Asian Jr. of Microbiol. Biotech. Env. Sc. Vol. 23, No. (2) : 2021 : 196-201

ISSN-0972-3005

EFFECT OF GIBBERELLIC ACID AND GYPSUM ON GROWTH AND YIELD OF GROUNDNUT (*Arachis hypogea* L.)

JANGA HARSHA VARDHINI*[1] AND SHIKHA SINGH[2]

Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj 211 007, Uttar Pradesh, India

(Received 8 March, 2021; Accepted 2 April, 2021)

Key words: *Groundnut, Gibberellic acid, Gypsum and yield*

Abstract – A field experiment was conducted during *kharif* 2020 at Crop Research Farm of SHUATS, Prayagraj to know the effect of Gibberellic and Gypsum on growth and yield of Groundnut. The experiment consisted of 12 treatments which includes 2 levels of gibberellic acid (GA_3 50 and 100ppm) and 3 levels of gypsum(200,250,300 kg/ha). The treatment receiving GA_3 100 ppm produced significantly higher plant height (109.16cm), No. of nodules per plant (53.93), Plant dry weight (56.73g) and GA_3 100ppm +Gypsum 300 kg/ha produced significantly higher number of pods per plant (21.31), number of kernels per pod (2.10), Seed yield (2.68t/ha) and Haulm yield (4.37t/ha) however, Gross return (2,07,642.89 INR/ha), Net return (1,36,627.69 INR/ha) and B:C ratio (1.92) was also obtained maximum with the application GA_3 100ppm +Gypsum 300kg/ha. This experiment showed treatment receiving GA_3 100ppm+Gypsum 300kg/ha was more productive and economic.

INTRODUCTION

Groundnut (*Arachis hypogea* L.) is an annual legume native to South America. It is grown in most tropical, sub-tropical and warm temperate regions of world between 400"N and 400"S latitudes. It is an important oil seed crop and a grain legume. India is the 2nd largest producer of groundnut after china. Groundnut belonging to the family *Leguminaceae* is the 4th most important source of edible oil also known as "The kind of oil seeds" and 3rd most important source of vegetable protein. Groundnut is the largely produced oil seed in India, it is also an important cash crop.

Plant growth regulators are known to enhance the source-sink relationship and stimulate the translocation of photo-assimilates there by helping in effective flower formation, fruit and seed development and ultimately enhance the productivity of the crop. Growth regulator improves the physiological efficiency including photosynthetic ability and can enhance the effective portioning of accumulates from source and sink in the field crops. Growth regulator through foliar spray at 45 DAS help to improve yield attributes like grains/pod, Pods/plant, stover yield and grain yield. Foliar application of nutrients has been proved to be ana important asset in fertilizer application with a specific aim of increasing nutrient availability at the time of need especially in the later stage of plant growth (Kuepper, 2003). Through, the emphasis has been laid on for foliar fertilization of trace elements at it has repeatedly been observed that the foliar application of macro nutrients, to, has a positive impact on plant metabolism and ultimately on the yield (Fageria *et al.,* 2019). Keeping in view the above fact the experiment was conducted to assess the effect of foliar application of nutrients on nodulation, yield attributes, yields of groundnut.

Gypsum is widely used as a source of calcium for groundnut worldwide. Groundnut response to gypsum as with any other fertilizer depends on fertility status of the soil. The dissolution is fairly rapid and therefor readily adds calcium to the podding zones. Survey data from the small holder farming sector has shown has the majority of the farmers apply gypsum to get the good yield and quality of groundnut (Sreelatha *et al*. 2004). Application of gypsum split doses facilitates the

calcium and sulphur requirement for better shell development and oil content I critical pod development period of plant growth.

