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Response of Groundnut (*Arachis Hypogaea* L.) to Nitrogen Levels and Plant Geometry

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ABSTRACT

A field experiment was conducted at the Agricultural College Farm, Bapatla on sandy upland soils during post-monsoon, 2018. The experiment consisted of four levels of nitrogen and four population densities laid out in randomized block design with factorial concept. The results revealed that among the four levels of nitrogen, application of 60 kg N ha^{-1}, recorded the highest drymatter accumulation, yield attributes (number of pods plant^{-1}, number of pops plant^{-1}), pod and haulm yield and soil available nutrient. Crop geometry with 15 cm x 10 cm spacing resulted in higher drymatter accumulation, number of pods plant^{-1} and pod and haulm yield.

Keywords: *Groundnut, nitrogen levels, population densities, drymatter accumulation, yield attributes, pods, pops, pod yield, haulm yield, soil available, Nutrients.*

Groundnut (*Arachis hypogaea* L.) is one of the most important and unique legume cum oilseed crop grown particularly in southern and western parts of India. Groundnut is an important source of edible oil in India and world. Its importance lies in high oil (45%) and protein (26%) content and minerals like iron, calcium and phosphorus.

Fertilizer management is a key factor in improving groundnut production with the recent changes in global agricultural commodity market. Yield is a function of plant density and hence, planting density is highly associated with yield potential and optimum density per unit area is an important non-monetary input to decide the maximum productivity of the crop. Optimum plant population and nutrient dose are necessary factors recognized to derive yield potential of a cultivar.

Ammonium-sulphate applied as a source of 'N' is readily soluble in water and has a strong acidifying action on the soil. Ammonium ion is absorbed by negatively charged colloids in the soil and its mobility through leaching is hence reduced. As a result, the availability of nutrients like phosphorus, sulphur, zinc and iron increases which can easily be taken by the plants thus resulting in the higher pod yield. Sulphur in the fertilization also play an important role in synthesis of proteins, oils and essential amino acids.

MATERIAL AND METHODS

A field experiment was conducted at the Agricultural College Farm, Bapatla on sandy upland soils during *post-monsoon,* 2018 on response of groundnut (*Arachis hypogaea* L.) to nitrogen levels and plant geometry**.** The experiment was laid out in a randomized block design with factorial concept in three replications. The treatments consisted of four levels of nitrogen (ammonium sulphate as source) *viz*., 0 , 30 , 60 and 90 kg ha^{-1} and four levels of population densities viz., 30 x 10 cm , 25 x 10 cm, 20 x 10 cm and 15 x 10 cm. Nitrogen at 60 kg ha^{-1} and 90 kg ha^{-1} were applied in three splits i.e., 1/3rd as basal, 1/3rd at 30 DAS and 1/3rd at 60 DAS. Phosphorous and potassium were applied at the rate of 40 kg ha^{-1} and 50 kg ha^{-1} respectively as basal dose to all the treatments uniformly. Gypsum was applied at early flowering stage @ 500 kg ha^{-1}. The soil was sandy in texture, near neutral in reaction, low in organic carbon (0.15 %), and in available nitrogen (120 kg ha^{-1}) and medium in available phosphorus (29.2 kg ha^{-1}) and potassium (168 kg ha^{-1}). The rainfall during the crop growth period was 191.2 mm. The data on drymatter production, yield attributes, yield and soil available nutrients were recorded and subjected to statistical analysis.

RESULTS AND DISCUSSION

Drymatter accumulation (kg ha^{-1})

Increase in nitrogen levels from 0 kg N ha^{-1} to 90 kg N ha^{-1} resulted in higher drymatter production (Table 1). Application of 90 kg N ha^{-1} resulted in significantly higher drymatter accumulation of 10166 kg ha^{-1} but was on par with 60 kg N ha^{-1} and superior to 30 kg N ha^{-1} and 0 kg N ha^{-1}. It was probably because of the enhanced crop growth with higher levels of nutrients, which enhanced photosynthesis and hence

Table 1. Growth, yield attributes and yield of groundnut as influenced by nitrogen levels and population densities

Treatments	Drymatter accumulation (kg ha^{-1})	No. of pods plant^{-1}	No. of pops plant^{-1}	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
Nitrogen levels (N)					
N1: 0 kg N ha^{-1}	6374	11.88	2.42	2404	4487
N2: 30 kg N ha^{-1}	8176	14.96	1.72	3065	5597
N3: 60 kg N ha^{-1}	9447	16.82	1.36	3631	6257
N4: 90 kg N ha^{-1}	10166	17.57	0.99	3850	6597
SEm±	258	0.54	0.06	103	120
CD (P=0.05)	746	1.57	0.17	297	340
Population densities (D)					
D1: 30 x 10 cm	7061	18.1	1.69	2732	4588
D2: 25 x 10 cm	7766	16.08	1.63	2979	5175
D3: 20 x 10 cm	8793	13.85	1.60	3382	5977
D4: 15 x 10 cm	10543	13.18	1.56	3857	7180
SEm±	258	0.54	0.06	103	120
CD (P=0.05)	746	1.57	NS	297	340
Interaction (N x D)					
SEm±	517	1.09	0.12	206	241
CD (P=0.05)	NS	NS	NS	NS	NS
CV%	10.5	12.3	12.8	11	7.3

Table 2. Available nitrogen, phosphrous and potassium in soil after harvest of groundnut as influenced by nitrogen levels and population densities.

