E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; SP-7(11): 162-165
Received: 05-08-2024
Accepted: 13-09-2024

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Impact of foliar nutrition on growth, yield attributes, yield, quality parameters and economics of groundnut [*Arachis hypogaea* (L.)] under rainfed condition

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DOI: https://doi.org/10.33545/2618060X.2024.v7.i11Sc.1944

Abstract
An investigation was carried out at College Farm, College of Agriculture, Navsari Agricultural University, Bharuch during the *kharif* season of 2023 to study the "FOLIAR NUTRITION IN GROUNDNUT [*Arachis hypogaea* (L.)] UNDER RAINFED CONDITION". The experiment was laid out in a randomized block design with nine treatments, which included: T_1 (Control), T_2 RDF (12.5-25-00 NPK kg/ha), T_3 (RDF + 2% Panchagavya), T_4 (RDF + 2% Cow urine), T_5 (RDF + 2% Vermi bed wash), T_6 (RDF + 1% Novel), T_7 (RDF + 2% Urea), T_8 (RDF + 1% 19-19-19) and T_9 (RDF + Nano urea 2 ml/lit), each with three replications. Foliar nutrition apllied at flowering and pegging stages of groundnut. The soil of experimental plot was clayey with low in available nitrogen (237 kg/ha), available phosphorus (34 kg/ha) and high in available potash (325 kg/ha). The soil reaction (pH) was slightly alkaline (7.78). The finding revealed that, significantly higher all the growth parameters *viz.* plant height at 75 DAS (41.56 cm) and at harvest (63.95 cm), number of branches per plant at 75 DAS (8.692) and at harvest (10.00), dry matter accumulation per plant at harvest (40.44 g) recorded Yield attributes *viz.* number of pods per plant (18.43) and number of seeds per pod (2.563) as well as seed yield (1384 kg/ha), haulm yield (2620 kg/ha) and shell percentage (72.16%) recorded significantly the highest with T_3 (RDF + 2% Panchagavya) which was statistically at par with T_8 (RDF + 1% 19-19-19) and T_6 (RDF + 1% Novel).

Keywords: Groundnut, foliar nutrition, growth parameters, yield attributes, panchagavya**,** novel and RDF

Introduction
Groundnut [*Arachis hypogaea* (L.)] is an annual legume, which is also known as peanut, earthnut and monkey nut. Groundnut is known as poor man's almond. It is the 13th most important food crop and fourth most important oilseed crop of the world. Groundnut seed contain about 50 per cent edible oil. The remaining 50 per cent of the seed has high quality protein (21.4 to 36.4%), carbohydrates (6.0 to 24.9%), vitamin E, niacin, falacin, calcium, phosphorus, magnesium, zinc, iron, riboflavin, thiamine and potassium (Das, 1997) [7]. This contains about 20 per cent saturated and 80 per cent unsaturated fatty acids. Polyunsaturated fatty acid has two types i.e., oleic acid (40-50%) and linoleic acid (24-35%) (Mathur and Khan, 1997) [9].

These multiple uses of groundnut make it an excellent cash crop for domestic markets as well as for foreign trade in several developing and developed countries. Kernels are also being used as processed foods like sweets and dry powder. Groundnut haulm and oil cake are used as either cattle feed or organic manure. The shells of groundnut are also utilized as fuel in boilers and as filler material in many organic and biological products like activated charcoal, cork substitutes and hard boards. Being a legume, groundnut plant symbiotically fixes atmospheric nitrogen and improves the soil fertility status.

In Gujarat, total groundnut area, production and productivity were 1.99 million hectare, 4.49 MT and 2262 kg/ha respectively, during the year of 2021-22 (Anon, 2022). In Gujarat groundnut is largely cultivated in Junagadh, Rajkot, Dwarka, Banaskantha, Amreli, Jamnagar, Bhavnagar, Gir Somnath and Kutch districts (Anon., 2022) [1].

Foliar application of nutrients is feasible, economically viable and eco-friendly approach of nutrient management.

