasons and soil types. The evaporative demand from the atmosphere is regarded crucial in defining the main element in crop water requirements, and it has gained relevance lately (Prihar *et al*., 1974) [9]. Based on irrigation water depth (IW) and cumulative pan evaporation (CPE), a climatological approach can be better utilized to schedule irrigation. Irrigation scheduling can greatly reduce the excess costs of wasting water and fuel without negatively impacting plant growth. Land configuration is critical in determining the efficacy of crop management strategies such as irrigation, nutrient application, and weed control, among others.

Groundnut is having characteristic mechanism i.e., geotropism therefore loose and well aerated soil surface has favorable impact on pod penetration and development. Hence, land configuration is important in planting of summer groundnut. Keeping this in view, an agronomic experiment was conducted to study the effect of irrigation regimes and land configurations growth and yield of summer groundnut in sub-montane zone of Maharashtra.

Materials and Methods

A field experiment was conducted at Agronomy Farm, Rajarshee Chhatrapati Shahu Maharaj College of Agriculture, Kolhapur (M.S.), India during summer, 2020 to study the effect of irrigation regimes and land configurations on growth and yield of summer groundnut (*Arachis hypogaea* L). The soil of the experimental plot was sandy clay loam in texture, low in available N (171.27 kg ha^{-1}), moderately high in available P_2O_5 (18.26 kg ha^{-1}), medium in available K_2O (183.19 kg ha^{-1}) and slightly alkaline in reaction (pH 7.81). The experiment was laid out in split plot design with three replications and twelve treatment combinations consist of main plot with four irrigation regimes *viz.*, I_1- 0.6 IW/CPE, I_2- 0.8 IW/CPE, I_3- 1.0 IW/CPE, I_4- 1.2 IW/CPE, and sub plot with three land configurations *viz.*, L_1- Broad Bed Furrow, L_2- Ridges and furrow, L_3- Flat bed. The gross and net plot size were 4.80 m x 4.00 m and 3.60 m x 3.00 m, respectively. The Recommended Dose of Fertilizer (NPK Kg ha^{-1}) was applied by using urea and single super phosphate by placement method. The variety of crop JL-1085 (Phule Dhani) was sown on 10th of March 2020 during experimentation by dibbling method at spacing 30 cm × 10 cm with different irrigation regimes and land configurations. The land configuration practices viz., broad bed furrow of 150cm with 120 cm top and 30 cm furrow width (L_1), ridges and furrows (60 cm wide ridge, 60 cm wide furrow) (L_2), flatbed method (L_3) were prepared. Three common irrigations, viz., first immediately after sowing, second and third at 7 days interval after first irrigation for proper germination and establishment of the plants. The treatments were comprised four irrigation regimes i.e., 0.6, 0.8, 1.0 and 1.2 IW/CPE ratio with 5 cm water depth as main plot. Scheduling of irrigation was done as per CPE values calculated viz., 83.4, 62.5, 50 and 41.6 mm in respective plots. Daily evaporation data was recorded from the USWB open pan evaporimeter installed in agrometeorological observatory. In all, 7 (83.4 mm), 9 (62.5 mm), 10 (50 mm) and 12 (41.6 mm) irrigations were applied as per treatments. The experimental data was statistically analyzed by using a standard method of "analysis of variance" as reported by Panse and Sukhatme (1967) [6].

Result and Discussion

Effect on growth contributing characters of groundnut

Effect of irrigation Regimes

The growth attributes were significantly influenced by irrigation regimes at all different development stages of crop. The maximum mean plant height (35.02 cm), plant spread (27.28 cm), number of branches (11.74), dry matter (36.49), number of nodules $plant^{-1}$ (53.21) and weight of root nodules (1.32 g) was recorded with 1.0 IW/CPE irrigation treatment (Table 1); However, it was at par with 0.8 IW/CPE and 1.2 IW/CPE. The treatment of 1.0 IW/CPE was found superior to 0.6 IW/CPE. It could be owing to an increase in irrigation frequency, which resulted in appropriate moisture availability near the crop root zone. Water is required for all metabolic processes in the plant body. As a result, maintaining optimal soil water content at all physiological phases may be the cause of increased growth and dry matter production. It resulted in favorable conditions for the crop's opulent growth. Similar results were reported by Naresha *et al*., (2019) and Madhuri Devi *et al*., (2019) [3].

Table 1: Growth attributing characters of groundnut as influenced by different treatments

Treatments	At harvest					
	Plant height (cm)	Plant spread (cm)	Number of branches $plant^{-1}$	Dry matter $Plant^{-1}$	Number of Nodules $Plant^{-1}$	Weight of Nodules $Plant^{-1}$ (g)
Main Plot: Irrigation Regimes						
I_1- 0.6 IW/CPE	30.21	23.58	10.06	31.49	46.86	1.11
I_2- - 0.8 IW/CPE	33.41	26.52	11.18	35.48	52.06	1.20
I_3- - 1.0 IW/CPE	35.02	27.28	11.74	36.49	53.21	1.32
I_4- - 1.2 IW/CPE	32.63	25.35	10.69	33.21	49.22	1.18
S. Em±	0.91	0.68	0.31	0.95	1.30	0.04
C. D. at 5%	3.15	2.37	1.08	3.30	4.51	0.14
Sub Plot: Land Configurations						
L_1 -Broad Bed Furrow	34.58	27.09	11.59	35.81	52.79	1.29
L_2- Ridge and Furrow	33.02	25.57	10.88	34.13	50.66	1.23
L_3- Flat Bed	30.86	24.38	10.28	32.56	47.56	1.09
S. Em±	0.76	0.53	0.26	0.63	1.03	0.03
C. D. at 5%	2.26	1.59	0.77	1.88	3.80	0.08
Interaction: I × L						
S. Em±	1.51	1.06	0.52	1.25	2.07	0.05
C. D. at 5%	NS	NS	NS	NS	NS	NS
General mean	31.99	25.68	10.92	34.17	50.34	1.20

