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Research Article

PHYSIOLOGICAL SCREENING OF GROWTH AND YIELD VARIATION IN BUNCH GROUNDNUT (*ARACHIS HYPOGAEA* L.) UNDER RAINFED CONDITION

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Abstract: A field experiment was conducted on medium black soil to study the screening of bunch groundnut varieties for physiological growth parameters and yield attributes under rainfed condition at Main Dry Farming Research Station, Junagadh Agricultural University, Targhadia, Gujarat, during *kharif*- 2017-18 to 2020-21. The experiment comprising of fourteen bunch groundnut varietal screening., *viz.* T_1 JL-501, T_2 TG-26, T_3 TLG-45, T_4 TPG-41, T_5.TAG-24 T_6TG-37 A, T_7 GJG-31, T_8 GJG-9, T_9, GG-2, T_{10} GG-4, T_{11} GG-5, T_{12}GG-6,T_{13}GG-7 and T_{14} GG-8with three replications laid out in randomized block design. In pooled results of these research study indicated that significantly higher pod yield was obtained in variety JL-501 (3304 kg ha^{-1}) which was remained at par with TG-26, TPG-41, TAG-24 and TG-37 A, while significantly higher haulm yield (4375 kg ha^{-1}) was obtained in GG-5 and which was remained at par with JL-501, TG-37 A, GJG-31, GJG-9, GG-2, GG-4, GG-6, GG-7, GG-8. In this study showed that JL-501 was gave higher pod yield as compare to other bunch groundnut varietal screening due to pod dry weight (15.6 g. plant-1), total dry weight (43.9 g. plant^{-1}), leaf growth rate (2.85 gm^{-2} day^{-1}) and crop growth rate (13.3 gm^{-2} day^{-1}) is higher as compare to other bunch groundnut varieties. Similarly, maximum net return (138448 Rs. ha^{-1}) and B: C ratio (3.14) were obtained in variety JL-501 as compared to other bunch groundnut varieties.

Keywords: *Growth, Yield, Bunch Groundnut, Physiological parameters, Rainfed and economics*

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Introduction

Groundnut (*Arachis hypogaea* L.) is one of the world's very importance leguminous crops. The word groundnut (*Arachis hypogaea* L.) is derived from Greek word "Arachis" means legume and "hypogaea" means below the soil/ground. It is commonly referred to as peanut, monkey-nut and goobernut. Groundnut is native to South America and originated in Brazil or Peru as early as 950 BC and later spread to Africa, North America, Europe and Asia. The groundnut producing countries are China, Nigeria, U.S.A., Taiwan, Indonesia, Senegal, Ghana, Argentina and Brazil. It's the important commercial crop mostly grown in semi-arid tropical regions like India. The crop may be grown successfully in areas receiving rainfall from 600 mm to 1200 mm. The soil is suited for the groundnut crop is sandy loam, loamy and medium black [1].

Groundnut (*Arachis hypogaea* L.) is a crucial oilseed crop of tropical and sub-tropical regions globally. In India, groundnut is generally grown in five states viz., Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra which covers 70 per cent of the total area and 71 per cent of the total production of summer groundnut. In our country, sowing of groundnut crop was 40.684 lakh ha with a production of 66.152 lakh tonnes and a yield of 1626 kg ha^{-1}. However, during the summer season, it's grown in a region of 8.393 lakh ha with a production of 16.018 lakh tonnes and also the yield was 1909 kg ha^{-1} [2].

Groundnut crop is grown as rain-fed in bulk during kharif season but it's also taken during the summer season, wherever, the irrigation facilities are available. The crop is grown as monoculture within the Saurashtra region of Gujarat. Junagadh, Rajkot, Amreli, Jamnagar, Bhavnagar and Kutch districts of Gujarat state contribute about 15% total production of summer groundnut of Gujarat state. In Gujarat, large area covered in kharif groundnut cultivation was 16.272 lakh ha with a production of 39708.76 million tonnes [3].