Treatments	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})
Nitrogen levels (N)			
N1: 0 kg N ha^{-1}	91.2	43.2	261.7
N2: 30 kg N ha^{-1}	147.1	42.5	258.9
N3: 60 kg N ha^{-1}	168.2	42	244.8
N4: 90 kg N ha^{-1}	184.8	35.4	231.7
SEm±	6.1	2.4	10.2
CD (P=0.05)	17.4	NS	NS
Population densities (D)			
D1: 30 x 10 cm	162.0	44.0	268.07
D2: 25 x 10 cm	153.6	42.1	253.02
D3: 20 x 10 cm	143.1	39.2	243.11
D4: 15 x 10 cm	132.5	37.9	237.87
SEm±	6.1	2.4	10.2
CD (P=0.05)	NS	NS	NS
Interaction (N x D)			
SEm±	12.3	4.7	20.3
CD (P=0.05)	NS	NS	NS
CV (%)	14.4	20.08	14.14

resulted in accumulation of higher quantity of drymatter. This is in accordance with the results reported by Sengupta *et al.* (2016), Karunakaran *et al.* (2010) and Meena *et al*. (2011).

Population density with 15 cm x 10 cm spacing resulted in significantly superior drymatter accumulation (10543 kg ha^{-1}) compared to other population densities. The lowest drymatter accumulation was found with 30 cm x 10 cm spacing (7061 kg ha^{-1}). Drymatter accumulation differed significantly with population densities and increased with increase in population density, this might be due to increase in plant population per unit area. Increase in drymatter accumulation with increase in plant density was also reported by Priya *et al.* (2016) and Kathirvelan and Kalaiselvan (2006).

Yield Attributes

The number of pods per plant and pops per plant was influenced significantly due to levels of nitrogen. Application of 90 kg N ha^{-1} proved superior to other levels producing 17.57 pods per plant; however it was on par with 60 kg N ha^{-1}. The minimum numbers of pods were observed in the control plot. Significantly higher numbers of pops (2.42) were observed in control compared to other levels. The lowest numbers of pops of 0.99 were observed at 90 kg N ha^{-1}. Elevated levels of nitrogen resulted in greater availability of nutrients to plant and thus greater utilization of assimilates into pods and in turn increased number of pods per plant. The reduction in number of pops with increasing nitrogen fertilization might be due to greater production of source for the sink and better pod filling. These results are in accordance to Waghmode *et al*. (2017) and Chaudhary *et al*. (2015).

Pod number increased significantly with decrease in population density (18.10) with 30 x 10 cm spacing however, it was on par with 25 cm x 10 cm. Lowest numbers of pods was observed with the closest spacing of 15 cm x 10 cm. Availability of sufficient space for individual plants (at spacing of 30 cm x 10 cm) might have helped the crops to grow vigorously and hence producing more pegs and pods per plant. These results are in accordance with the findings of Chaudhary *et al.* (2018) and Waghmode *et al*. (2017). The interaction was however found to be non- significant for both number of pods and pops per plant.

Yield (kg ha^{-1})

With the increase in levels of nitrogen, yield increased significantly (Table 1). Nitrogen application @ 90 kg N ha^{-1} produced significantly superior pod yield of 3850 kg ha^{-1} over 30 and 0 kg N ha^{-1} and was on par with 60 kg N ha^{-1}. Haulm yield also responded positively producing higher haulm yield with 90 kg N ha^{-1} (6597 kg ha^{-1}) and on par with 60 kg N ha^{-1} (6257 kg ha^{-1}) compared to 30 and 0 kg N ha^{-1}. The lowest pod yield and haulm yield was recorded in control plot. Increased level of nitrogen fertilization created better condition for formation, growth and development of vegetative and reproductive organs in groundnut, thereby increasing seed haulm yield. These results are in line with those of Waghmode *et al*. (2017) and Meena *et al*. (2013).

Pod yield differed significantly with population densities. Higher pod yield (3857 kg ha^{-1}) was obtained with the closest spacing of 15 cm x 10 cm. Pod yield gradually decreased with decrease in population and lowest yield of 2732 kg ha^{-1} was observed with 30 cm x 10 cm. Population densities also produced significant result with higher haulm yield of 7180 kg ha^{-1} produced from the closer spacing of 15 cm x 10 cm. The increase in pod yield might be due to increased sink capacity and better availability of growth factors under narrow row spacing. Though number of pods per plant was higher with wider spacing of 30 cm x 10 cm but it was not exhibited on yield per unit area. The increase in haulm yield is due to more number of plants per unit area. These results are in line with those of Choudhary *et al*. (2018), Waghmode *et al*. (2017) and Haricharan Reddy *et al.* (2014).

Soil Available Nutrients (kg ha^{-1})

Available nitrogen in soil after harvest of groundnut was significantly influenced by nitrogen levels (Table 2). Levels of nitrogen failed to produce significant effect on soil available phosphrous and potassium. Population densities and their interaction also did not produce any significant result. Application of nitrogen @ 90 kg N ha^{-1} resulted in significantly higher available soil N however; it was on par with 60 kg N ha^{-1}. The lower available soil nutrients were observed from control plots. The nutrients retained in the soil after harvest of the crop mainly depends on both supply of nutrients through various sources and uptake by the crop. Split application with ammonium form of nitrogen might have reduced loss of nutrients, in terms of leaching, volatilization as well as denitrification and as a result increasing available nitrogen content. These results are in conformity with the findings of Sengupta *et al*. (2016) and Karunakaran *et al.* (2010).

CONCLUSION

It can be concluded from the present investigation that maximum pod yield can be obtained by the application of 60 kg N ha^{-1} and with a spacing of 15 cm x 10 cm which can be advisable under rainfed conditions of Coastal Andhra Pradesh.

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