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Effect of land configuration and nutrient management on growth analysis and yield of *kharif* groundnut (*Arachis hypogaea* L.)

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Abstract
A field investigation was under taken during *kharif* seasons of 2019 and 2020 at the Research Farm of Indira Gandhi Krishi Vishwavidyalaya, College of Agriculture and Research Station, Raigarh (CG). The results of the experiment revealed that ridge and furrow land configuration method recorded the maximum values of growth analysis parameters (leaf area index, leaf area duration, crop growth rate and net assimilation rate) and pod as well as haulm yields of groundnut and these parameters were the minimum under flatbed land configuration method. Further, the relative growth rate analysis factor was increased substantially between sowing to 50 DAS. Thereafter, continuous decrease trend was noticed till 100 DAS under different land configurations treatments, Similarly, among the nutrient management practices, 100% RDN (30, 60 and 30 kg of N, P_2O_5 and K_2O ha^{-1}) +5t FYM ha^{-1} recorded the maximum values of above all growth analysis characters as well as pod and haulm yields of *kharif* groundnut. The lowest values of these characters were recorded with absolute control practice of nutrient management system. Further, the relative crop growth rate obtained values were more or less equal under nutrient management treatments in relation to different time intervals.

Keywords: Groundnut, growth analysis**,** yields

Introduction

In India, various crops are cultivated depending upon soil types and climatic conditions in different agro climatic regions. Oilseed crops have been considered as backbone of agricultural economy of our country from time immemorial. Among the oilseeds, groundnut is considered as a cash crop, grown largely during *kharif* and summer seasons in Chhattisgarh. Like other oilseed crops, the area, production and productivity of groundnut is fluctuating from year to year. There are several factors responsible for low and unstable yield of groundnut *viz.*, lack of improved varieties, poor fertility status of soils, non-adoption of proper agronomic practices, which are influenced by environmental factors, such as biotic and abiotic (Singh and Joshi, 1993). Groundnut pods grow underground; therefore, the loose and well aerated seed bed is important for penetration of pegs and development of pods (Patil *et al.*, 2007) [7]. Inadequate use and improper management of nutrients have in general, been found to be one of the critical input with holding oilseed production. Inadequate and imbalance use of nutrients are responsible for low yield of groundnut (Veeramani and Subrahmaniyan, 2010) [12]. Keeping these points in view, this experiment was conducted to find out the suitable land configuration and nutrient management practice for higher yield of kharif groundnut.

Materials and methods

To find out the influence of land configuration and nutrient management on kharif groundnut, a study entitled **"**Effect of land configuration and nutrient management on growth analysis and yield of *kharif* groundnut (*Arachis hypogaea* L.), was under taken during *kharif* seasons of 2019 and 2020 at the Research Farm of Indira Gandhi Krishi Vishwavidyalaya, College of Agriculture and Research Station, Raigarh (CG). Three land configuration methods (flatbed, ridge and furrow, and broad bed furrow) and six nutrient management practices *viz.*, absolute control, 100% RDN (30, 60 and 30 kg of N, P_2O_5 and K_2O ha_{-1}), 100% RDN +5t FYM ha^{-1}, 100% RDN + foliar spray of 2% DAP at 30 DAS, 100% RDN+ foliar spray of 0.5% $ZnSO_4$ at 30 DAS and 100% RDN+ foliar spray of 0.2% boron at 30 DAS were allocated in main and sub-plots, respectively under split plot design with three replications. The soil of the experimental field was sandy loam, neutral in reaction, normal in electrical conductivity, medium in nitrogen, phosphorus as well as organic carbon and high in potassium content. Treated seeds of groundnut variety JL-776 were sown manually on 22.07.2019 and 20.06.2020 during 2019 and 2020, respectively adopting a spacing of 30 cm x10 cm. Further, crop was harvested manually on 30.11.2019 and 24.10.2020, respectively.

Results and discussion

Leaf area index: Data on leaf area index (LAI) as influenced periodically by various land configuration and nutrient management practices are given in Table.1. Perusal of data revealed that LAI was affected significantly due to different treatments. Its value obtained was the highest (0.08, 2.53 and 4.49) in ridge and furrow method (L_2) at 25, 50 and 75 DAS, respectively followed by broad bed furrow (L_3) and flatbed (L_1). This might be due to higher production of number of leaves with more number of branches and also due to maintenance of proper air moisture regimes under ridges and furrow sowing which in turn resulting in good supply of required moisture, available nutrients, soil aeration, soil environment and better growth and development. Among the nutrient management, 100% RDN + 5 t FYM ha^{-1} (N_3) treatment recorded significantly the highest value of LAI (0.86, 2.73 and 4.74 cm^2) compared to others and the lowest values 0.57, 1.98 and 3.74 cm^2 were noted under absolute control (N_1) at 25, 50 and 75 DAS, respectively. Treatments, 100% RDN +foliar spray of 2% DAP (N_4), 100% RDN +foliar spray of 0.5% zinc sulphate (N_5) and 100% RDN +foliar spray of 0.2% boron (N_6) being at par and significantly better than 100% RDN (N_2) and absolute control (N_1) treatments at 50 and 75 DAS. Similar findings have been reported by Murthy *et al.* (2009) [5]. The association of nutrient elements from inorganic and organics produced more number of leaves resulting in higher LAI and foliar spray stimulates an increase in chlorophyll production, cellular activity and respiration.

Leaf area duration (days): The data analyzed in respect of leaf area duration (LAD) at different time intervals as influenced by various treatments are presented in Table 2. Leaf area duration observed during 2020 was more than 2019 season due to early sowing in 2020 season, might be favorable weather condition for growth and development of crop. Results reveal that ridge and furrow (L_2) recorded significantly maximum LAD value (10.06, 41.69 and 61.80 days) and the minimum (7.25, 34.00 and 50.06 days) with flatbed (L_1) at 25, 50 and 75 DAS, respectively. Further, broad bed furrow (L_3) was also found better than flatbed (L_1). Application of 100% RDN+ 5 t FYM ha^{-1} (N_3) recorded significantly the highest value of LAD (10.69, 44.75 and 67.38 days) compared to other studies practices and its value was the lowest (7.06, 31.75 and 45.44 days) in absolute control (N_1) at 25, 50 and 75 DAS, respectively. Treatments 100% RDN+ foliar spray of 2% DAP (N_4), 100% RDN+ foliar spray of 0.5% zinc sulphate (N_5) and 100% RDN+ foliar spray of 0.2% boron (N_6) were significantly on par at 25, 50 and 75 DAS and superior over 100% RDN (N_2) and absolute control (N_1) treatments. Further, 100% RDN (N_2) was also found significantly better than absolute control (N_1) treatment under investigation.

