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Effect of potassium and magnesium on growth and yield of groundnut (*Arachis hypogaea* L.)

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Abstract
A field experiment entitled "Effect of Potassium and Magnesium on growth and yield of Groundnut (*Arachis hypogaea* L.) was conducted during *kharif* season, 2021 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (UP). The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.4), low in organic carbon (0.147%), available N (171.48 Kg/ha), available P (10.3 Kg/ha) and available K (213.7 Kg/ha). The experiment was laid out in Randomized Block Design comprised of 3 replications and total 9 treatments *viz.* T1: 40 kg/ha Potassium + 10 kg/ha Magnesium, T2: 40 kg/ha Potassium + 15 kg/ha Magnesium, T3: 40 kg/ha Potassium + 20 kg/ha Magnesium, T4: 50 kg/ha Potassium + 10 kg/ha Magnesium, T5: 50 kg/ha Potassium + 15 kg/ha Magnesium, T6: 50 kg/ha Potassium + 20 kg/ha Magnesium, T7: 60 kg/ha Potassium + 10 kg/ha Magnesium, T8: 60 kg/ha Potassium + 15 kg/ha Magnesium, T9: 60 kg/ha Potassium + 20 kg/ha Magnesium. Results obtained that there was significant increase in growth attributes *viz*., Plant height (44.20 cm), Nodules/pod (80.30), Dry weight (41.64 g/plant);Crop growth rate (7.07 g/m 2 /day), Relative growth rate (0.0035 g/g/day) are non- significant and Yield attributes *viz*., Pods/plant (25.80), Kernels/pod (2.4), Seed index (46.27 g), Seed yield (2.48 kg/ha), Haulm yield (5.51 t/ha), Harvest index (31.07%) were recorded with the application of 60 kg/ha Potassium+20 kg/ha Magnesium. Therefore, it is concluded that the application of 60 kg/ha Potassium +20 kg/ha Magnesium was recorded higher growth and yield of Groundnut.

Keywords: Groundnut, potassium, magnesium, growth attributes, yield attributes

Introduction
Groundnut (*Arachis hypogaea* L.) is an important oilseed crop of India, popularly known as peanut, monkey nut and locally called as "moongphali". It is world's largest source of edible oil, ranks 13th among the food crops as well as 4th most important oilseeds crops of the world (Ramanathan, 2001). Groundnut seeds contain high quality edible oil (48%), easily digestible protein (26%) and carbohydrates (20%). Groundnut occupies premier position with regards to both area and production in India. It accounts about 22 per cent (5.95 m/ha) and 24 per cent of production (7.54 mt) with the productivity of 1268 kg/ha. In Rajasthan, groundnut is cultivated mainly in north-western region covering the districts of Bikaner, Jaipur, Jodhpur, Nagpur and Sikar. Total area of groundnut in Rajasthan is 3.46 Lakh ha. with total production of 6.81 Lakh tons with productivity of 1963kg/ha.

Groundnut is originated from Latin America and was introduced into west Africa by Portuguese traders in the 16 th century Groundnut is a legume that is widely grown as a food crop. It is an annual crop primarily grown for its protein rich kernel and edible oil. It bears its seeds below the surface of the ground and their abound many locally named varieties e.g. boro read, ela, Mokwa, Guta and Kampala (Ayoola and adeyeye, 2010). It provides considerable amounts of minerals elements to supplements the dietary requirements of humans and farm animals (Asibuo *et al*., 2008). Application of potassium and magnesium become more essential and these need to be supplied in adequate quantity for obtaining higher yield.

Groundnut belongs to the family Fabaceae. Groundnut is an important oil seed crop and proteins source to a large portion of the population in Asia, Africa and the America. Groundnut also called as king of oilseeds in India, occupies pre-eminent position in national edible oil economy. Groundnut seeds contain mainly non- dry oil and protein groundnut cake is rich food for cattle.

With increasing global population particularly in developing countries and a limited or even shrinking supply of arable land, the challenge to agriculture is to met the worlds food and fiber

needs without reducing the capacity of the resource base (soil and water) the enable guaranteed production for posterity and also to accommodate society's environmental and energy concerns.

Potassium is one of the three major essential nutrient elements required by plants. Through potassium is not a constituent of any compound or structurally bound in groundnut. It is required for translocation of assimilates and involved in maintenance of water status of plant especially the turgor pressure of cells and opening and closing of stomata and increase the availability of metabolic energy for the synthesis pof proteins and starch. Besides, it increased peg formation, nodulation, synthesis of sugar and starch and help in growth an d filling. Effect of different levels of potassium was found to be non-significant in case of plant population, plant height and harvest index. The increase in yield attributes of plant might be due to the potassium plays a vital role in maintaining balance in enzymatic, stomatal activity, transport of sugar and synthesis of proteins, photosynthesis and starch. Effect of potassium on yield also make a pronounced role in carbohydrates synthesis, photosynthesis cell elongation, stomatal activity and higher nutrient uptake under this level resulted in higher plant height and number of branches per plant and ultimately helped in realization of higher haulm yield. It significantly increased peanut oil and seed yields.

