RUFORUM Working Document Series (ISSN 1607-9345) No. 14 (3): 135-140.
Available from http://repository.ruforum.org

Research Application Summary

The effects of plant density on growth and yield of groundnuts

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Abstract

Groundnut (A*rachis hypogea*) is one of the grain legumes that is widely grown by smallholder farmers in Malawi. The yield and quality of groundnut is affected by a number of factors such as plant density. A study was conducted at Exagris Africa farm in Salima district of Malawi in the 2015/2016 growing season to evaluate the effect of plant density on the growth and yield of groundnut. Groundnut was planted at three densities: 89000, 178000 and 285000 plants per hectare. The experiment was laid out in a randomized complete block design with four replicates. The results show that plant density has no effect on stem diameter and leaf length of groundnut. However, the number of leaves per plant was higher at low plant density. Also, plants with a density of 285000 plants/ha grew taller and gave higher pod yield than lower density (89000 and 178000 plants ha^{-1}) treatments.

Key words: Groundnut, growth parameters, Malawi, plant density, yield

Résumé

L'arachide (*Arachis hypogea*) est l'une des légumineuses graines largement cultivées par les petits exploitants au Malawi. Le rendement et la qualité de l'arachide sont affectés par un bon nombre de facteurs tels que la densité des plantes. La présente étude a été conduite à la ferme Exagris Africa dans le district de Salima au Malawi pendant la saison végétative 2015/2016 pour évaluer l'effet de la densité de semis sur la croissance et le rendement de l'arachide. L'arachide a été plantée à trois densités à savoir 89000, 178000 et 285000 plantes par hectare. L'expérimentation a été menée suivant un dispositif de bloc aléatoire complet avec quatre répétitions. Les résultats montrent que la densité de semis n'a aucun effet sur le diamètre de la tige et la longueur des feuilles de l'arachide. Toutefois, le nombre de feuilles par plante était plus élevé à faible densité de semis. De plus, les plantes ayant une densité de 285 000 plantes/ ha ont grandi en hauteur et donné un rendement de gousses plus élevé que les traitements à faible densité (89 000 et 178 000 plantes ha^{-1}).

Mots clés: arachide, paramètres de croissance, Malawi, densité de la plante, rendement

Introduction

Groundnut is one of the grain legumes that is widely grown by smallholder farmers in Malawi. The current recommended density of sole cropped groundnut is 89000 plants/ha (GoM, 2012). Plant density is one of the key agronomic practices that influence growth, yield and quality of groundnut. Optimum density ensures minimal competition between species and efficient capture and utilization of growth resources below and above ground to optimize grain seed yield (Johnson *et al*., 1982). According to Howlader *et al*. (2009), the yield of erect type groundnut can be maximized with closer spacing (30 cm × 10 cm) while spreading or semi-spreading type groundnut will yield optimally at a spacing of 40 cm × 20 cm. In Malawi, the recommended plant density of CG7, one of the groundnut varieties grown by smallholder farmers is 89000 plants per hectare (75 cm x 15 cm x 1 seed) (GoM, 2012). At this spacing, the potential yield for CG7 is 2500 kg/ha. However, yields higher than this have been recorded. It is not clear whether the recommended plant population of CG7 is optimum or not. Therefore, this study was undertaken to evaluate the effect of different plant densities on the growth and yield of groundnut variety CG7.

Materials and methods

The experiment was conducted during the 2015-2016 growing season at Mpatsanjoka farm for Exagriss Africa Limited in Salima District of Malawi. Mpatsanjoka farm is located at S13º42.740', E034º28.879' along the lakeshore. The altitude of the district is generally low ranging from 400 to 1000 metres above sea level. The annual rainfall ranges from 600 to 800 mm (GoM, 2012). Soil are sandy loams.

The groundnut variety CG7 was planted at three densities of 89000, 178000 and 285000 plants/ha. Planting for the two lower plant density treatments was done on 50 cm wide raised beds. For the lowest density, one row was planted per bed, with an intra-row spacing of 15cm while for the 178000 plants/ha density, two rows were planted per bed with a spacing of 25 x 15cm. For the high density planting (285000 plants/ha), planting was done on a 90cm wide bed in three rows spaced at 25 x 7 cm. Net plot size was 8 m by 8 m. The crop was sown on 24th December, 2015.