Crop growth rate (g day^{-1} plant^{-1}): Crop growth rate (CGR) as influenced by land configuration and nutrient management treatments was calculated between 0-25, 25-50, 50-75 and 75-100 DAS and depicted in figure 1 and 2. In general, the CGR was slow up to 0-25, very fast between 25-50, fast between 50-75 and declined drastically thereafter *i.e.,* at 75- 100 DAS. Dry matter accumulation is directly propositional to crop growth. Among the different land configuration, the maximum CGR was noted in ridge and furrow (L_2) followed by broad bed furrow (L_3) and flatbed (L_1) at 0-25, 25-50, 50-75 and 75-100 DAS. The high CGR was observed between 50-75 DAS for all the treatments. The higher CGR values under ridge and furrow (L_2) may be attributed to more vigorous growth of plants and higher dry matter accumulation plant^{-1}. In case of nutrient management treatments, the highest CGR was found with 100% RDN + 5 t FYM ha^{-1} (N_3) followed by 100% RDN + foliar spray of 2% DAP(N_4) at 0-25 and 25-50 DAS. However, CGR was higher in 100% RDN + foliar spray of 0.5% zinc sulphate (N_5) followed by 100% RDN + foliar spray of 2% DAP (N_4) at 50-75 DAS while; it is more in 100% RDN (N_2) followed by 100% RDN + 5 t FYM ha-1 (N_3) during 75-100 DAS of groundnut. The lowest CGR was recorded in absolute control (N_1) at all the time intervals. The higher CGR value was observed between 50-75 DAS for all the treatments. Increased dry matter production under 100% RDN+ 5 t FYM ha^{-1} (N_3) treatment evidently resulted in higher crop growth rate.

Relative growth rate (g g^{-1} day^{-1}): The relative growth rate (RGR) influenced by various treatments under different time duration is depicted in figure 3 and 4. The RGR was increased substantially between sowing to 50 DAS. Thereafter, continuous decrease trend was noticed till 100 DAS under different land configurations and nutrient management treatments. RGR was maximum between 25-50 DAS and it was minimum between 75-100 DAS in groundnut. In general, all nutrient management treatments improved the RGR up to 50 DAS. However, obtained values were more or less equal under nutrient management treatments in relation to different time intervals. The higher RGR values might be attributed to more vigorous growth of plants and higher dry matter production plant^{-1}. The decline in RGR towards physiological maturity could be due to leaf shedding, shadow of upper leaves over the lower leaves which reduce the photosynthetic capacity of the lower leaves.

Net assimilation rate (g cm^{-2} day^{-1}): The effect of different treatments on net assimilation rate (NAR) of groundnut at various time intervals is presented in figure 5 and 6. The NAR was increased continuously up to 75 DAS and it was decreased between 75-100 DAS of groundnut. The maximum NAR was recorded under ridge and furrow (L_2) land configuration treatment compare to broad bed furrow (L_3) and flatbed (L_1). However, obtained values were more or less equal under all treatments in relation to different time intervals. Under nutrient management treatments, the higher NAR value was found in 100% RDN +5t FYM ha^{-1}(N_3)

compare to others. However, trend noted among the nutrient managements in relation to NAR during different date of observations shows that value was maximum between 50-75 DAS and minimum between 75-100 DAS.

Pod and haulm yields (t ha^{-1}): The data pertaining to pod and haulm yield of groundnut as influenced by land configuration and nutrient management are presented in Table 3. Perusal of data revealed that pod and haulm yields were affected significantly due to different treatments. Pod yield was found significantly the highest (3.46 t ha^{-1}) in ridge and furrow (L_2) followed by broad bed furrow (L3) and flatbed (L_1). Similarly, broad bed furrow (L_3) was also significantly better than flatbeds (L_1) which produce 3.09 t ha^{-1} pod yield. Flatbed (L_1) recorded significantly the lowest pod yield (2.63 t ha^{-1}). The increase in pod yield with ridge and furrow (L_2) was 10.70 and 24.12 per cent over broad bed furrow (L_3) and flatbed (L_1) treatment, respectively. Further, pod yield obtained under broad bed furrow (L_3) was also 15.02 per cent higher than flatbed (L_1) under study. Haulm yield also followed the similar trend as that of pod yield. The haulm yield increase was 9.60 and 14.63 per cent higher with ridge and furrow (L_2) method as compared to broad bed furrow (L_3) and flatbed (L_1), respectively. The yield of a crop is a function of various growth and yield characters; hence, the increase in pod and haulm yield under ridge and furrow (L_2) was a result of higher growth analysis parameters. Increase in pod yield was in accordance with the findings of Nikam and Firake (2002) [6] and Shrinivas (2012) [9]. In respect of haulm yield, similar result was found by Baskaran *et al.* (2003) [1] and Vekariya *et al.* (2015) [11]. The favorable influence of ridge and furrow (L_2) sowing on increasing the yield contributory characters or sink characters provided evidence for greater yield over broad bed furrow (L_3) and flatbed (L_1) method of sowing. Further, it was interesting to note that in spite of less plant population in broad bed furrow (L_3) as compared to flatbed (L_1), the broad bed furrow (L_3) plays crucial role in ameliorating micro flora and availability of major nutrients resulting in tremendous boosting to the groundnut pod yield over the flatbed (L_1) system. The broad bed furrow (L_3) provide better air-moisture relationship and improved physico-chemical as well as biological environment to groundnut crop than flatbed (L_1) planting resulting in spectacular yield improvement. The fact that the yield was significantly augmented in broad bed furrow (L_3) as compared to flatbed (L_1). These reasons are supported by the findings of Patra *et al.* (1996), and Gore (2012) [8, 3].