The growth analysis techniques help in understanding, growth pattern and contribution of many plant parts to economical yield. It also helps in find out yield contributing characters. Thus, growth analysis forms the premise for manipulation of productivity of the crop. The yield of groundnut is widely influenced by the partitioning of assimilates between reproductive and vegetative parts. The growth parameter of root, stem, leaf, pod and crop and partitioning percentage contributing the higher yield in groundnut. CGR is that the function of amount of growing material present and is influenced by the environment. These growth parameters are greatly influenced by stage of growth and varieties [4].

The knowledge about crop physiology is needed for mainly three reasons: (i) For optimal groundnut yield in an environment, the life cycle of the crop should match to the length of season, (ii) The introduction of an improved verities into new region is basically determined by temperature and phenology and (iii) Phenology is an importance component of whole crop simulation model, which might be required to specify the more appropriate rate and time of specific developmental process to maximize yield of crop. For this research paper, an attempt was made to provide knowledge of groundnut physiological characters to grow high yielding groundnut bunch varieties especially to dry land area with targeted yield and to extend and improve the productivity.

Materials and Methods

The experiment was conducted on medium black soil of Main Dry Farming Research Station, of Junagadh Agricultural University, Targhadia (Rajkot), Gujarat during four consecutive kharifseasons of 2017-18 to 2020-21. The year wise total rainfall received during the crop growth seasons 2017-18 to 2020-21 were 1328.5, 613.6, 1360.4 and 1160.4 mm, with 38, 26, 41 and 45 rainy days, respectively.

Table-1 *Yield and economics of bunch groundnut verities (Pooled data-2017 to 2020)*

Tr. No.	Treatment	Yield (kg ha^{-1})		Gross Realization (Rs. ha^{-1})	Total cost of cultivation (Rs. ha^{-1})	Net realization (Rs. ha^{-1})	B:C ratio
		Pod	Haulm				
T_1	JL-501	3304	4117	182481	44033	138448	3.144
T_2	TG-26	2789	2903	151176	44033	107143	2.433
T_3	TLG-45	2566	3176	141614	44033	97581	2.216
T_4	TPG-41	2785	3137	152150	44033	108117	2.455
T_5	TAG-24	2994	3810	165756	44033	121723	2.764
T_6	TG-37 A	3269	4033	180346	44033	136313	3.096
T_7	GJG-31	2246	3849	129299	44033	85266	1.936
T_8	GJG-9	2425	4204	139845	44033	95812	2.176
T_9	GG-2	2179	4091	127226	44033	83193	1.889
T_{10}	GG-4	2044	4091	120611	44033	76578	1.739
T_{11}	GG-5	2691	4372	153719	44033	109686	2.491
T_{12}	GG-6	1871	3971	111534	44033	67501	1.533
T_{13}	GG-7	2402	4207	138733	44033	94700	2.151
T_{14}	GG-8	2176	3870	125974	44033	81941	1.861
S. Em.±		196	195				
C.D. at 5%		562	559				
C.V.%		14	14.1				

Table-2 *Mean performance of dry weight and growth parameters of bunch groundnut varieties (Pooled data-2017 to 2020)*