MATERIALS AND METHODS

A field experiment was conducted during *kharif* at Crop Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P) which is located at 25º24' 42" N latitude, 81° 50' 56" E longitude and 98 m altitude above the mean sea level, during kharif season 2020 on sandy loam soil, having moderately basic pH (7.5), organic carbon (0.58%), available nitrogen (219 kg/ha), phosphorus (19.60 kg/ha) and potassium (239.2 kg/ha). The climate of the region is semi-arid subtropical. Treatments comprised of T_1- Gypsum 200kg/ha, T_2- Gypsum 250kg/ha, T_3- Gypsum 300 kg/ha, T_4-$GA_3$50 pmm + Gypsum 200kg/ha, T_5- GA_3 50 ppm + Gypsum 250 kg/ha, T_6- GA_3 50 ppm + Gypsum 300kg/ha, T_7-GA_3 100ppm +Gypsum 200 kg/ha, T_8-GA_3 100ppm + Gyspum 250kg/ha, T_9-GA_3 100pmm+Gypsum 300kg/ha, T_{10}-GA_3 50ppm, T_{11}-GA_3 100ppm, T_{12}- Control RDF (20:60:40 N:P:K kg/ha). These was replicated thrice on Randomized Block Design recommended dose of fertilizers were applied at the time of sowing in the form of urea, SSP, MOP. Seeds was placed in row-row spacing 30cm and plant -plant 10cm.

Note: Blanket application of RDF for all the treatments, T_4-T_{11} Foliar spray of GA_3 at 35 and 45 DAS at flowering and pegging stage, Gypsum has to be applied 50% basal+ 50% side dressing at flowering stage.

Chemical analysis of soil

Composite soil sample were collected before layout of the experiment to determine the intial soil properties. The soil samples were collected from 0-15 cm were dried under shade, were powdered with wooden pestel and motor, passed through 2 mm sieve and were used for analysis. Available organic carbon and black method by Jackson (1973), Available nitrogen was estimated by alkaline permanganate method by Subbaih and Asija (1956), Available phosphorus by Olsen's colorimeter method as outline by Olsen *et al.*, (1954), Available potassium was determined by using flame photometer by Toth and Prince (1949).

Statistical analysis

Experiment data collected was subjected to statistical analysis by adopting Fishers method of Analysis of variance (ANOVA) as outline by Gamze and Gomez (2010). Critical Difference (CD) values were calculated the 'F' test was found significant at 5% level.

Plant sampling

Growth attributes

The height of the plants were measured from the base of the plant up to the last leaf. Five randomly selected plants were recorded at 20,40,60,80 and 100 DAS from each plot.

Number of nodules/plant three plants from each plot were selected randomly and uprooted carefully without damaging the root nodules the number of nodules from each plot was counted and their mean values were recorded at 20,40,60,80 and 100 DAS.

Dry weight of the plant was recorded without root at intervals of 20,40,60,80 and 100 DAS by uprooting of m^2 area plants from each plot.

Yield attributes

After harvest, number of pods/plant was recorded from five tagged plants in each plot at harvest. Thereafter, the mean was calculated treatment - wise. Kernels from the five pods were counted separately which were obtained randomly from the tagged plants and there average was recorded. Seed index was recorded with the weight of 100 kernels were randomly counted from pods obtained from each plot and weighed and recorded as seed index. Seed from the harvest area (1.0 m^2) were sundried in sun, cleaned and weighted separately from each plot for calculation the seed yield in t/ha. Haulm yield after plucking the pods from harvested groundnut plant, the remaining produce was sun dried to constant weight and haulm yield/plot was recorded. Harvest index was obtained by dividing the economic yield (seeds) by the biological yield (seed+ straw). It was calculated for each plot and was represented in %.

RESULTS AND DISCUSSION

Effect of Gibberellic acid and Gypsum on growth attributes of groundnut

Plant height

At 20 DAS, the highest plant height was recorded with the application of Gypsum 250 kg/ha (22.47 cm) and lowest was obtained with the application

of GA_3 50ppm + Gypsum 300 kg/ha (19.77 cm). There is no significant difference among the treatments. At 40 DAS, the highest plant height was observed with the application of GA_3 100ppm+ Gypsum 300 kg/ha (67.77 cm) and lowest was obtained with the application GA3 50ppm (58.09 cm). There is no significant difference among the treatments. At 60 DAS, the highest plant height was recorded with the application of GA_3 100ppm +Gypsum 300 kg/ha (87.89 cm) and lowest was recorded with the application of control (76.3 cm). There is no significant different among the treatments. At 80 DAS, the highest plant height was recorded with the application of GA_3 100ppm (97.14 cm) which is significantly superior over all the treatments except with the application of GA_3 100ppm + Gypsum 250 kg/ha (95.71 cm), GA_3 100ppm + Gypsum 300 kg/ha (94.79 cm) and GA_3 50ppm + Gypsum 300 kg/ha (94.28 cm).