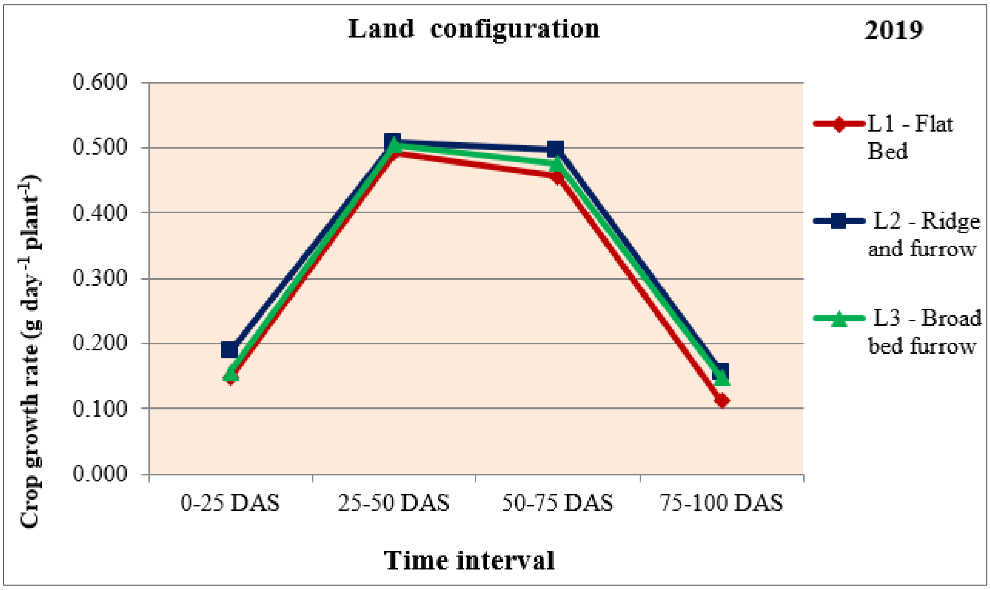
The recorded data on pod and haulm yields revealed the fertility levels differed significant among themselves. Among different nutrient management system, significantly the highest pod and haulm yields (3.72 and 7.10 t ha^{-1}, respectively) were recorded under 100% RDN+ 5 t FYM ha^{-1} (N_3). Treatments, 100% RDN+ foliar spray of 2% DAP (N_4), 100% RDN+ foliar spray of 0.5% zinc sulphate (N_5) and 100% RDN + foliar spray of 0.2% boron (N_6) being at par each other and significantly superior than 100% RDN (N_2) and absolute control (N_1). However, 100% RDN (N_2) was also showed its superiority over absolute control (N_1). The lowest pod and haulm yield (2.38 and 5.42 t ha^{-1}, respectively) were obtained with absolute control (N_1). Pod yield increased in 100% RDN+ 5 t FYM ha^{-1} (N_3) was 22.05 and 36.08 per cent, over 100% RDN (N_2) and absolute control (N_1), respectively. The haulm yield was also increased by 10.20 and 23.68 per cent under former treatment than later. Production of higher pod and haulm yield by treatment 100% RDN + 5 t FYM ha^{-1} (N_3) was a result of higher growth and yield attributes. The increased pod yield was attributed to significant improvement in growth analysis components. Similar result was reported by several workers (Chitdeshwari *et al.*, 2007; Murthy *et al.*, 2009 and Thomas and Thenua, 2010) [5, 2, 10]. Further, the significant increase in haulm yield in 100% RDN+ 5 t FYM ha^{-1} (N_3) treatment over others was as a result of highest growth analysis characters. These results were in conformity with the findings of Mohapatra and Dixit (2010) [4].

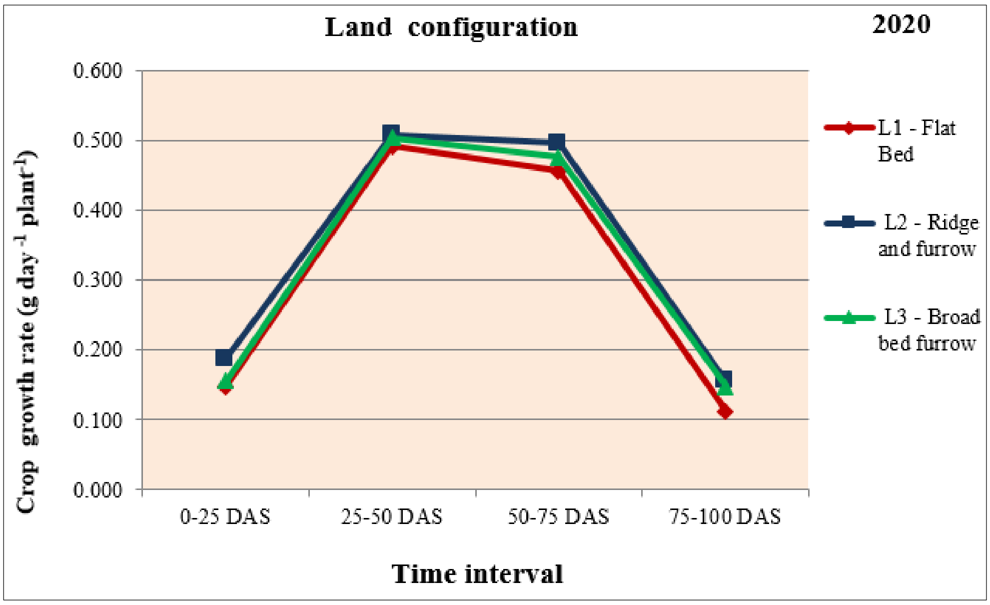
Table 1: Effect of land configuration and nutrient management on leaf area index of *kharif* groundnut at different time intervals

Treatment	Leaf area index								
	25 DAS			50 DAS			75 DAS		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
Land configuration									
L_1 - Flat Bed	0.54	0.62	0.58	2.09	2.19	2.14	3.83	4.06	3.95
L_2 - Ridge and furrow	0.76	0.85	0.81	2.46	2.60	2.53	4.39	4.60	4.49
L_3 - Broad bed furrow	0.67	0.77	0.72	2.30	2.45	2.38	4.14	4.32	4.23
CD (5%)	0.08	0.05	0.06	0.10	0.12	0.11	0.13	0.16	0.14
Nutrient management									
N_1- Absolute control	0.52	0.61	0.57	1.93	2.02	1.98	3.67	3.81	3.74
N_2- 100% RDN	0.64	0.74	0.69	2.18	2.31	2.25	4.01	4.16	4.08
N_3- 100% RDN+ 5 t FYM	0.80	0.91	0.86	2.65	2.80	2.73	4.60	4.89	4.74
N_4- 100% RDN+ foliar spray of 2% DAP at 30 DAS	0.68	0.76	0.72	2.33	2.46	2.39	4.15	4.37	4.26
N_5- 100% RDN+ foliar spray of 0.5% $ZnSO_4$ at 30 DAS	0.66	0.74	0.70	2.31	2.46	2.39	4.16	4.39	4.27
N_6- 100% RDN+ foliar spray of 0.2% boron at 30 DAS	0.64	0.72	0.68	2.28	2.42	2.35	4.13	4.35	4.24
CD (5%)	0.06	0.07	0.06	0.08	0.10	0.09	0.09	0.23	0.16

Table 2: Effect of land configuration and nutrient management on leaf area duration of *kharif* groundnut at different time intervals

Treatment	Leaf area duration (days)								
	25 DAS			50 DAS			75 DAS		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
Land configuration									
L_1 - Flat Bed	6.75	7.75	7.25	32.88	35.13	34.00	48.99	51.12	50.06
L_2 - Ridge and furrow	9.50	10.63	10.06	40.25	43.13	41.69	60.57	63.03	61.80
L_3 - Broad bed furrow	8.38	9.63	9.00	37.13	40.25	38.69	55.50	57.65	56.58
CD (5%)	0.98	1.05	1.01	2.05	1.73	1.89	2.78	2.90	2.84
Nutrient management									
N_1- Absolute control	6.50	7.63	7.06	30.63	32.88	31.75	45.04	45.85	45.44
N_2- 100% RDN	8.00	9.25	8.63	35.25	38.13	36.69	52.37	53.92	53.15
N_3- 100% RDN+ 5 t FYM ha^{-1}	10.00	11.38	10.69	43.13	46.38	44.75	65.61	69.15	67.38
N_4- 100% RDN+ foliar spray of 2% DAP at 30 DAS	8.50	9.50	9.00	37.63	40.25	38.94	56.05	58.38	57.21
N_5- 100% RDN+ foliar spray of 0.5% $ZnSO_4$ at 30 DAS	8.25	9.25	8.75	37.13	40.00	38.56	55.92	58.65	57.29
N_6- 100% RDN+ foliar spray of 0.2% boron at DAS	8.00	9.00	8.50	36.50	39.25	37.88	55.14	57.65	56.40
CD (5%)	0.73	0.93	0.83	1.42	1.74	1.58	2.06	3.10	2.58