Magnesium increasing supply on mg deficient sites tends to increase the crop production. Magnesium is a structural component of chlorophyll. The increase in pod yield of groundnut as a result of mg along with RDF were attributed to better crop stand, increase in plant height, number of pod per plant, pod weight per plant as a consequent of improvement in root growth and nodulation. It plays a major role on growth and yield of groundnut. Sandy soils are inherently low in mg and the increased supply of the nutrient in soil solution is reflected by its increased uptake. They might be due to the deficiency of magnesium which has been reported to help in seed formation, seed filling, and weight. The increased growth and yield with the soil application of magnesium and potassium in combination attributed to complementary effect of these nutrients on growth parameters, nutrient utilization efficiency and yield. Application of potassium and magnesium become more essential and these need to be supplied in adequate quantity for obtaining higher yield.

Materials and Methods

The experiment was carried out during *kharif* season of 2021 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P). Which is located at, 25.57o N latitude, 87.19o E longitude and 98 m altitude above the mean sea level. The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.4), low in organic carbon (0.147%), available N (171.48 Kg/ha), available P (10.3 Kg/ha) and available K (213.7 Kg/ha). The crop was sown on 25th July 2021 using variety K-6. The treatment consists of three levels of Potassium (40, 50, and 60 kg/ha) soil application and three levels of Magnesium (10, 15 and 20 kg/ha) respectively. The experiment was laid out in Randomized Block Design comprised of 3 replications and total 9 treatments *viz*. T1: 40 kg/ha Potassium + 10 kg/ha Magnesium, T2: 40 kg/ha Potassium + 15 kg/ha Magnesium, T3: 40 kg/ha Potassium + 20 kg/ha Magnesium, T4: 50 kg/ha Potassium + 10 kg/ha Magnesium, T5: 50 kg/ha Potassium + 15 kg/ha Magnesium, T6: 50 kg/ha Potassium + 20 kg/ha Magnesium, T7: 60 kg/ha Potassium + 10 kg/ha Magnesium, T8: 60 kg/ha Potassium + 15 kg/ha Magnesium, T9: 60 kg/ha Potassium + 20 kg/ha Magnesium. Control *i.e.*, recommended N, P and K (40:50:40 kg/ha) alone. The plots were prepared with dimension of 5 m × 3 m and seeds of variety K-6 were sown with a spacing of 30cm × 10 cm. Weeds cause much damage to the groundnut crop during the first 45 days of its growth. Growth characteristics plant height (cm), number of nodules per plant, dry weight per plant (g), crop growth rate (g/m2/day) and relative growth rate (g/g/day) were recorded, Irrigation were given uniformly and regularly to all plots as per requirement so as to prevent the crop from water stress at any stage. The crop was completely harvested at physiological maturity stage and their biometric observations such as number of pods per plant, number of kernel per pod, seed index (g), seed yield (kg/ha), haulm yield (t/ha) and were recorded. All nutrients were applied through soil as urea, single super phosphate (SSP) and muriate of potash (MOP). The growth parameters were recorded at periodical intervals of 20, 40, 60, 80 DAS and at harvest stage from the randomly selected five plants in each treatment. Statistically analysis was done and mean compared at 5% probability level of significant results.

Results and Discussion

Effect of Potassium and Magnesium on growth attributes of Groundnut

Effect of potassium and Magnesium on growth attributes of Groundnut are presented in Table1. The results obtained that higher Plant height (48.1 cm), Nodules/plant (43.30), Dry weight (41.64 g/plant), Crop growth rate (7.07 g/ m2 /day), Relative growth rate (0.0035 g/g/day) were recorded with application of 60 kg/ha Potassium + 20 kg/ha Magnesium closely followed by the Plant height (47.7 cm), Nodules/plant (42.90), Dry weight (41.06 g/plant) which was recorded in the treatment of 60 kg/ha Potassium+15 kg/ha Magnesium. Enhanced plant height of Groundnut crop in response to the combined application of the two nutrients might be attributed to the synergistic effects of the nutrients, which were supplied to the soil. Possibly, the application of the two nutrients might have enhanced cell division and growth, which subsequently resulted in increased plant height. Higher plant height with increased potassium application levels might be due the fact that higher doses of potassium enhanced the metabolic and meristematic activities of crop resulting in optimum growth, plant height and nodules per plant of groundnut. Similar results are also reported by Patel *et al.* (2008).

The reason might be higher number of nodules per plant the availability of more nutrients due to higher level of K application enabled crop to uptake more nutrients and increase in amount of growth substances and thus resulted in improved crop growth and more nodules per plant. Similar results reported by Tagwira *et al.* (2007). Increase in number of dry matter yield could be as a result of potassium being involved in carbohydrate and protein metabolism that promotes cell division and enlargement resulting in more productive pods and dry matter yields. The results are in line with Gashti *et al.* (2012) who reported increase in number of pods per plant with increasing K rate.

Which might be due to better availability of magnesium leading to higher photosynthesis and it is a structural component of chlorophyll. Due to increase in plant height the number of nodules might have permitted. This could be

attributed to increase mainly the growth attributes in groundnut crop. Which might have influenced the yield attributes afterwards. Reported by Raghu *et al.* (2016).