At 100 DAS the highest plant height was observed with the application of GA_3 100ppm (110.41cm) which is significantly superior all the treatments except with the application of GA_3 100ppm + Gypsum 300 kg/ha (109.16cm) and GA_3 50ppm+ Gypsum 300 kg/ha (108.82cm). When gibberellic acid is utilized via foliar application; an increase in hypocotyls length and in the length of the two nodes immediately above it take place and consequently affects the height of plants. This results is similar to that reported by Emongor (2007). Therefore, the application of GA_3 100ppm was recorded maximum plant height.

No. of nodules/plant

At 20 DAS, the highest No. of nodules/plant was observed the application of GA_3 50 ppm (37.66) and lowest was obtained with the application of control (30.00). There is no significant among the different treatments. At 40 DAS, the highest No. of nodules/ plant was observed with the application of GA_3 100ppm (146.17) which was significant superior over all the treatments. At 60 DAS, the highest No. of nodule/plant was observed with the application of GA_3 100 ppm (104.82) which is significantly superior over all the treatments except with the application of GA_3 50ppm + Gypsum 300 kg/ha (102.34) and GA_3 100ppm + Gypsum 300 kg/ha (102.30). At 80 DAS, the highest No. of nodules/ plant was observed with the application of GA_3 100ppm (63.47) which is significantly superior over all the treatments. At 100 DAS the highest No. of nodules/plant was observed with the application of

Table 1. Effect of Gibberellic acid and Gypsum on growth attributes of groundnut:

Treatments	Plant height (cm)					No. of nodules/ plant					Dry weight (g/plant)				
	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS	20 DAS	40 DAS	60 DAS	80 DAS	100 DAS
T1- Gypsum 250 kg/ha	21.54	60.28	87.40	90.74	106.46	32.55	143.01	101.66	60.31	50.77	1.34	10.46	39.10	44.48	47.03
T2- Gypsum 250 kg/ha	22.47	59.38	80.1	93.64	103.28	31.66	141.14	99.79	58.44	48.90	2.03	10.84	39.99	45.073	48.54
T3- Gypsum 300 kg/ha	22.43	61.6	82.6	92.53	106.57	30.88	141.66	100.31	58.96	50.39	1.76	10.62	41.07	43.80	49.15
T4-GA_3 50 ppm + Gypsum 200 kg/ha	21.91	61.90	83.69	93.45	105.97	34.77	142.12	100.16	59.42	49.88	2.13	10.03	39.58	43.2	51.33
T5-GA_3 50ppm+ Gypsum 250kg/ha	19.83	60.16	80.19	92.54	104.84	33.77	142.96	101.61	60.26	49.43	1.78	10.53	39.75	46.16	53.2
T6- GA_3 50 ppm+ Gypsum 300 kg/ha	19.77	63.72	84.5	94.28	108.82	34.44	142.22	102.34	59.526	52.35	1.93	11.9	41.66	50.47	52.62
T7-GA_3 100ppm+ Gypsum 200kg/ha	21.90	62.32	83.76	93.55	105.96	33.33	141.82	99.523	59.12	49.58	1.79	10.45	39.45	47.92	51.74
T8- $GA_3$100ppm+Gypsum 250 kg/ha	21.83	66.94	87.62	95.71	106.38	32.55	141.08	99.73	58.38	48.84	1.51	10.56	40.28	46.80	52.22
T9-$GA_3$100ppm+ Gypsum 300 kg/ha	20.43	67.77	87.79	94.79	109.16	32.55	142.08	102.30	59.38	52.15	1.66	11.98	41.48	52.21	55.28
T10- GA_3 50 ppm	20.60	58.09	81.77	92.89	106.55	37.66	141.42	100.07	58.72	49.18	1.57	10.64	39.60	44.49	52.89
T11- GA_3 100 ppm	21.53	63.78	86.02	97.14	110.41	34.88	146.08	104.82	63.47	53.93	1.66	12.47	43.45	53.36	56.73
T12- Control (20:60:40 NPK kg/ha)	20.50	61.07	76.3	92.03	103.28	30	141.44	100.09	58.74	49.2	1.42	10.7	38.94	43.16	50.55
SEm (±)	0.67	3.17	2.60	1.08	1.13	1.67	0.74	1.03	0.74	0.80	0.21	0.39	0.68	1.58	0.76
CD (P= 0.05%)	NS	NS	NS	3.17	3.32	NS	2.17	3.03	2.17	2.36	NS	1.17	2.02	4.65	2.23

GA_3 100 pmm (53.93) which is significantly superior over all the treatments except with the application of GA_3 100ppm + Gypsum 300 kg/ha (52.15) and GA_3 50ppm + Gypsum 300 kg/ha (52.35). The results are in according with the findings of (Maekawa *et al.*, 2005). However, foliar spraying of GA_3 caused an improvement in nodule number and dry matter generation. Khairul Mazed *et al.,* (2015) confirmed that plant height and dry matter, were obtained from plants that received high GA_3 concentration.