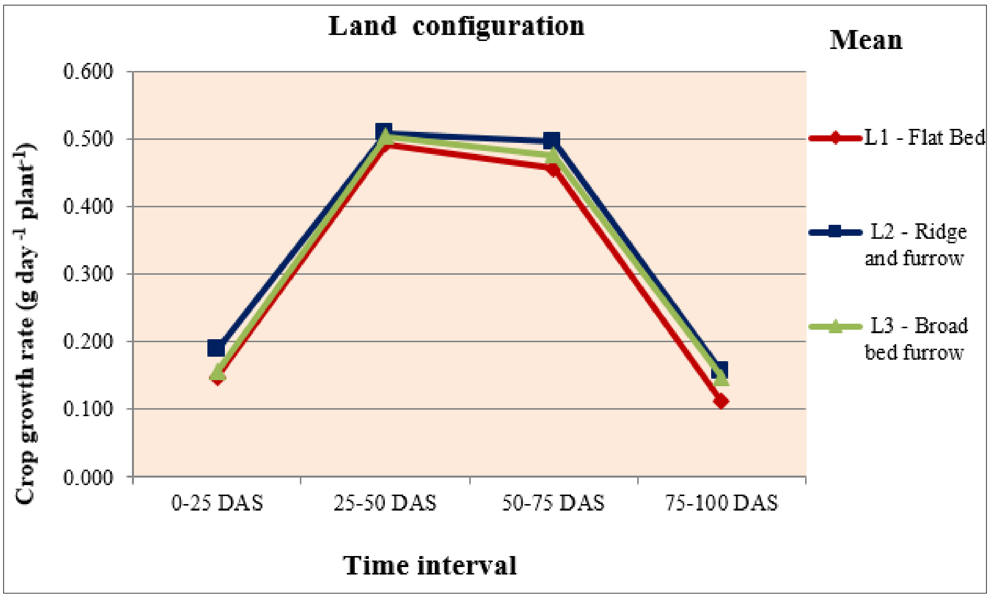
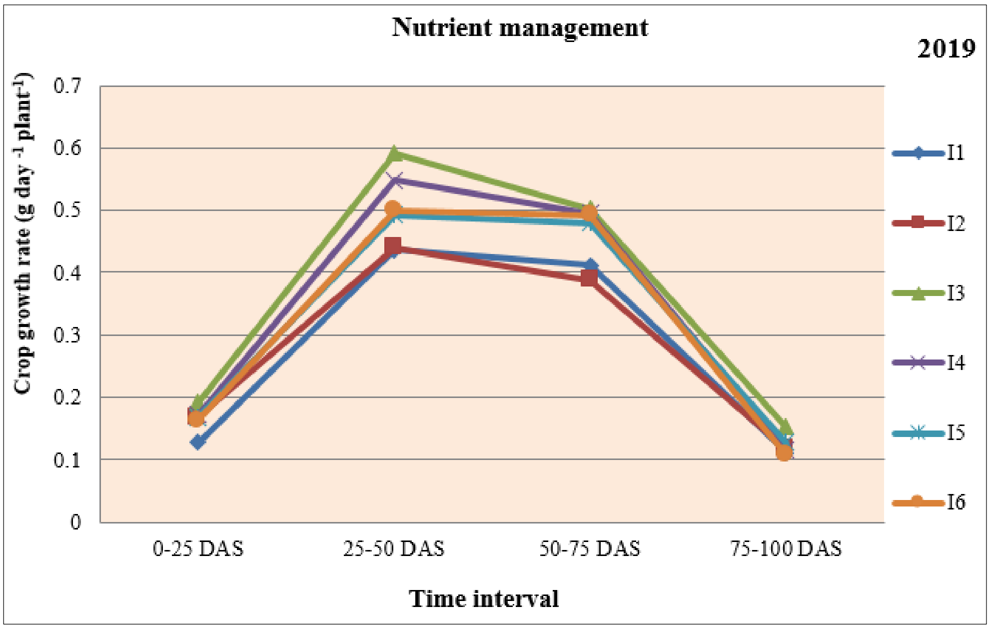
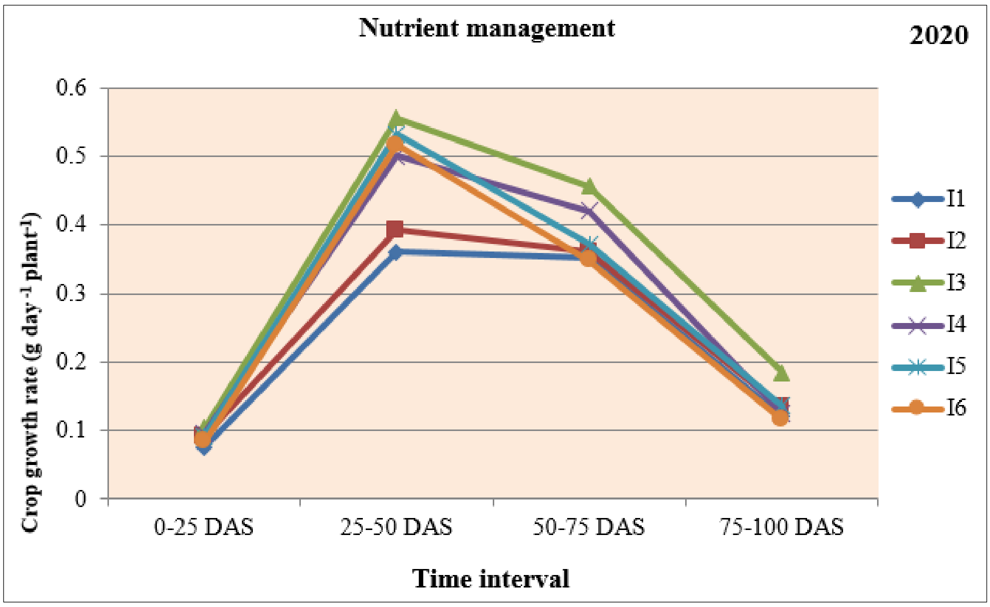


Fig 1: Effect of land configuration on crop growth rate of *kharif* groundnut at different time intervals





