EFFECT OF CROP GEOMETRY ON GROWTH, YIELD AND ECONOMICS OF RABI GROUNDNUT

E. Aruna*, A. Pratap Kumar Reddy

Agricultural Research Station, Utukur, Kadapa –PIN-516 003, India

Received – August 22, 2019; Revision – September 19, 2019; Accepted – October 09, 2019
Available Online – October 15, 2019

DOI: http://dx.doi.org/10.18006/2019.7(5).477.480

ABSTRACT

A field experiment was conducted during rabi seasons of 2017 and 2018 at Agricultural Research Station, Utukur, Kadapa, Andhra Pradesh. The experiment was laid out in RBD design with eight spacings viz., 22.5 cm x10 cm, 20 cm x10 cm, 17.5 cm x10 cm, 15cm x 10 cm, 22.5 cm x 8 cm, 20 cm x 8 cm, 17.5 cm x 8 cm and 15cm x 8 cm with three replicates. The test variety kadiri-6 (popular variety grown during rabi season) was sown on 16th and 20th October 2017 and 2018 respectively. Results of present study revealed that planting groundnut in narrow spacing of 15cm x 8 cm have higher pod yield of 3981 kg ha\(^{-1}\) (19% more compared to recommended spacing 22.5 cm x10 cm) which was significantly not differ from 15 cm x10 cm (3801 kg ha\(^{-1}\)) spacing. Planting groundnut in narrow spacing increases the seed rate by 150 kg ha\(^{-1}\) while the net monetary benefit was of Rs 18000/- ha\(^{-1}\). From the results of study it can be concluded that narrow spacing is best option for ground nut crop in rabi season.

* Corresponding author
E-mail: arunaettapu@gmail.com (E. Aruna)

KEYWORDS
Rabi groundnut
Crop geometry
Growth
Yield
Economics
1 Introduction

Groundnut is one of the world’s most popular crops cultivated in tropical and sub-tropical regions. It is a leguminous oil seed crop which contains 45-50% oil, 20-26% protein, 16-18% carbohydrate and 5% minerals (Gulluoglu et al., 2016). Because of its high nutritive value, it is called as wonder nut and poor men’s cashew nut. Though, India leads the world both in area and production of groundnut, the country ranks eighth in productivity. The low yield levels might be due to cultivation of the crop mostly in rain fed areas and in marginal lands with low inputs, low technology, poor plant population, inadequate fertilization and lack of plant protection. Plant density is one of the most important management factors affecting the groundnut growth, by changing the capacity to capture radiation, water and nutrients. Optimum plant density vary with the location as the response to plant density changes depending upon environmental conditions, genotype and sowing time. Hence, there is a need to establish optimum plant population per unit area of the field to get maximum yield (Morla et al., 2018). Though there is a recommendation of 190 kg ha⁻¹ with 22.5 cm x 10 cm spacing for rabi groundnut under irrigated conditions farmers are cultivating with higher seed rate of approximately 300 kg ha⁻¹ with narrow spacings of 15-17.5 cm x 10 cm. (ZREAC, 2016).

Further, Sowmya (2011) reported significantly higher growth characters viz., plant height, leaf area index, dry matter production, crop growth rate, relative growth rate as well as pod yield, haulm yield, kernel yield, harvest index and oil yield with increase in seed rate and were reported highest at seed rate @ 150 kg ha⁻¹ for groundnut. As the lion’s share of cost of cultivation of groundnut is involved in purchasing seed, the present investigation “Effect of crop geometry on growth, yield and economics of rabi groundnut” was taken up with the objectives to study the effect plant density on growth and yield of rabi groundnut and on increase in seed rate and to observe weed growth and pest population under high density.

2 Materials and Methods

A field experiment was conducted during rabi seasons of 2017 and 2018 at Agricultural Research Station, Utukur, Kadapa, Andhra Pradesh. The soil of the experimental site was analyzed and it was clayey loam with low nitrogen (139 kg ha⁻¹), high phosphorus (87 kg ha⁻¹) and potassium (460 kg ha⁻¹) with P₀ of 7.9 and EC of 0.06 dS/m. The experiment was laid out in randomized block design with eight spacings viz., 22.5 cm x 10 cm, 20 cm x 10 cm, 17.5 cm x 10 cm, 15 cm x 10 cm, 22.5 cm x 8 cm, 20 cm x 8 cm, 17.5 cm x 8 cm and 15 cm x 8 cm with three replications. Most popularly grown groundnut variety kadiri-6 was sown on 16th and 20th October in 2017 and 2018 respectively. Single seed was kept at each hill and seed rate was calculated accordingly for each plot. Recommended NPK of 30-40-50 kg ha⁻¹ was applied in the form of urea, SSP and MOP respectively. After 1st irrigation, weeds were removed by hoeing. All other agronomic practices were common to all spacings. Need based plant protection measures were taken up during the crop period. A sample of 5 plants was taken at random from the inner rows of each plot to measure the parameters related to plant growth and yields such as plant height, number of branches per plant, number of pods per plant, shelling percentage etc. The data thus collected was analyzed statistically by the analysis of variance technique and treatment means were compared using Duncan test at 5% level of probability (Steel et al., 1997).