Plant dry weight (g/plant)

At 20 DAS, the highest plant dry weight was observed with the application of GA_3 50ppm + Gypsum 200 kg/ha (2.13 g/plant) and lowest was obtained with the application of Gypsum 200 kg/ha (1.34 g/plant). There is no significant difference among the treatments. At 40DAS, the highest plant dry weight was observed with the application of GA_3 100ppm (12.47 g/plant) which is significantly superior over all the treatments except with the application of GA_3 100ppm + Gypsum 300 kg/ha (41.66 g/plant) and GA_3 100ppm + Gypsum 300 kg/ha (41.48 g/plant). At 60 DAS, the highest plant dry weight was recorded with the application of GA_3 100ppm (43.45 g/plant) which is significantly superior over all the treatments except with the application of GA_3 50ppm + Gypsum 300 kg/ha (41.66 g/plant) and GA_3 100ppm + Gypsum 300 kg/ha (41.48 g/plant). At 80 DAS, the highest plant dry weight was recorded with the application of GA_3 100ppm (53.36 g/plant) which is significantly superior over all the treatments. At 100 DAS, the highest plant dry weight was observed with the application of $GA_3$100 ppm (56.73 g/plant) which is significantly superior over all the treatments except with the application of GA_3 ppm+ Gypsum 300kg/ha (55.28g/plant). Foliar spraying of GA_3 caused an improvement in plant height and dry matter generation. Khairul Mazed *et al.* (2015) confirmed that the plant height, number of branches per plant and total dry matter, particularly maximum plant dry matter, were obtained from plants that received high GA_3 concentrations and the treatment with the application of GA_3 100ppm was recorded significant plant dry weight.

Effect of Gibberellic acid and Gypsum on yield attributes and yield of groundnut

The highest number of pods per plant was

Table 2. Effect of Gibberellic and Gypsum on yield attributes, yield and economics of groundnut.

Treatments	No. of pods/ plant	No. of kernels/ pod	Seed index (g)	Seed yield (t/ha)	Haulm yield (t/ha)	Harvest index (%)	Cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C ratio
Gypsum 200 kg/ha	15.49	1.56	35.44	2.25	3.70	37.78	70135.2	171042.6	100907.4	1.44
Gypsum 250 kg/ha	17.78	1.68	36.33	2.06	3.61	36.44	70460.2	180625.6	110165.4	1.56
Gypsum 300 kg/ha	18.82	1.84	37.42	2.54	4.10	38.22	70785.2	175945.6	105160.4	1.49
GA_3 50 ppm + gypsum 200 kg/ha	15.88	1.77	35.92	2.23	3.50	38.99	70250.2	179872.4	109622.2	1.56
GA_3 50 ppm + gypsum 250 kg/ha	17.63	1.53	36.09	2.33	3.69	38.73	70575.2	185386.7	114811.5	1.63
GA_3 50 ppm + gypsum 300 kg/ha	19.75	1.95	38.00	2.54	4.11	38.21	70900.2	165648.4	94748.2	1.34
GA_3 100ppm + gypsum 200 kg/ha	17.46	1.78	35.79	2.23	3.64	38.04	70355.2	195634.8	125279.1	1.78
GA_3 100 ppm + gypsum 250 kg/ha	18.17	1.73	36.63	2.15	3.42	38.53	70690.2	169458.8	98768.56	1.40
GA_3 100 ppm + gypsum 300 kg/ha	21.31	2.10	36.51	2.68	4.39	37.92	71015.2	207642.9	136627.7	1.92
GA_3 50 ppm	18.19	1.72	35.95	2.29	3.62	38.84	68950.2	195678.1	126727.9	1.84
GA_3 100 ppm	20.01	2.00	37.83	2.57	4.7	38.15	69065.2	195648.8	126583.6	1.83
Control (20:60:40 NPK kg/ha)	16.95	1.64	35.28	2.10	3.46	37.78	68835.2	186237.5	117402.3	1.72
SEm (±)	0.61	0.09	0.68	0.07	0.1	0.63	-	-	-	-
CD (P= 0.05)	1.79	0.28	NS	0.21	0.32	NS	-	-	-	-