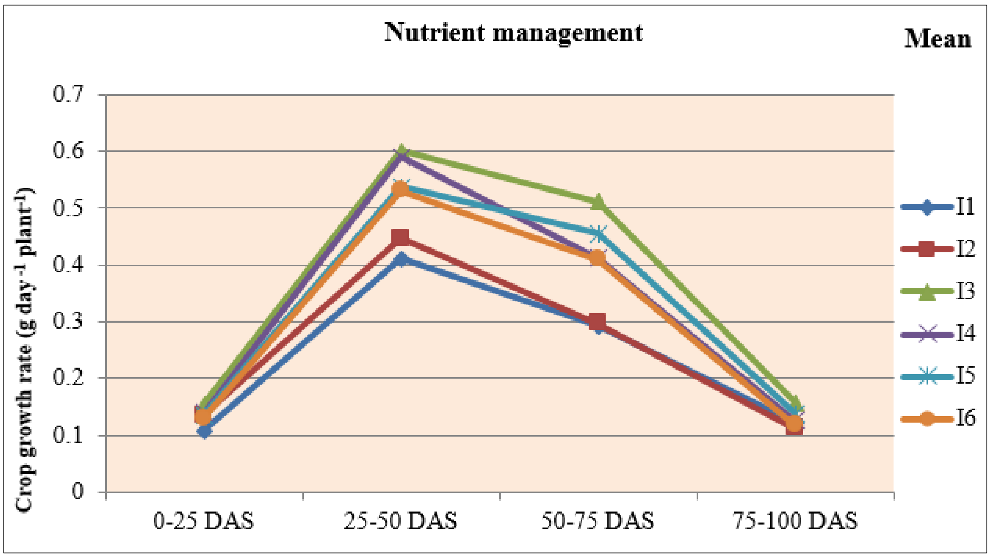
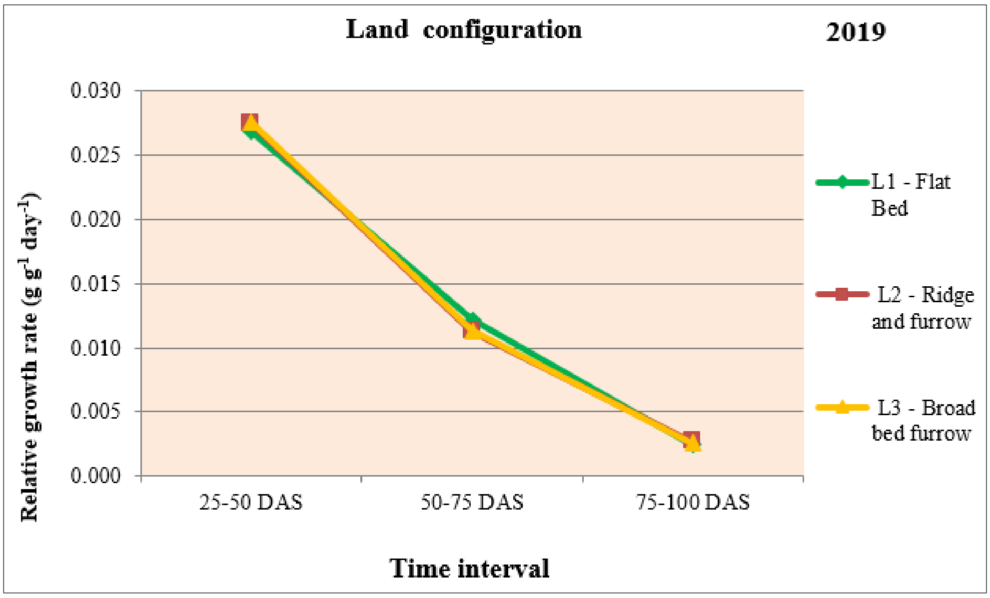
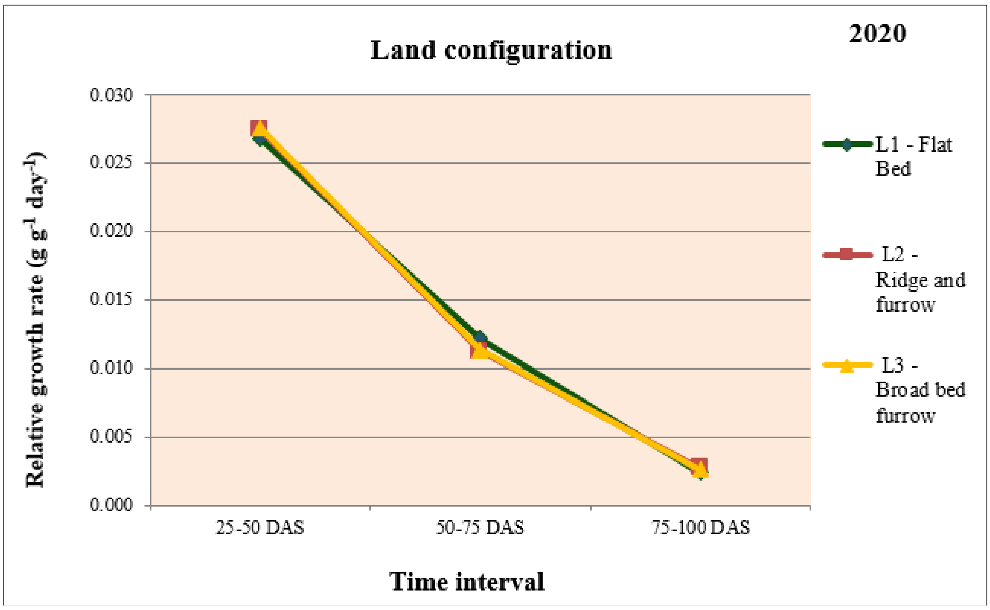


Fig 2: Effect of nutrient management on crop growth rate of *kharif* groundnut at different time intervals





