Impact of Nitrogen fertilizer on growth and yield of groundnut (*Arachis hypogaea L*)genotypes in northeast climate of Afghanistan

Abstract

A field experiment was conducted at the agronomic farm of Kunduz University during summer season of 2023 to evaluate effect of nitrogen fertilizer on spreading and bunch genotypes of groundnut, the experiment laid out in randomized complete block design with split arrangement each replicated thrice, both groundnut genotypes and nitrogen fertilizer were significantly affected on growth, yield component and yield of groundnut, between groundnut genotypes spreading genotype was best on growth and yield of groundnut, the maximum plant height (31.15cm), branches/plant (9.39), LAI (4.75), dry matter (5,170.04 kg/ha),pod weight (21.98gr/plant), 100 kernel weight (71.53gr), Pod yield (2,504.64kg/ha) and Biological Yield (7,674.69 kg/ha) were in spreading genotype compared to bunch genotype, Nitrogen fertilizer also affected on growth and yield of groundnut, the maximum plant height (32.61cm), branches/plant (10.05), LAI (5.20) and dry matter (5,533.55kg/ha), Pods/plant (32.30), Kernel/pod (2.23), pod weight (24.46gr/plant), 100 kernel weight (76.38gr), Pod yield (2,890.00kg/ha) and Biological Yield (8,423.55kg/ha) were in spreading genotype compared tobunch genotype. Therefore application of 45 kg N/ha along with groundnut spreading genotype is the best combination for groundnut productivity in northeast of Afghanistan.

Key Words: bunch, genotype, groundnut, growth, Nitrogen, spreading, yield

Introduction

Groundnut (*Arachis hypogaea* L) is a crucial legume oilseed crop, and is also known as peanut, earth nut, monkey nut and goober. Locally it is called *Pali* and *Mumpali*in Pashto and *Badam-e-zamini*in Dari language. It is thirteenth most important crop of the world, fourth important source of vegetable oil and third important source of vegetable protein, Groundnut seed contains nearly 50% high quality edible oil, 25% digestible protein and 20% carbohydrates, The crop contain valuable source of E, K and B vitamin (it is the richest plant source of thiamin, B1). The groundnut protein consists of two type's proteins, namely, arachin and conarachin.*26* Amino Acid analysis shown that the main amino acid was glutamic acid (22-27) %, arginine (11-13%), aspartic acid (8-13%) (*Nazir et al., 2023* and *Sadiq et al., 2023*). Groundnut is cultivated worldwide in tropical, sub-tropical and warm temperature regions between 40^0 N and 40^0 S latitude. The global area under groundnut cultivation is 31.57 million hectare with total product 53.64 million tones, the average production is 1.691 ton ha^{-1} (*FAO, 2022*).Among the nutrients nitrogen, phosphorus, potassium, plays an important role in the nutrition of groundnut crop. Soil application of nutrients leads to losses of nutrients in the form of leaching, volatilization and fixation affecting the nutrient use efficiency. Hence, an attempt has been made to increase the crop yield through foliar application of fertilizer along with basal soil application. It is the most versatile legume because of drought tolerant characters, soil restoring properties, weeds smothering, and multi-purpose confectionary and dilatory uses. As a legume oil yielding crop, it has an important place in most of the cropping systems (*Vinod Kumar et al 2017).*Nitrogen (N) is a major element in crop production throughout the world. This nutrient is themost crucial for upgrading soil fertility and improving crop productivity (*Fageria., 2008)*. The application of urea has been a common practice in Afghanistan in recent years to meet crop N requirements and increase yields. However, N mainly supplied in the form of urea fertilizers is among the most highly consumed energy resources for crop production in Afghanistan, as shown in previous studies. The application of chemical fertilizers has adverse impacts on the environment in terms of different categories (*Soltani et al., 2010 and Khaleeq., 2023c)*.Such as nutrient leaching, salinity and acidification of agricultural soils, emission of greenhouse gases, and accumulation of chemical residues (*Rosenstock et. al 2014 and Farkhari et al., 2023).* Therefore, appropriate use of fertilizers in agriculture is essential for limiting the environmental impact of conventional farming (*Hasler et al 2015*). Peanut is a significant oil and food crop, grown mainly for the production of oil (seed oil 43–55%) (*Hemmat et al., 2023* and *Hosseinzadeh et al., 2009*). The crop is cultivated primarily for human consumption and has several uses either as whole seeds or as a processed product for use in peanut butter, oil, and other products. The cultivation of peanut globally covers a total area of 24.07 million ha, most of which (11.45 million ha) is located in Asia. The global production of peanut pods is 37.64 million tons per annum (*FAO. 2017*). Nitrogen (N) is required by plants in comparatively larger amounts than other elements. As a crop of Leguminosae family, groundnut can fix as much as 40-80 kg N ha-1 yr^{-1} about 86-92% of the N taken up by the groundnut comes from Biological Nitrogen Fixation (BNF)which is equivalent to 125-178 kg N ha^{-1}. Although legumes can fix their own N, they often need phosphorus and calcium and other nutrients for good seed formation (*Asied et al., 2000*).