recorded with the application of GA_3 100ppm +Gypsum 300kg/ha (21.31) which is significantly superior over all the treatments except with the application of GA_3 100ppm (2.10) and GA_3 50ppm +Gypsum 300kg/ha (19.75). The highest number of kernels per pod was recorded with the application of GA_3 100ppm + Gypsum 300kg/ha (2.10) which is significantly superior over all the treatments except with the application of GA_3 100ppm (2.00), GA_3 50ppm + Gypsum 300 kg/ha (1.95) and Gypsum 300 kg/ha (1.84). The highest number of Seed Yield was recorded with the application of GA_3 100ppm + Gypsum 300kg/ha (2.68t/ha) which is significant superior over all the treatments except with the application of GA_3 100ppm (2.57t/ha), GA_3 50ppm+ Gypsum 300kg/ha and Gypsum 300kg/ha (2.54t/ha). The highest number of Haulm yield was recorded with the application of GA_3 100ppm + Gypsum 300 kg/ha (4.39t/ha) which is significantly superior over all the treatments except with the application of $GA_3$100ppm (4.17t/ha), GA_3 50 ppm + Gypsum 300 kg/ha (4.11t/ha) and Gypsum 300 kg/ha (4.10 t/ha). The highest seed index was recorded with the application of GA_3 100ppm (37.83g) and the lowest was recorded with the application of control (20:60:40: NPK kg/ha) (35.28g) there is no significant difference among the treatments. The highest harvest index was recorded with the application of GA_3 50ppm (38.84%) and the lowest was recorded with application of control (20:60:40 NPK kg/ha) (37.78%) there is no significant difference among the treatments. Application of GA_3 to groundnut plants improved the yield factors. The enhancement of yield factor is attributes to the role of gibberellic acid in the improvement of cell elongation and division, internodal elongation, and improvement of cell wall elasticity (Emongor 2007). As observed by Yakubu *et al.* (2013), during the dry and wet season, the pod and kernel produce of groundnut were found to be highest at the GA_3 concentration. Ramamoorthy *et al.* (1997) reported that the application of gypsum significantly increased yield of groundnut. The ability of GA_3 to hasten flowering and fruit growth processes by changing the physiological progression in plants is the inherent cause behind the increased yield of groundnut. Thayamini (2016) revealed that full dose of NPK fertilizer with gypsum treatment give significant higher seed yield than the typical control which had in groundnut. Rathore *et al.* (2006) by application of gypsum significantly increased the yield attributes and haulm yield.

Effect of Gibberellic acid and Gypsum on Economics of groundnut

Application of $GA_3$100ppm +Gypsum 300 kg/ha recorded maximum Gross return (2,07,642.89 INR/ha), net return (1,36,627.69 INR/ha) and B:C ratio (1.92) which was superior over all the treatments. GA_3 concentration and the cost affective nature of plants regulators were helps in better return and groundnut being an oil seed crop will have the more economic importance and increase in seed yield as well as haulm yield have positive impact on net price will leads to greater benefit cost ratio recorded was (1.97). Similar findings were confirmed by Chetram *et al.,* 2016 Naresh *et al.,* (2018) reported that application of gypsum (at flower initiation) recorded (50% as basal and 50% at flower initiation).

CONCLUSION

On the basis of one season experimentation application of GA_3 100ppm +Gypsum 300 kg/ha was found more productive (2.68t/ha) as well as economic (1,36,672.69 INR/ha) however, these results are only indicative and required further experimentation to arrive at more consistent and final conclusion.

ACKNOWLEDGMENT

The authors are thankful to Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, (U.P) India for providing field, facilities and assistance in conducting this research.

REFERENCES

Chetram, S., Jain, N.K. and Mathukia, R.K. 2016. Effect of sulphur and plant-growth regulators on growth, yield and economics of summer groundnut (*Arachis hypogaea* L.). *Indian Jr. of Agronomy*. **61**(1): 115-118.

Emongor, V. 2007. Gibberellic Acid (GA_3) Influence on Vegetative Growth, Nodulation and Yield of Cowpea (*Vigna unguiculata* L.Walp). *J. Agron.* **6**(4) : 509-517.