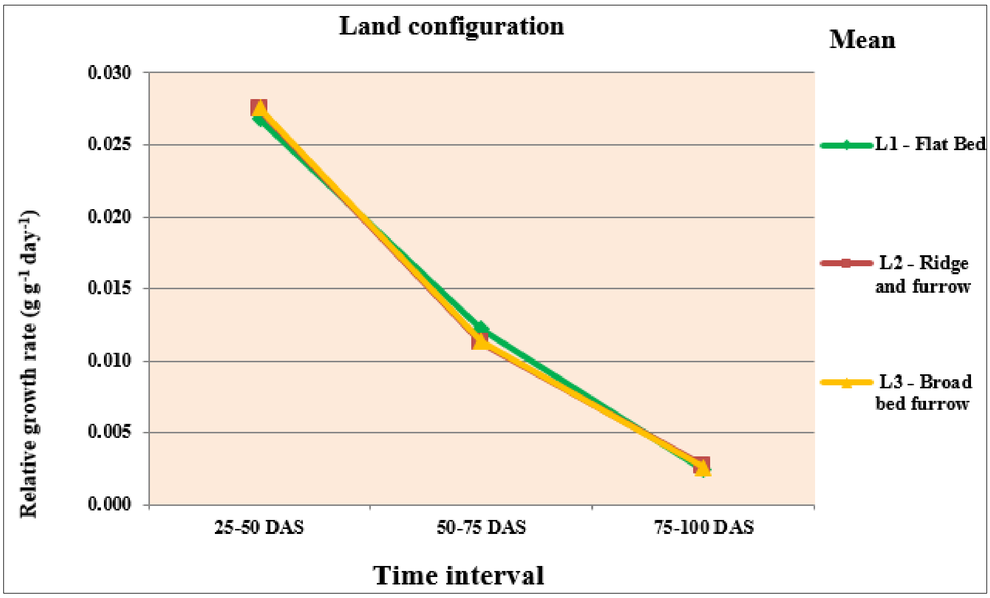
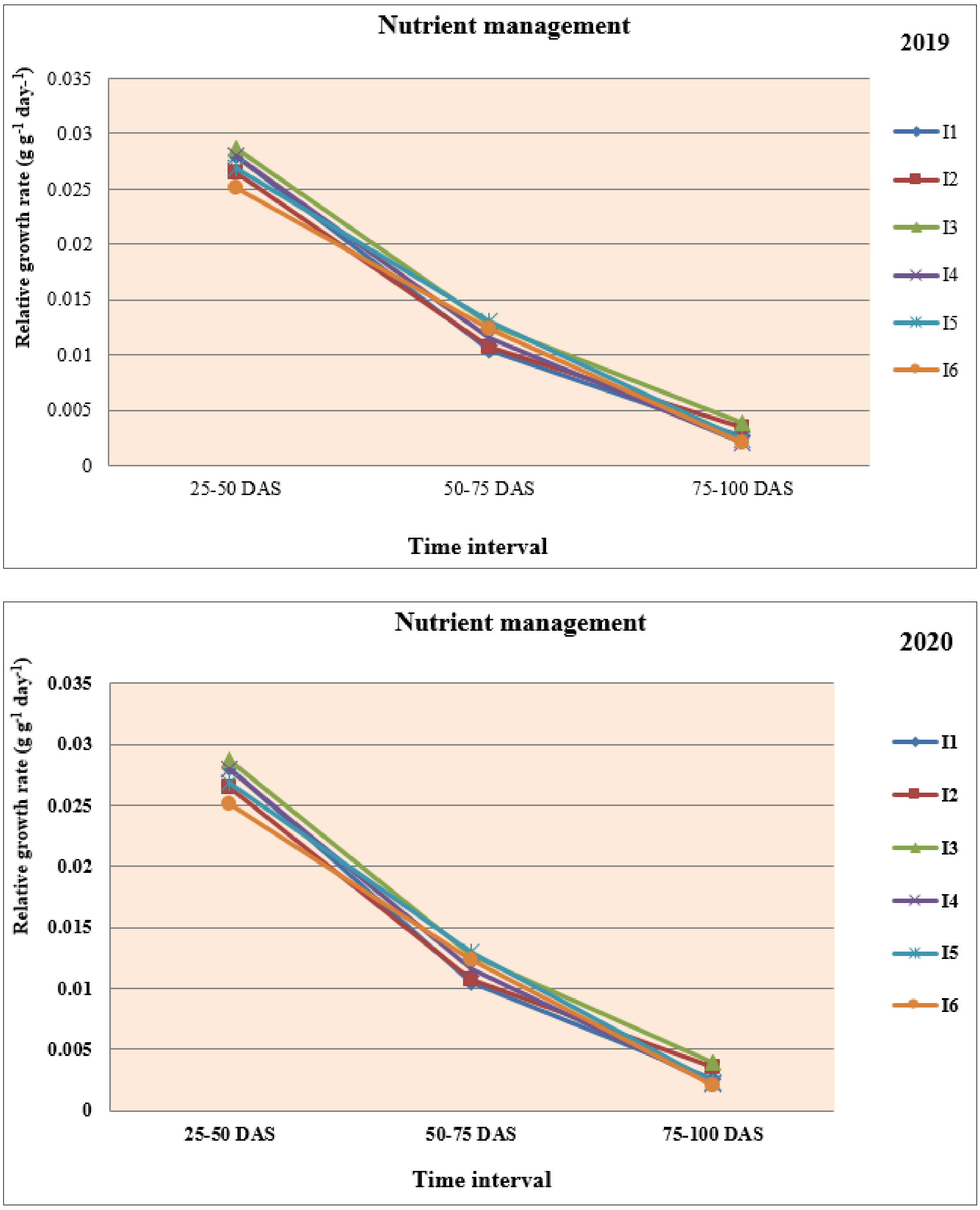


Fig 3: Effect of land configuration on relative growth rate of *kharif* groundnut at different time intervals