Balanced nutrition under favorable environment might have helped in production of new tissues and development of new shoots which have ultimately increased the plant height, dry matter accumulation, number of nodules per plant, and CGR. Relatively higher relative growth rate resulted, similar results reported by Chaudhary *et al.* (2019) [3].

Effect of Potassium and Magnesium on yield and yield attributes of Groundnut

Effect of Potassium and Magnesium on yield and yield attributes of Groundnut presented in Table 2. The results obtained that higher Pods/plant (25.80), Kernels/pod (2.4), Seed index (46.27 g), Seed yield (2.48 kg/ha), Haulm yield (5.51 t/ha), Harvest index (31.07%) were recorded with the application of 60 kg/ha Potassium+20 kg/ha Magnesium closely followed by Pods/plant (24.30), Kernels/pod (2.3), Seed index (43.76 g), Seed yield (2.31 kg/ha), Haulm yield (5.39 t/ha), Harvest index (29.88%) which was recorded in the treatment of 60 kg/ha Potassium+15 kg/ha Magnesium. The progressive effect of potassium and magnesium on yields may be due to the pronounced role of potassium in carbohydrates synthesis, photosynthesis and cell elongation. The present results are also strongly agreed with Application of 60 kg/ha Potassium + Magnesium 20 kg/ha exhibited augmentation of yield components and seed yield because good supply of K and Mg promotes higher uptake by plants might have stimulated the rate of various physiological processes in plant and resulted to increase in growth and yield parameters. The increase in oil yield and protein content with the application of potassium and magnesium is consequence of the increase in oil content and protein content and seed yield (Ananth Kumar *et al.*, 2016) [1]. There was a spectacular increase in oil and protein content.

Table 1: Effect of potassium and magnesium on growth attributes of groundnut at Harvest 80 – At Harvest

Treatments	Plant height (cm)	Nodules/plant	Dry weight (g/plant)	Crop Growth Rate (g/ m2 /day)	Relative Growth Rate (g/g/day)
40 kg/ha Potassium + 10 kg/ha Magnesium	45.8	38.90	38.13	6.76	0.0037
40 kg/ha Potassium + 15 kg/ha Magnesium	46.2	39.60	38.53	6.33	0.0034
40 kg/ha Potassium + 20 kg/ha Magnesium	46.9	40.70	39.36	6.70	0.0036
50 kg/ha Potassium + 10 kg/ha Magnesium	46.7	40.40	39.04	6.30	0.0034
50 kg/ha Potassium + 15 kg/ha Magnesium	47.1	42.00	39.83	6.67	0.0035
50 kg/ha Potassium + 20 kg/ha Magnesium	47.3	42.20	40.15	6.57	0.0034
60 kg/ha Potassium + 10 kg/ha Magnesium	47.0	41.20	39.71	6.57	0.0035
60 kg/ha Potassium + 15 kg/ha Magnesium	47.7	42.90	41.06	7.16	0.0037
60 kg/ha Potassium + 20 kg/ha Magnesium	48.1	43.30	41.64	7.07	0.0035
F test	S	S	S	NS	NS
S.Em(±)	0.16	0.25	0.22	0.31	0.0001
CD (p=0.05)	0.48	0.75	0.68	-	-

Table 2: Effect of Potassium and Magnesium on yield and yield attributes of Groundnut

Treatments	Pods/plant	Kernels/pod	Seed index (g)	Seed yield(kg/ha)	Haulm yield(t/ha)	Harvest index (%)
40 kg/ha Potassium + 10 kg/ha Magnesium	20.70	1.7	39.92	1.26	4.06	23.70
40 kg/ha Potassium + 15 kg/ha Magnesium	21.00	1.8	41.86	1.32	4.33	24.36
40 kg/ha Potassium + 20 kg/ha Magnesium	22.20	1.8	42.07	1.64	4.71	25.88
50 kg/ha Potassium + 10 kg/ha Magnesium	22.30	1.8	41.71	1.41	4.50	23.93
50 kg/ha Potassium + 15 kg/ha Magnesium	23.00	2.0	41.66	1.85	4.95	27.33
50 kg/ha Potassium + 20 kg/ha Magnesium	22.70	2.2	43.16	1.93	5.22	26.98
60 kg/ha Potassium + 10 kg/ha Magnesium	22.30	2.0	43.02	1.86	4.77	28.18
60 kg/ha Potassium + 15 kg/ha Magnesium	24.30	2.3	43.76	2.31	5.39	29.88
60 kg/ha Potassium + 20 kg/ha Magnesium	25.80	2.4	46.27	2.48	5.51	31.07
F test	S	S	S	S	S	S
S.Em(±)	0.51	0.09	0.96	0.12	0.10	1.39
CD (p=0.05)	1.52	0.26	2.86	0.38	0.32	4.19

Conclusion

It can be concluded from the present study that application of 60 kg Potassium per ha, 20 kg Magnesium per ha is sufficient to sustain the higher growth and yield physiological parameters and productivity of groundnut under irrigated north Indian conditions. These findings are based on one season; therefore, further trial may be required for further confirmation.

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