Materials and Methods

A Field experiment was conducted at the agronomic research farm of Kunduz University to investigate effect of Nitrogen fertilizer on groundnut spreading and bunch genotypes, the experimental design was randomized complete block design with Split arrangement with two factors each replicated thrice, the main plots were groundnut genotypes *viz*. spreading genotype and Bunch genotype and subplots were Nitrogen fertilizer *viz.* 0 kg N/ha, 15 kg N/ha, 30 kg N/ha and 45 kg N/ha. Treatment combinations were spreading+0 kg N/ha, spreading+15 kg N/ha, spreading+30 kg N/ha, spreading+45 kg N/ha, Bunch+0 kg N/ha, Bunch+15 kg N/ha, Bunch+30 kg N/ha, Bunch+15 kg N/ha. The gross plot size was 3×4=12 m^2 net plot size was 10 m^2, the experiment site was sandy loan in soil texture, alkaline in reaction (7.4), medium in organic carbon (0.44 %) The gross plot size was 12m^2 net plot was 10m^2, Groundnut genotypes were sown manually on 16th March 2023 with the 30 x 10 cm spacing and 4cm depth and Sowing was done under dry condition with recommended seed rate of 120 kg/ha. Irrigation was given just after sowing, phosphorus and Nitrogen were applied through single super phosphate and urea respectively, the full dose of phosphorus was applied as basal application at final layout preparation, nitrogen was applied based on treatments, half of nitrogen was applied when sowing remaining nitrogen was applied after 25 and 35 days after sowing, The analysis of variance (one–way ANOVAs) was used to determine treatment effects Standard error of means (SEm$\pm$) and least significant difference [LSD (p=0.05)] level of significance worked out for each parameter.

Result and Discussion

Effect of nitrogen on growth parameters of groundnut genotypes

The scientific analysis of variance revealed on table (1) groundnut genotypes were significantly affected on branches/plant and leave area index, the highest branches/plant (9.39) and leave area index (4.75) were in spread genotype compared to bunch genotype, there were no significantly affected on plant height and dry matter accumulation. Nitrogen fertilizer was significantly affected on plant height, Branches/plant, LAI and Dry Matter, the highest plant height (32.61 cm), Branches/plant (10.05), LAI (5.20) and Dry Matter (5,533.55 kg/ha) were in 45 kg N/ha followed by 30 kg N/ha, the minimum growth parameters were in 0 kg N/ha. Similar finding with*G. Bekele et al. (2019) andSamim et al. (2023)* reported application of nitrogen fertilizer significantly increased plant height, branches/plant and dry matter accumulation, application of 46 kg N/ha increased plant height, branches/plant and dry natter accumulation compared to control. *Khaleeq et al.(2023a)* reported Nirogen fertilizer significantly increased growth parameters of common bean, application of 40 kg N/ha increased plant height, Dry matter accumulation, Branches/plant and leave area index over the control.