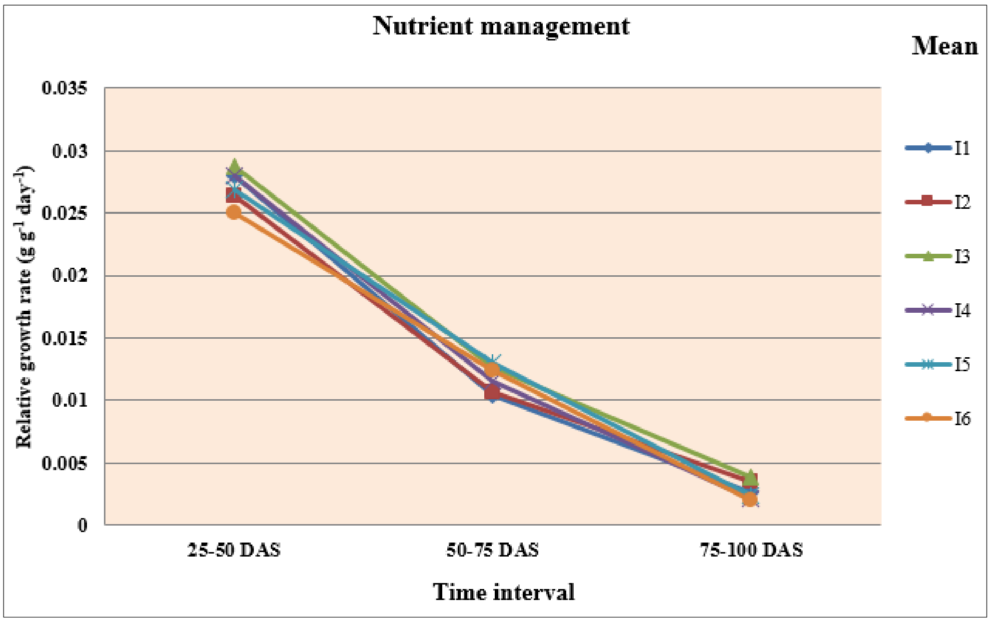
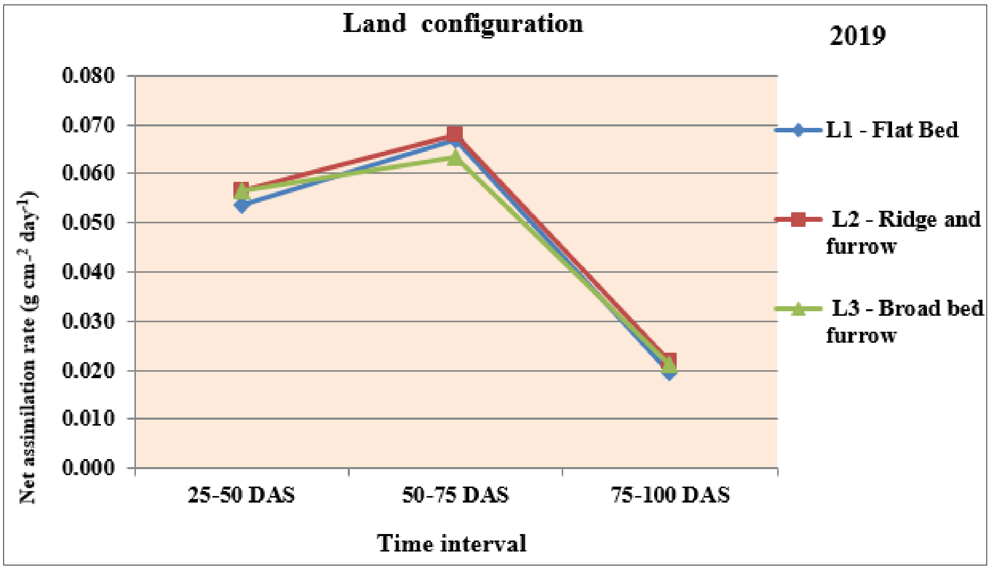
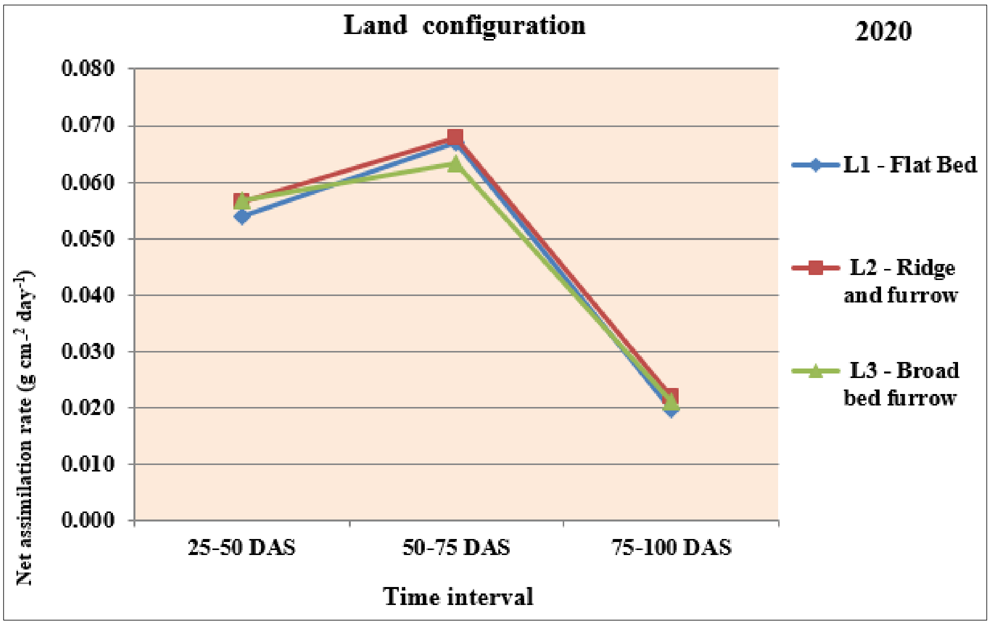


Fig 4: Effect of nutrient management on relative growth rate of *kharif* groundnut at different time intervals