3 Results and Discussion

3.1 Growth and yield characteristics

Remarkable effect of crop geometry on growth and yield characteristics of groundnut (K-6) was reported during both the study years (Table 1 & 2). Crop geometry did not have significant

| Initial plant population (lakh/ha) | Final plant population (lakh/ha) | Plant height (cm) | No. of branches | No. of pods/plant |
|-----------------------------------|---------------------------------|-------------------|-----------------|------------------|
| **2017**                          | **2018**                        | **2017**          | **2018**        | **2017**         |
| 22.5 cm x 10 cm                   | 3.46                            | 2.87              | 30.53           | 30.16¹           |
|                                  |                                 |                   | 4.26            | 4.76¹            |
|                                  |                                 |                   |                 | 28.80¹           |
|                                  |                                 |                   |                 | 21.73¹           |
| 20.0 cm x 10 cm                   | 3.74                            | 3.24              | 29.46           | 29.31¹           |
|                                  |                                 |                   | 4.20            | 4.40¹           |
|                                  |                                 |                   |                 | 28.73¹           |
|                                  |                                 |                   |                 | 18.36⁰           |
| 17.5 cm x 10 cm                   | 4.21                            | 3.33              | 29.76           | 28.34¹           |
|                                  |                                 |                   | 4.13            | 4.03³           |
|                                  |                                 |                   |                 | 28.73¹           |
|                                  |                                 |                   |                 | 17.83⁰           |
| 15 cm x 10 cm                     | 4.75                            | 3.61              | 32.86           | 31.74²           |
|                                  |                                 |                   | 3.93            | 4.43²           |
|                                  |                                 |                   |                 | 28.13¹           |
|                                  |                                 |                   |                 | 16.70⁰           |
| 22.5 cm x 8 cm                    | 3.77                            | 3.82              | 29.20           | 28.35³           |
|                                  |                                 |                   | 4.20            | 4.50³           |
|                                  |                                 |                   |                 | 26.86⁰           |
|                                  |                                 |                   |                 | 18.33⁰           |
| 20.0 cm x 8 cm                    | 4.04                            | 3.16              | 29.00           | 33.75⁰           |
|                                  |                                 |                   | 4.06            | 4.73³           |
|                                  |                                 |                   |                 | 26.00⁰           |
|                                  |                                 |                   |                 | 21.56⁰           |
| 17.5 cm x 8 cm                    | 4.49                            | 3.39              | 29.90           | 31.35²           |
|                                  |                                 |                   | 4.06            | 4.40³           |
|                                  |                                 |                   |                 | 24.00⁰           |
|                                  |                                 |                   |                 | 19.56⁰           |
| 15 cm x 8 cm                      | 5.05                            | 4.09              | 29.20           | 31.44²           |
|                                  |                                 |                   | 3.87            | 4.00³           |
|                                  |                                 |                   |                 | 25.00⁰           |
|                                  |                                 |                   |                 | 16.20⁰           |
| **Significance**                  |                                 |                   | **NS**          | **NS**          |
|                                 |                                 |                   |                 | **NS**          |
| **P value**                       |                                 |                   | 0.87            | 0.04            |
|                                 |                                 |                   |                 | 0.17            |
|                                 |                                 |                   |                 | 0.02            |
|                                 |                                 |                   |                 | 0.05            |
|                                 |                                 |                   |                 | 0.00            |