Effect of land configurations

Land configurations had substantial effect on growth attributes. The broad bed furrow produced the maximum plant height (34.58 cm), plant spread (27.09 cm), number of branches $plant^{-1}$ (11.59), dry matter (35.81 g) number of nodules $plant^{-1}$ (52.79) and weight of root nodules (1.29 g) among the land configurations at all phases of crop growth (Table 1). At all times of observation, it was superior to the land configurations flat bed. At all growth phases, the BBF and ridge and furrow were found to be statistically at par. It could be because the broad bed furrow created a loose soil mass, which allowed for optimal moisture conservation and soil aeration. It also improved the soil environment, which led to improved crop growth and development. similar results were noted by Sathiya *et al*., (2020) [10] and Dutta (2006) [2].

Effect of interactions
The interaction effect between irrigation regimes and land configurations was found to be non-significant in respect of growth contributing characters of groundnut.

Effect on yield of groundnut
Effect of irrigation regimes
Irrigation at various regimes had a substantial impact on groundnut dry pod and haulm yield. Among irrigation regimes, the application at 1.0 IW/CPE recorded significantly the highest dry pod yield (27.84 q ha^{-1}) and haulm yield (39.60 q ha^{-1}) of groundnut over 0.6 IW/CPE (Table 2). However, it was at par with application of irrigation at 0.8 IW/CPE and 1.2 IW/CPE for dry pod yield and haulm yield respectively. The lowest dry pod yield and haulm yield was obtained at 0.6 IW/CPE ratio. With the 1.0 IW/CPE ratio, adequate moisture availability combined with higher irrigation frequency resulted in luxurious crop growth and, as a result, raised the values of yield attributes when compared to 0.6 IW/CPE ratio treatment. Higher pod yields with more frequent irrigation (1.0 IW/CPE ratio) might be due to positive impact on yield-related features like number of kernels pod^{-1}, number of pods per plant, 100 kernel weights, and finally leading to highest dry pod yield and dry haulm yield. Similar results were recorded by Pawar *et al*., (2013) [8], Behera *et al*., (2015) [1] and Tambe *et al.*, (2017) [11].

Effect of land configurations
The different land configurations treatments significantly differed in respect of the pod yield and haulm yield. The highest dry pod yield (27.34 q ha^{-1}) and dry haulm yield (38.94 q ha^{-1}) of groundnut was observed in BBF layout, it was significantly superior over flatbed (Table 2). However, it was on par with ridges and furrows layout. The broad bed furrow provided a loose soil mass with sufficient moisture. These conditions favored efficient peg penetration and pod development, which resulted in an increase in groundnut dry pod yield and dry haulm yield. Similar results were recorded by Vekariya *et al*., (2015) [12] and Patil *et al.*, (2007) [7].

Effect of interaction
The interaction effect between irrigation regime and land configuration was found to be non-significant in respect of yield of summer groundnut.

Table 2: Mean dry pod yield, dry haulm yield, biological yield and harvest index of groundnut as influenced by various treatments

Treatments	At harvest			
	Dry pod yield (q ha^{-1})	Dry haulm yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)
Main Plot: Irrigation Regimes				
I_1- 0.6 IW/CPE	23.38	34.63	58.02	40.31
I_2- - 0.8 IW/CPE	25.84	37.50	63.35	40.87
I_3- - 1.0 IW/CPE	27.84	39.60	67.44	41.20
I_4- - 1.2 IW/CPE	25.10	36.66	61.76	40.61
S. Em±	0.81	0.90	1.27	0.92
C. D. at 5%	2.79	3.13	--	--
Sub Plot: Land Configurations				
L_1 -Broad Bed Furrow	27.34	38.94	66.28	41.20
L_2- Ridge and Furrow	25.76	37.04	62.81	41.06
L_3- Flat Bed	23.53	35.31	58.84	39.99
S. Em±	0.56	0.77	0.81	0.81
C. D. at 5%	1.67	2.30	--	--
Interaction: I × L				
S. Em±	1.11	1.53	1.61	1.62
C. D. at 5%	NS	NS	NS	NS
General mean	25.54	37.10	62.64	40.75

Conclusions
1. Among different irrigation regimes, scheduling of irrigation at 1.0 IW/CPE recorded the higher growth and development of summer groundnut, so irrigation at 1.0 IW/CPE could be remunerative for groundnut.
2. Among different land configurations Broad Bed Furrow (BBF) recorded the higher growth and development of summer groundnut, so adopting broad bed furrow could be remunerative for groundnut.
3. Among irrigation regimes irrigation at 1.0 IW/CPE and Broad Bed furrow recorded highest dry pod yield and dry haulm yield so it could be remunerative for groundnut.

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