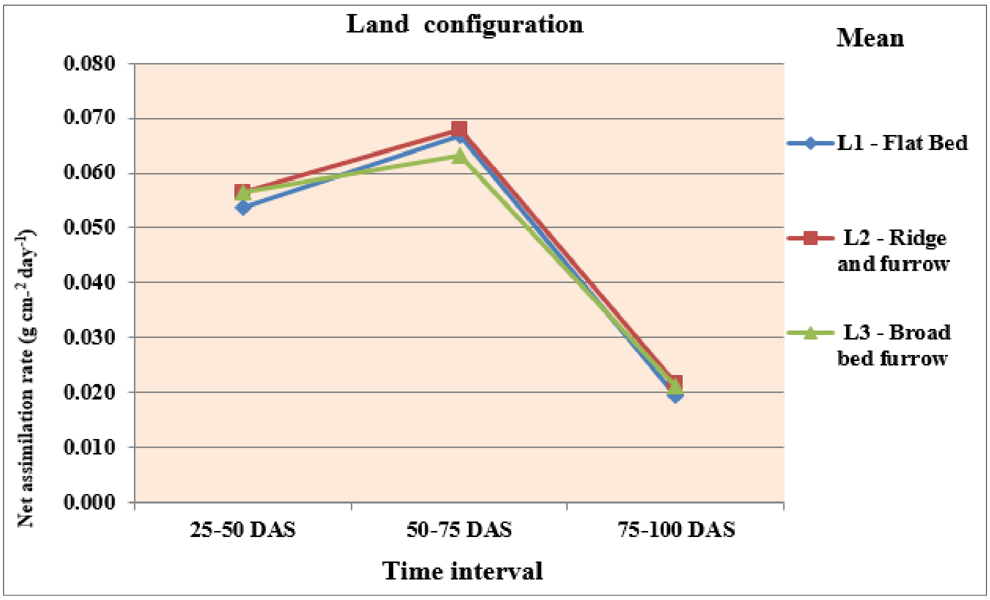
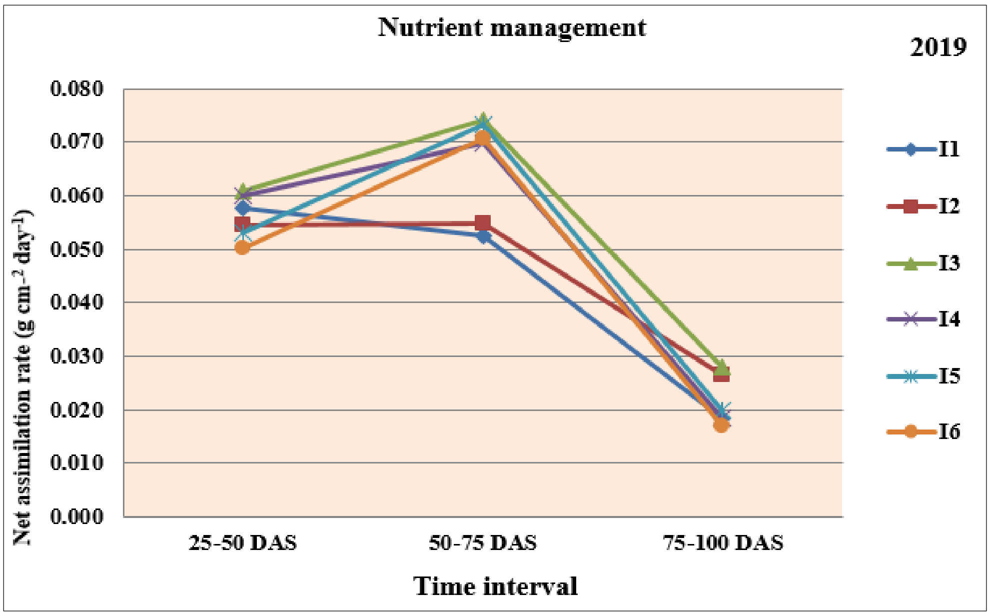
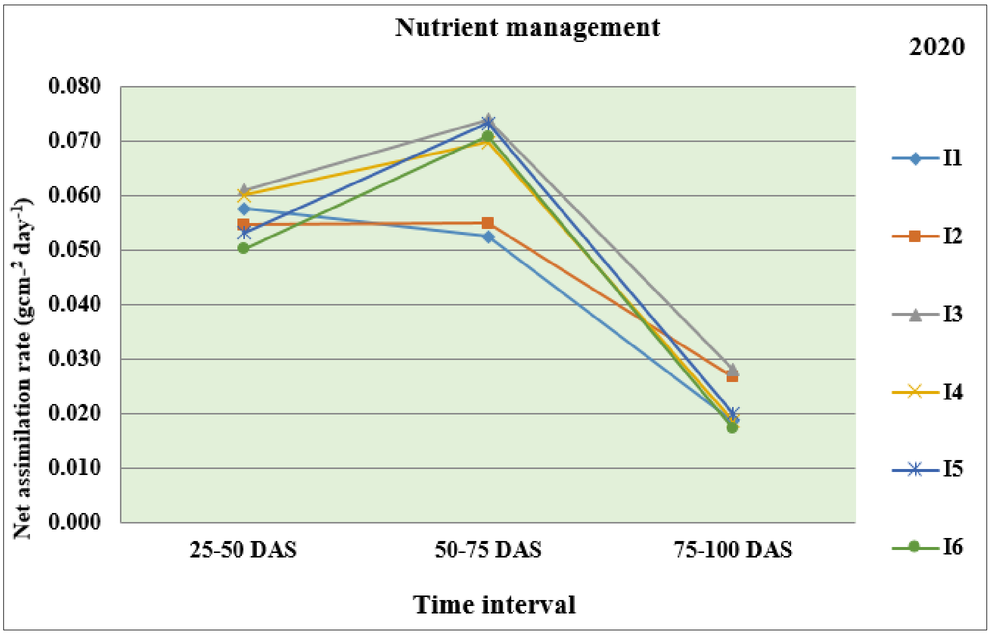


Fig 5: Effect of land configuration on net assimilation rate of *kharif* groundnut at different time intervals





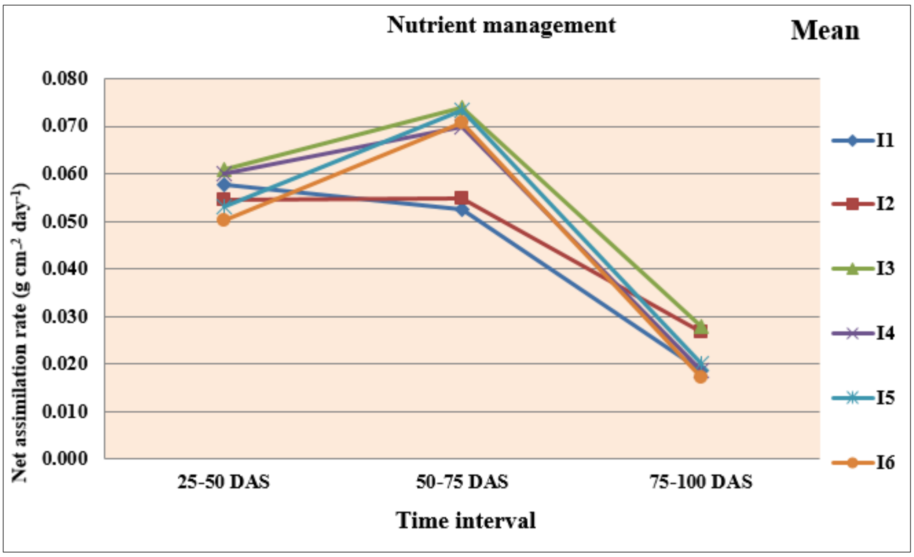


Fig 6: Effect of nutrient management on net assimilation rate of *kharif* groundnut at different time intervals

Table 3: Effect of land configuration and nutrient management on pod and haulm yield of *kharif* groundnut

Treatment	Pod yield (t ha^{-1})			Haulm yield (t ha^{-1})		
	2019	2020	Mean	2019	2020	Mean
Land configuration						
L_1 - Flat Bed	2.55	2.71	2.63	5.84	6.24	6.04
L_2 - Ridge and furrow	3.29	3.63	3.46	6.76	7.39	7.08
L_3 - Broad bed furrow	2.96	3.22	3.09	6.17	6.63	6.40
CD (5%)	0.23	0.16	0.19	0.25	0.27	0.26
Nutrient management						
N_1- Absolute control	2.27	2.48	2.38	5.20	5.64	5.42
N_2- 100% RDN (30, 60 and 30 kg N, P_2O_5 and K_2O ha^{-1})	2.78	3.02	2.90	6.12	6.64	6.38
N_3- 100% RDN+ 5 t FYM ha^{-1}	3.59	3.86	3.72	6.82	7.38	7.10
N_4- 100% RDN+ foliar spray of 2% DAP at 30 DAS	3.03	3.29	3.16	6.50	7.00	6.75
N_5- 100% RDN+ foliar spray of 0.5% Zinc sulphate at 30 DAS	2.97	3.23	3.10	6.46	6.95	6.71
N_6- 100% RDN+ foliar spray of 0.2% boron at 30 DAS	2.96	3.21	3.09	6.43	6.90	6.67
CD (5%)	0.20	0.15	0.17	0.27	0.30	0.28

Conclusions

Land configuration system ridge and furrow (L_2) produced the highest growth analysis (LAI, LAD and CGR) as well as pod and haulm yields. Among the nutrient management practices, 100% RDN+ 5 t FYM ha^{-1} (N_3) recorded the maximum values of growth parameters, pod yield and haulm of groundnut under investigation.

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