Early in the growth of the crop, five plants were randomly selected from each plot and tagged for subsequent data collection. Stem diameter, stem length, plant height, leaf number and leaf length of these plants were measured at 4, 8 and 12 weeks after planting. At harvest, yield (pod weight) was measured. The data collected were subjected to analysis of variance using Genstat computer package 16th edition. Treatments means were compared using the Least Significant Difference (LSD) test at 5 % probability level.

Results and discussion

Plant density had no significant effect on stem diameter from 4 to 12 weeks after planting (Fig. 1). This may be because of the genetic ability of the plant (Sousa *et al*., 2014). However, there were significant differences in length of leaves among the diferent plant densities at 4

weeks, 8 weeks and 12 weeks after planting. The length of leaves per plant increased with decrease in plant density (Fig. 2). This could be due to less intraplant competition at lower plant densities (Giayetto *et al.*, 1995).

As shown in Figure 3, there were no significant diferences in plant height at 4 and 8 weeks after planting between the three plant densities. This shows that there was no intraplant competion during early stages of groundnut growth. However, at 12 weeks after planting, plant density was positively related to plant height ($p<0.05$). This can be attributed to competition for light and space. A study by Farnham (2001) and Awal and Aktar (2015)

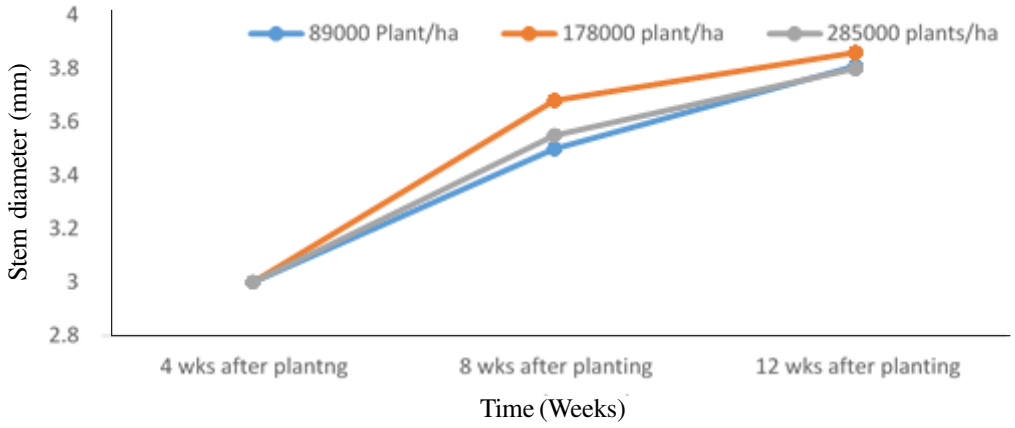

Figure 1. Groundnut stem diameter at differrent plant densities

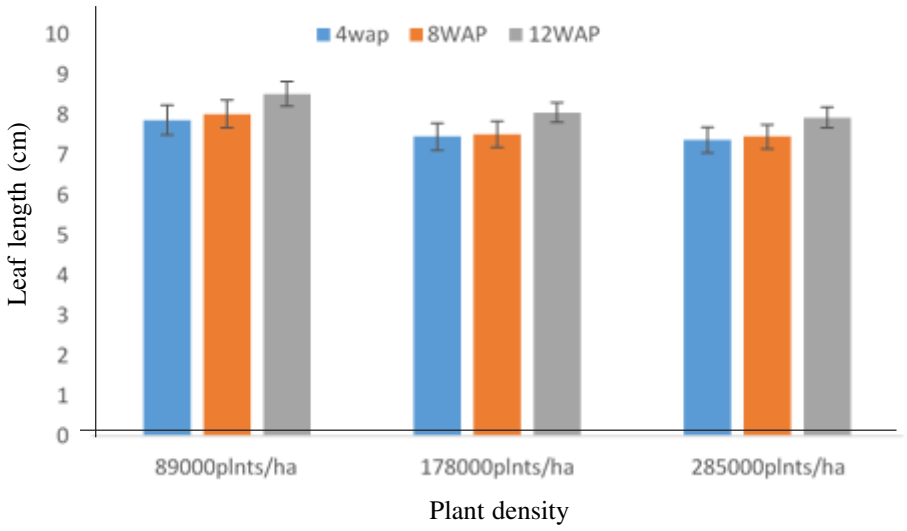

Figure 2. Groundnut leaf length at differrent plant densities

reported that higher densities can significantly reduce canopy as plants grow vertically to compete for space and light.