Tr. No.	Treatments	Pod Dry Weight (g) plant^{-1}		Total Dry Weight (g) plant^{-1}		RGR* (gm^{-2} day^{-1})	SGR* (gm^{-2} day^{-1})	LGR* (gm^{-2} day^{-1})	PGR* (gm^{-2} day^{-1})	CGR* (gm^{-2} day^{-1})	Partitioning percentage (%)
		75 DAS*	Mat.	75 DAS*	Mat.						
T_1	JL-501	6.68	15.6	23.1	43.9	0.125	3.72	2.85	5.5	13.3	42.9
T_2	TG-26	4.85	13.1	15.7	34.1	0.108	2.67	2.14	5.2	11.8	45.9
T_3	TLG-45	5.39	13.9	16.2	33.9	0.104	2.73	2.14	5.4	11.4	48.6
T_4	TPG-41	5.49	13.4	17.4	35.9	0.102	2.84	2.36	4.9	11.7	42.7
T_5	TAG-24	6.15	15.3	18.6	39.0	0.132	3.30	2.30	5.9	13.2	45.3
T_6	TG-37 A	6.04	15.0	22.2	43.0	0.114	3.34	2.50	5.5	13.2	42.6
T_7	GJG-31	4.21	10.9	18.3	34.3	0.103	3.28	2.36	3.8	10.2	37.0
T_8	GJG-9	4.40	12.3	19.7	37.6	0.103	3.32	2.80	4.7	11.5	42.4
T_9	GG-2	4.47	10.7	17.3	33.5	0.099	4.25	2.37	3.7	10.7	34.8
T_{10}	GG-4	4.34	10.6	16	33.5	0.098	4.31	2.72	3.7	11.5	31.6
T_{11}	GG-5	5.15	12.9	22.1	41.0	0.103	3.81	2.55	4.7	12.0	39.0
T_{12}	GG-6	3.76	10.5	15.7	31.8	0.095	4.03	2.62	3.9	10.5	37.3
T_{13}	GG-7	5.34	13.8	18.7	36.1	0.111	3.79	2.10	4.9	11.2	45.6
T_{14}	GG-8	3.61	10.8	18	35.2	0.104	4.15	2.54	4.2	11.3	37.8
S. Em.±		0.65	0.9	2.3	3.0	0.006	0.35	0.15	0.3	0.6	2.5
C.D. at 5%		1.86	2.7	NS	NS	0.016	1.0	0.42	0.8	1.8	7.3
C.V.%		19.87	13.9	14.6	10.8	13.8	12.59	15.58	14.9	12.3	14.2

The experiment was comprised fourteen bunch groundnut varietal screening, *viz.* T_1 JL-501, T_2 TG-26, T_3 TLG-45, T_4 TPG-41, T_5TAG-24, T_6 TG-37 A,T_7 GJG-31, T_8 GJG-9, T_9 GG-2, T_{10} GG-4, T_{11} GG-5, T_{12} GG-6, T_{13} GG-7 and T_{14} GG-8.

The experiment was laid out in randomized block design with fourteen bunch groundnut varietal screening with three replications as well as individual plot size of 5.0m x 2.7m (gross) and 4.5m x 1.8m (net). Fourteen bunch groundnut varieties were sown at 45 cm row to row and 10 cm plant to plant distance. The crop was fertilized with RDF (12.5-25.0-0.0 NPK kg ha^{-1}). All other recommended agricultural practices were followed throughout the crop period. Growth and yield attributers were recorded at the time to time.

Results and Discussion

Physiological screening of yield variation of bunch groundnut varieties

The results indicated that significantly higher pod yield was obtained in variety JL-501 (3304 kg ha^{-1}) which was remained at par with TG-26, TPG-41, TAG-24 and TG-37 A, while significantly higher haulm yield (4375 kg ha^{-1}) was obtained in GG-5 and which was remained at par with JL-501, TG-37 A, GJG-31, GJG-9, GG-2, GG-4, GG-6, GG-7, GG-8 [Table-1]. In this result indicated, JL-501 gave higher pod yield as compare to other bunch groundnut varietal screening due to pod dry weight (15.6 g. plant^{-1}), total dry weight (43.9 g. plant^{-1}), leaf growth rate (2.85 gm^{-2} day^{-1}) and crop growth rate (13.3 gm^{-2} day^{-1}) were higher as compared to other bunch groundnut varieties.

Effect of dry weight and growth parameters in different bunch verities of groundnut

The pooled results revealed that significant differences were observed among different bunch varieties of groundnut for pod dry weight (g) per plant, pod growth rate (gm^{-2}day^{-1}), crop growth rate (gm^{-2}day^{-1}), partitioning percentage (%), root growth rate (gm^{-2}day^{-1}), stem growth rate (gm^{-2}day^{-1}), leaf growth rate (gm^{-2}day^{-1}), except total dry weight (g) per plant. The growth stages of groundnut plants based on visual observations of vegetative and reproductive growth have been described and defined by Blackman (1919) [5].