Table 1 Growth and yield of groundnut (K-6) as influenced by crop geometry
influence on plant height during 2017 whereas taller plants (33.75 cm) were recorded with 20 cm x 8 cm spacing which was at par with 17.5 cm x 8 cm and 15 cm x 8 cm during second year. The number of branches per plant was higher (4.26 and 4.76 respectively in 2017 and 2018) with wider row spacing of 22.5 cm for both the years (Table 1). Giayetto et al. (2003) also confirmed that the number of branches per plant was reduced with the increase in plant density. At low plant density, existing plants developed more branches and pegs because of reduced competition among the plants. Higher plant densities increases competition for growth resources such as nutrients, water and light and decreases productivity. El Naim et al. (2010) also reported similar findings that at closer spacing plants have fewer branches than at the wider spacing. The number of pods per plant were reported higher (28.8) with wider row spacing i.e 22.5 cm x 10 cm but it is not significantly different than all the other spacings except 17.5 cm x 10 cm during 2017 whereas, in 2018 significantly higher number of pods were recorded with 22.5 cm x 10 cm as compared to other row spacings except 20 cm x 8 cm (Table 1). When the groundnut was grown in low plant densities, plants will be benefited from more water, solar energy and nutrition resulting in higher pod number and pod weight per plant. These results are in agreement with the findings of Konlan et al. (2013) and Dapaah et al. (2014).

Shelling percentage and 100 kernel weight of groundnut were not significantly influenced by row spacing. A similar result of non-significant variation for hundred kernel weight was observed among different row spacings by Nayeem Ahmed et al. (2007). Higher pod yield (3325 kg ha\(^{-1}\)) was recorded with 15 cm x 10 cm spacing which was at par with 17.5 cm x 8 cm (3259 kg ha\(^{-1}\)) and 15 cm x 8 cm (3284 kg ha\(^{-1}\)) during 2017. While in 2018, narrow spacing of 15 cm x 8 cm (4681 kg ha\(^{-1}\)) have significantly higher pod yield (Table 2) and it was as at par with 17.5 cm x 10 cm (4431 kg ha\(^{-1}\)). Higher shelling percentage and pod yield during 2018 were due to favorable weather conditions for groundnut crop. Pooled analysis of yield indicated 19 per cent improvement in yield due to narrow spacing in groundnut. Konlan et al. (2013) also reported 16.0 % higher pod yield in narrow-row plantings than traditional wide-row crop.

### Table 2 Growth and yield of groundnut (K-6) as influenced by crop geometry

| Treatments       | Shelling percentage | 100 kernel weight (g) | Pod yield (kg ha\(^{-1}\)) | Pooled yield (kg ha\(^{-1}\)) |
|------------------|---------------------|-----------------------|----------------------------|-------------------------------|
|                  | 2017 | 2018 | 2017 | 2018 | 2017 | 2018 | 2017 | 2018 | 2017 | 2018 | 2017 | 2018 | 2017 | 2018 |
| 22.5 cm x 10 cm  | 66.67 | 76.33\(^{ab}\) | 36.54 | 34.66 | 2640 | 3812\(^{bc}\) | 3341\(^{cd}\) |
| 20.0 cm x 10 cm  | 72.33 | 77.00\(^{ab}\) | 36.14 | 35.50 | 2826 | 4158\(^{b}\) | 3492\(^{cd}\) |
| 17.5 cm x 10 cm  | 71.33 | 76.33\(^{ab}\) | 36.57 | 35.83 | 2871 | 4278\(^{b}\) | 3535\(^{cd}\) |
| 15 cm x 10 cm    | 72.50 | 77.33\(^{ab}\) | 35.73 | 33.66 | 3325 | 4431\(^{ab}\) | 3801\(^{ab}\) |
| 22.5 cm x 8 cm   | 72.83 | 77.16\(^{ab}\) | 35.34 | 34.16 | 2857 | 4187\(^{b}\) | 3522\(^{cd}\) |
| 20.0 cm x 8 cm   | 67.90 | 77.66\(^{ab}\) | 35.41 | 34.66 | 2840 | 4172\(^{b}\) | 3546\(^{bc}\) |
| 17.5 cm x 8 cm   | 71.50 | 76.83\(^{ab}\) | 36.72 | 31.83 | 3259 | 4253\(^{b}\) | 3715\(^{bc}\) |
| 15 cm x 8 cm     | 73.83 | 77.33\(^{ab}\) | 36.20 | 34.33 | 3284 | 4681\(^{b}\) | 3981\(^{ab}\) |

Significance: NS NS NS NS * ** *

P value: 0.16 0.28 0.97 0.56 0.05 0.00 0.05

Years 2017 2018

Significance: ** **

P value: 0.00

3.2 Economics

It is imperative that narrow row spacing increases the seed rate (Table 3). Seed rate ranged from 180 kg ha\(^{-1}\) in recommended spacing (22.5 cm x 10 cm) to 333 kg ha\(^{-1}\) at narrow spacing (15 cm x 8 cm) which resulted in extra cost of Rs 13,770 ha\(^{-1}\) over control. But there is 19 per cent improvement in yield over
Effect of crop geometry on growth, yield and economics of rabi groundnut

The net monetary benefit due to narrow spacing in groundnut was Rs 18,320/- ha⁻¹.