There were no significant diferences in number of leaves at 4 weeks after planting between the three plant densities. This is expected as the crop was still in the juvenile stage where there was no competetion for resources (Fig. 4). However, the effect of crop density became significant for number of leaves at 8 weeks and 12 weeks after planting ($p<0.05$), with number of leaves per plant increasing with the decrease in plant density. This can be as a result of increased canopy area which takes advantage of more available space for horizontal growth compared to the space available to closely spaced crop. However, close spacing resulted in complete and early canopy closure, consistent with the findings of Brown *et al.* (2005) and Tillman *et al.* (2006).

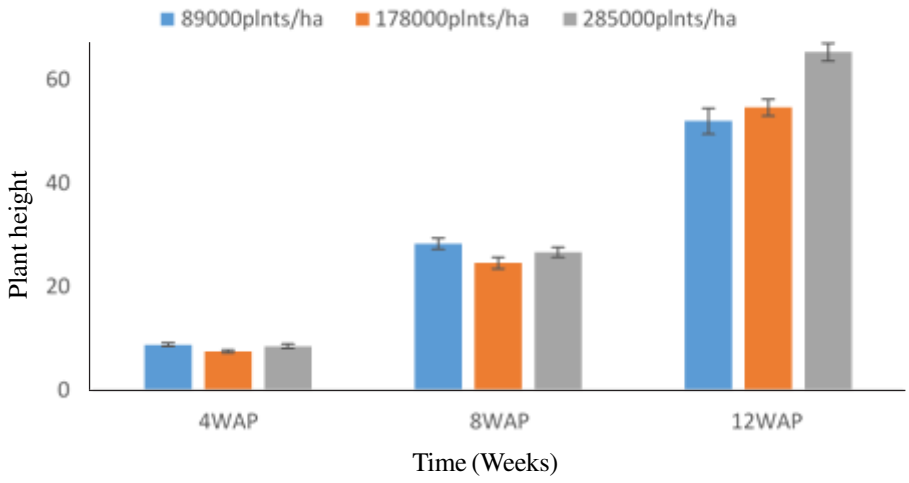

Figure 3. The plant height of groundnut overtime at three plant densities

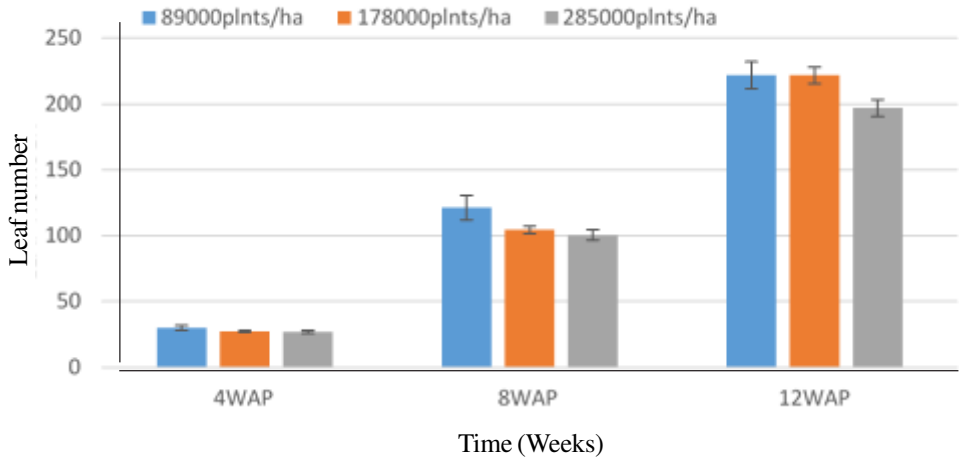

Figure 4. Number of leafs over time at three densities of groundnut

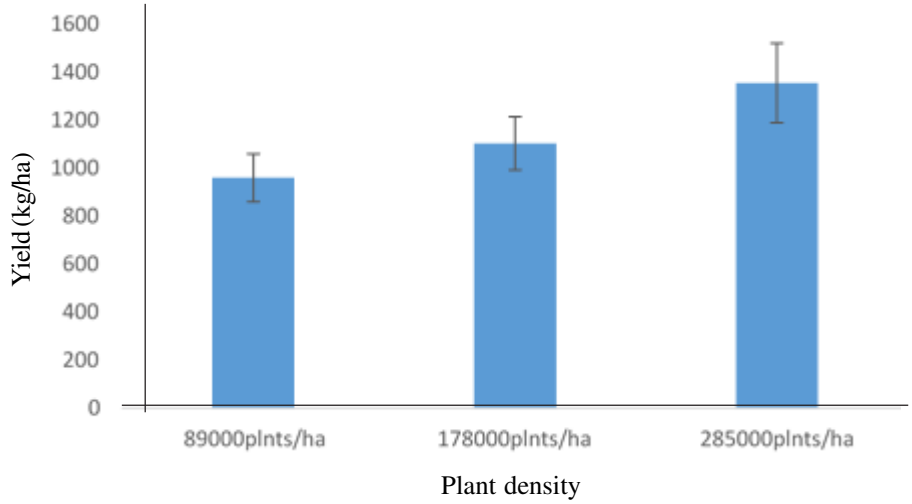

Figure 5. Pod yield of groundnut grown at three densities 2015/2016 season

There were significant difference in grain yield ($p<0.05$) across the three plant densities (Fig. 5). Plant densities of 89000, 178000 and 285000 had grain yield of 960.9, 1104 and 1356 kg/ha, respectively. These were all below the crop's potential yield of 2500 kg/ha (GoM, 2012) but above the average groundnut production in Malawi which ranges from 350-750 kg/ha.

Conclusion and recommendations

It can be concluded that apart from stem diameter, plant density influences the rest of the agronomic traits including grain yield in groundnuts. From the study, it is recommended that for the groundnut cultivar in question, and probably for other cultivars, farmers should adopt high density planting (285,000 plant/ha) to maximize land use and yield.