Fageria, N.K., Barbosa F.M. P., Moreira, A. and Guimaraes, C. M. 2009. Foliar Fertilization of Crop Plants. *In J. Plant Nutrition.* **32**(6): 1044-1064.

Gomez, K.A. and Gomez, A.A. 1984. *Statistical Procedures for Agricultural Research.* 2nd edition. New York, 680p.

Jackson, M.L. 1973. *Soil Chemical Analysis.* Prentice Hall of India Pvt. Ltd., New Delhi. pp. 56.

Khairul, M.H.E.M., Haque M.N., Jahan, I.I.M., Islam, A.P. and Aabdullah, A.H. 2015. Effect of seed priming on growth, yield and seed quality of chickpea (BARI chhola-6). *International Journal of Multidisciplinary Research and Development.* **7**: 142-147.

Kuepper, G. 2003. Foliar fertilizatiom. NCAT Agriculture Specialist, Published 2003, ATTRA Publication CT 135.

Lievens, S., Goormachtig, S., Den, H.J., Capoen, W., Mathis, R., Hedden, P. and Holsters, M. 2005. Gibberellins are involved in nodulation of *Sesbania rostrata. Plant Physiology.* **139**(3): 1366-1379.

Maekawa, T., Maekawa Y.M., Takeda, N., Imaizumi A.H., Murooka, Y. and Hayashi, M. 2009. Gibberellin controls the nodulation signaling pathway in *Lotus japonicus*. *The Plant Journal.* **58**(2): 183-194.

Mazid, M. and Naqvi, N. 2014. Differential yield and quality response of four chickpea cultivars following the foliar spray of five selected plant growth regulators. *Agricultural Science Digest* **34**(4): 268-272.

Naresha, R.P., Laxminarayana, K.B., Suneetha, D. and Sailaja, V. 2018. Quality, Yield and Economics of Rabi Groundnut as Influenced by Irrigation Scheduling and Phosphogypsum Levels. *International Journal of Current Microbiology Applied Sciences***.** **7**(3): 3292-3303.

Olsen, S.H., Cole, V.V., Watanabe, F.S. and Dean, L.A. 1954. Estimation of available phosphorus in soil by extraction with sodium bicarbonate. United States Department of Agriculture, Circular, 939: 1-9.

Ramamoorthy, K., Balasubramanian, A. and Arokiaraj, A. 1997. Response of rainfed blackgram (*Phaselous mungo* L.) to phosphorus and sulphur nutrition in red lateritic soils. *Indian Journal of Agronomy*. **42**(1) : 191-193.

Rathore, M.S., Chankawat, M.S. and Singh, S. 2006. Response of groundnut, (*Arachis hypogaea* L.) to dates of sowing application of gypsum and micronutrient in Western Rajastan. *Journal of Oil Seed Research*. **23**(1) : 101-102.

Sruthi, D.S.V.S., Singh, S., Dhananjay, T. and Kavya, P. 2020. Effect of foliar spray of nutrients and plant growth regulators on growth and yield of green gram (*Vigna radiata* L.) *An international quarterly journal of life sciences*. **15** (2): 253-256, 2020.

Sreelatha, N. Seshaiah, B.V. and Sankara Rao, V. 2004. Effect of phosphorus and sulphur nutrition on nutrient composition oil content and yield of groundnut. *The Andhra Agricultural Journal*, **15**(3&4) : 380-383.

Subbaiah, B.V. and Asija, G.L. 1956. A rapid procedure for the determination of available nitrogen in soils. *Current Science*. **25** : 259–260.

Thyamini, H.S. 2016. Yield and Yield Components of (*Arachis hypogaea* L.) as Influenced by NPK Chemical Fertilizers, Farm Yard Manure and Gypsum. *Bangladesh Journal of Sciences*. **51**(4):285-290.

Tooth, S.J. and Prince, A.L. 1949. Estimation of Cation exchange capacity and exchangeable Ca, K and NA content of soil by flame photometer technique. *Soil Science*. **67** : 439-445.

Yakubu, H., Izge, A.U., Hussaini, M.A., Jibrin, J.M., Bello, O.G. and Isyaku, M.S. 2013. Varietal response and gibberellic acid concentrations on yield and yield traits of groundnut (*Arachis hypogaea* L.) under wet and dry conditions. *Academia Journal of Agricultural Research*. **1**(1): 1-8.