Significantly higher pod dry weight (g) per plant were obtained in JL-501(6.68 g & 15.6 g) cultivar and it was at par with TG-26, TLG-45, TPG-41, TAG-24, TG-37 A, GG-5 and GG-7 at 75 DAS and at maturity [Table-2] due to significant favorable yield contributing characters were recorded like number of pods per plant, harvest index and the physiological efficiency of plant, partitioning NAR, CGR, total chlorophyll content *etc.* Similar type of results was also reported in groundnut [6-10]. Whereas, total dry weight (g) per plant was found non-significant at 75 DAS and maturity. Because dry matter was an important criterion to determine the source-sink relationship and depends upon the net gain in the processes on anabolism and catabolism of plant [4].

Similar results were found by various researchers, it was observed that pod dry matter was less up to juvenile stage and then increases with the age of the plant with respect to pod dry weight [11].

The results presented in [Table-2], it shown that significantly higher root growth rate significantly higher value (0.132 gm^{-2}day^{-1}) was observed in TAG-24 and it remained at par with JL-501. Significantly higher stem growth rate (4.31 gm^{-2}day^{-1}) were obtained in GG-5 cultivar which was at par with TG-37 A, GJG-9, GG-2, GG-4, GG-5, GG-6, GG-7 and GG-8. Significantly higher leaf growth rate (2.85 gm^{-2}day^{-1}) were observed in JL-501 variety and it was remained at par with TG-37 A, GJG-9, GG-4, GG-5, GG-6 and GG-8.

These results were in conformity with the result of growth analysis and developmental data were normally for calibration of crop simulation models in order to determine the cultivar co-efficient that correspond to the unique characteristics of each crop and cultivar [12, 13]. The early growth is due to stem elongation and leaf production, simultaneously the lateral branches accounts for the bulk of later growth. The leaf and stem dry weight increases in sigmoid fashion up to maximum value, which occur 90 to 100 days after planting. During this stage leaves and stems accumulate weight at similar rates, after that the leaf weight reduce but stem weight either remains constant or decreases. Though growth is a genotypic character, mainly influenced by seasonal and environmental conditions, the dry matter accumulation in groundnut crop follows the growth pattern characterized by (i) a lag phase in early growth, (ii) exponential increases in weight from vegetative to flowering stage, (iii) a linear and maximum growth rate during late vegetative to early pod filling, and (iv) leveling of weight during late pod filling stage.

In case of significantly higher pod growth rate (5.9 $gm^{-2}day^{-1}$) were obtained in TAG-24 variety which was at par with JL-501, TG-26, TLG-45 and TG-37 A. In case of crop growth rate significantly higher value (13.3 $gm^{-2}day^{-1}$) was observed in JL-501 and it remained statically at par with TG-26, TAG-24, TG-37 A, GJG-9, GG-4 and GG-5 [Table-2]. Similar results followed in groundnut [9]. Significantly higher partitioning percentage (48.6 %) were observed in TLG-45 cultivar and it was remained at par with JL-501, TG-26, TPG-41, TAG-24, TG-37 A, GJG-9 and GG-7 [Table-2]. The growth parameter viz., CGR equation worked out [5].

Formula- Growth rate (Root, Stem, Leaf, pod and crop) = $1/P\ (DW_2 - DW_1)/\ (T_2-T_1)(g\ m^{-2}\ day^{-1})$

Where, P= ground area per plant,

DW_1 and DW_2 =Root, Stem, Leaf, pod and whole plant dry weight at time $T_1 - T_2$, respectively.

Economics

Economics was worked out on the basis of pooled results and presented in [Table-1]. The data indicated that maximum net returns (138448 Rs. ha^{-1}) and B: C ratio (3.14) obtained in variety JL-501 as compared to other varieties of groundnut.

Conclusion

It can be concluded that the bunch groundnut varieties were grown under North Saurashtra Agro-Climatic Zones especially for dry farming condition are advised to grow bunch groundnut variety JL-501 followed by TG-37 A, TAG-24, TPG-41 or TG-26 for obtaining higher pod yield and net return due to enhance growth parameters.

Application of research: Study of physiological screening of growth and yield variation in bunch groundnut

Research Category: Rainfed Agriculture

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Cultivar / Variety / Breed name: Groundnut (*Arachis hypogaea* L.)

Conflict of Interest: None declared

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