Acknowledgement

This paper is a contribution to the 2016 Fifth African Higher Education Week and RUFORUM Biennial Conference.

References

Awal, M.A. and Aktar, L. 1996. Effect of row spacing on the growth and yield of peanut (*Arachis hypogaea* L.) stands. 3 (1):7–11.

Brown, S.L., Culbreath, A.K., Todd, J.W., Gorbet, D.W., Baldwin, J.A., Coolman, R.M. and Hoyt, G.D. 2005. Increasing sustainability by intercropping. *Hor. Technol.* 3 (3):309-311.

Farnham, D.E. 2001. Row spacing, plant density, and hybrid effects on corn grain yield and moisture. *Agronomy Journal* 93:1049-1053.

Giayetto, O., Cerioni, G. A. and Asnall, W. E. 1995. Effect of sowing spacing on vegetative growth, dry matter production, and peanut pod yield.

Government of Malawi. 2012. Guide to Agriculture Production. Ministry of Agriculture, Irrigation and Water Development. Lilongwe, Malawi.

Howlader, S.H., Bashar, H.M.K., Islam, M.S., Mamun, M.H., Jahan, S.M.H., Science, P. and Officer, S. 2009. Effect of plant spacings on the yield and yield attributes of groundnut 4:41–44.

Johnson, R.R., Green, D.E. and Jordan, C.W. 1982. What is the best soybean row width? Australian perspective. *J. Crops and Soils* 34: 10-13.

Sousa, G.G., De Azevedo, B.M., De Newdmar, C., Fernandes, V. and Vinicius, T. 2014. Crescimento, trocas gasosas e produtividade do amendoim sob frequência de. pp. 27–34.

Tillman, B.L., Gorbet, D.W., Culbreath, A.K. and Todd, J.W. 2006. Response of peanut cultivars to seeding density and row patterns. Online. *Crop Management* doi: 10.1094/CM-2006-0711-01-RS.