Conclusion

From the result of current study, it can be concluded that higher pod yield (3981 kg ha⁻¹) can be obtained by narrow spacing of 15 cm x 8 cm by using higher seed rate of 333 kg ha⁻¹. Further, it was also reported that high plant population per unit area in narrow spacings covers the ground quickly due to its vegetation resulting in less weeds and reduction in weeding costs.

Conflicts of interest and financial disclosures

No conflict of interest exist.

References

Dapaah HK, Mohammed I, Awuah RT (2014) Growth Yield Performance of Groundnuts (Arachis hypogaea L.) in Response to Plant Density. International Journal of Plant and Soil Science 3:1069-1082.

El Naim AM, Eldouma, MA, Abdalla, AE (2010) Effect of weeding frequencies and plant population on vegetative growth characteristics of groundnut (Arachis hypogaea L.) in North Kordofan of Sudan. International Journal of Applied Biology and Pharmaceutical Technology 1 : 1188-1193.

Giayetto O, Cerioni GA, Amsn MS (2003) Use of asymptotic model to obtain optimum plant density in peanut (Arachis hypogaea L.). Journal of Peanut Science 32 (1): 1-6.

Gulluoglu L, Bakal H, Onat B, Kurt C, Arioglu H (2016) The Effect of Harvesting Dates on Yield and Some Agronomic and Quality Characteristics of Groundnut Grown in Mediterranean Region (Turkey). Turkey Journal of Field Crops 21: 224-232.

Konlan S, Sarkodie-addo J, Asareand E, Kombiok MJ (2013) Groundnut (Arachis hypogaea L.) Varietal Response to Spacing in the Guinea Savanna Agro-Ecological Zone of Ghana. Growth and Yield. African Journal of Agriculture Research 8: 2769-2777.

Morla FD, Giayetto O, Fernandez EM, Cerioni GA, Cerliani C (2018) Plant density and peanut crop yield (Arachis hypogaea) in the peanut growing region of Córdoba (Argentina). Peanut Science 45: 82-86.

Naeem Ahmad, Mohammad Rahim, Ulas Khan (2007) Evaluation of Different Varieties, Seed Rates and Row Spacing of Groundnut, Planted under Agro-Ecological conditions of Malakand Division. Journal of Agronomy 6: 385-387.

Sowmya (2011) Standardization of seed rate for promising groundnut varieties under rainfed conditions of southern telangana zone of Andhra Pradesh, M.Sc. Thesis submitted to the Acharya N. G. Ranga Agricultural University, Andhra Pradesh, India.

Steel RGD, Torrie, JH and Dickey DA (1997) Principles and Procedures of Statistics, A Biometrical Approach. 3rd Edn. McGraw-Hill Co. Inc., New York.

ZREAC (2016) Zonal Research and extension council proceedings of southern zone, Acharya N. G. Ranga Agricultural University, Andhra Pradesh, India.

Table 3 Economics of higher seed rate in groundnut (K-6) during rabi season

| Treatments | Pod yield (kg ha⁻¹) | Seed rate (kg ha⁻¹) | Cost of the seed Rs ha⁻¹ | Extra cost over control (Rs) | Improvement in yield over control (kg ha⁻¹) | Extra income over control (Rs ha⁻¹) |
|------------|---------------------|---------------------|-------------------------|-----------------------------|------------------------------------------|----------------------------------|
| 22.5 cm x 10 cm | 3341² | 180 | 16,200 | - | - | - |
| 20.0 cm x 10 cm | 3492³ | 198 | 17,820 | 1620 | 151 | 7550 |
| 17.5 cm x 10 cm | 3535³ | 225 | 20,250 | 4050 | 194 | 9700 |
| 15 cm x 10 cm | 3801⁴ | 277 | 24,930 | 8730 | 460 | 23,000 |
| 22.5 cm x 8 cm | 3522³ | 220 | 19,800 | 3600 | 181 | 9050 |
| 20.0 cm x 8 cm | 3546⁴ | 240 | 21,600 | 5400 | 205 | 10,250 |
| 17.5 cm x 8 cm | 3715⁶ | 280 | 25,200 | 9000 | 374 | 18,700 |
| 15 cm x 8 cm | 3981¹ | 333 | 29,970 | 13,770 | 640 | 32,000 |