Table (1): Effect of nitrogen fertilizer and groundnut genotypes on growth parameter

Treatments	Plant Height (cm)	Branches/plant	LAI	Dry Matter (kg/ha)
Genotypes				
Bunch	28.71	7.86	4.33	4,252.67
Spread	31.15	9.39	4.75	5,170.04
SE m±	0.918	0.161	0.021	163.152
CD (P=0.05)	NS	1.054	0.137	NS
Nitrogen Fertilizer (kg/ha)				
0 kg N/ha	27.42	7.39	4.14	4,187.71
15 kg N/ha	28.27	8.22	4.35	4,370.83
30 kg N/ha	31.41	8.83	4.47	4,753.35
45 kg N/ha	32.61	10.05	5.20	5,533.55
SE m±	0.532	0.299	0.664	214.202
CD (P=0.05)	1.658	0.931	0.213	667.334

Effect of nitrogen on productivity of groundnut genotypes

Groundnut genotypes were significantly affected on pod weight, Pod yield and Biological Yield, the highest yield attributes and yield, pod weight gr/plant, Pod yield and Biological Yield was on spreading genotypes while pods/plant, kernel/pod. 100 kernel weight and shelling % were did not affected by groundnut genotypes.

Nitrogen fertilizer was significantly affected on yield attributes and yield of groundnut, the highest pods/plant (32.30), kernel/pod (2.23), pod weight (24.46gr/plant), 100 kernel weight (76.38gr), Pod yield (2,890.00kg/ha) and Biological Yield (8,423.55 kg/ha) were in 45 kg N/ha followed by 30 kg N/ha, the minimum yield attributes and yield was in 0 kg N/ha.*Nazir et al. (2023)* reported groundnut genotype was significantly affected by spreading and bunch genotypes, the maximum pods/plant, kernel/pod, pod weight, 100 seed weigh weight, pod weight and haulm yield was in spreading genotype compared with bunch genotype. *Khaleeq et al. (2023b)* reported nitrogen fertilizer was significantly affected on yield component and yield of mungbean, the highest pods/plant, seeds/pod, 100 seed weight, weight of pods/plant, pod yield, biological yield and straw yield was in treatment with 40 kg N/ha over control.

Table (2): groundnut productivity as affected by nitrogen fertilizer and groundnut genotypes

Treatments	Pods/ plant	Kernel/ pod	pod weight gr/plant	100 kernel weight gr	shelling %	Pod yield kg/ha	Biological Yield kg/ha
Genotypes							
Bunch	28.19	1.79	18.13	67.41	66.21	2,274.69	6,527.36
Spread	29.40	1.86	21.98	71.53	65.77	2,504.64	7,674.69
SE m±	1.754	0.080	0.374	0.915	0.396	28.247	151.667
CD (P=0.05)	NS	NS	2.452	NS	NS	185.048	993.595
Nitrogen Fertilizer (kg/ha)							
0 kg N/ha	26.57	1.51	15.78	65.40	64.96	1,897.25	6,084.96
15 kg N/ha	26.91	1.73	18.01	65.83	65.19	2,207.80	6,578.63
30 kg N/ha	29.39	1.84	21.96	70.28	65.36	2,563.62	7,316.97
45 kg N/ha	32.30	2.23	24.46	76.38	68.45	2,890.00	8,423.55
SE m±	1.007	0.073	0.579	1.261	1.178	44.605	191.002
CD (P=0.05)	3.137	0.227	1.804	3.928	NS	138.963	595.055

Conclusion:

The results of this study revealed that the combination of spreading genotype along with 45 kg N/ha significantly enhance groundnut production and profitability. These findings have important implications for farmers and agricultural practitioners, as they provide valuable insights into optimizing groundnut cultivation practices for enhanced productivity. However, further research and experimentation in different locations would be beneficial to validate and expand upon these findings.

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