It is often the most effective and economical way to 3 correct plant nutrient deficiencies at critical growth stages. Reports indicate that foliar application promoted root absorption of the same nutrient or other nutrients through improving root growth and increasing nutrients uptake. It has the advantage of low application rates, uniform distribution of fertilizer materials and quick response to applied nutrients. The effectiveness of foliar applied nutrients is determined by the type of formulation and the time of application. Yield increase to an extent of 5-10 per cent (Sonawane *et al*., 2010) [12] can be achieved by using the right product at right time. Foliar nutrition is 8-10 times more effective than soil application. Foliar spray stimulates an increase in chlorophyll production, cellular activity and respiration. It also triggers a plant response to increased water and nutrient uptake from the soil (Veeramani *et al*., 2012) [15].

Material and Methods

A field experiment was carried out at College farm, College of Agriculture, Navsari Agricultural University, Campus Bharuch during *kharif* 2023. The soil of experimental plot was clayey (*Vertisols*) with low in available N (237 kg/ha), medium in P_2O_5 (34.2 kg/ha) and high in K_2O (325 kg/ha). The soil reaction (pH) was slightly alkaline (7.78). The experiment was arranged in a randomized block design (RBD) with nine treatments, which included: T_1 (Control), T_2 (RDF 12.5-25-00 NPK kg/ha), T_3 (RDF + 2% Panchagavya), T_4 (RDF + 2% Cow urine), T_5 (RDF + 2% Vermi bed wash), T_6 (RDF + 1% Novel), T_7 (RDF + 2% Urea), T_8 (RDF + 1% 19-19-19) and T_9 (RDF + Nano urea 2 ml/lit). Foliar nutrition apllied at flowering and pegging stages of groundnut. The groundnut *var*. Gujarat GJG 22 was used for experimental purpose and sown on 5th July, 2023 at 45 x 10 cm spacing, by adopting the recommended seed rate 100 kg/ha and RDF (12.5-25-00 NPK kg/ha) given through urea and single super phosphate. The crop was harvested during 25th October 2023. Weeds were managed by herbicides and plant protection measures were taken up as and when required. In each plot five plants were randomly selected and tagged to record experimental observations on growth, yield attributes, yield and quality. At maturity, pods/plant, seeds/pod, Shell (%) and seed yield were recorded. The results were statistically analyzed using standard ANOVA techniques as suggested by (Panse and Sukhatme, 1985) [10] to draw appropriate inferences.

Results and Discussion

Growth attributes

Results in Table 1 showed significant differences on groundnut growth parameters in treatment T_3 (RDF + foliar spray of 2% Panchagavya), at flowering and pegging stage). However, treatments T_8 and T_6 registered equally as T_3.

Application of T_3 (RDF + 2% Panchagavya) at flowering and pegging stages of groundnut recorded significantly the highest growth attributes *viz*., plant height at 75 DAS (41.56 cm) and at harvest (63.95 cm), number of branches / plant at 45 (6.34), 75 DAS (8.69) and at harvest (10.00), dry matter accumulation / plant at 45 DAS (20.27 g) and at harvest (40.44 g) was significantly higher with T_3 (RDF + 2% Panchagavya). However, it was statistically at par with T_8 (RDF + 1% 19-19-19) and T_6 (RDF + 1% Novel).

The reason for the potential increase in plant height could be attributed to the application of growth-promoting substances or nutrients through spraying on the leaves. Spraying these nutrients during a critical stage of crop growth, such as when the plants are flowering and pegging stage, helps in promoting cell division, elongation and the development of leaves and other parts of the plant. The contains panchagavya might have contained microbial metabolites in appreciable amount that help in maintaining the opening of stomata and improved nutrition enable greater leaf area as well as increased branches per plant due to content cytokinins and gibberellic acids, Which tends to increase number of branches per plant. Significantly improvement in accumulation of dry matter and also increased supply of plant nutrients. When groundnut plants absorb these growth-promoting substances through foliar spraying, it's possible that they contribute to the increase in plant height. Similar findings have been reported by Britto and Girija (2006) [2], Shekh *et al*. (2018) [11] and Mathukia *et al*. (2023) [8].

Table 1: Impact of foliar nutrition spray of growth attributes of groundnut

Treatments	Plant height (cm)		Number of branches/plant			Dry matter accumulation (g/plant)	
	60 DAS	At harvest	45 DAS	75 DAS	At harvest	45 DAS	At harvest
T_1: Control	30.21	48.42	5.331	6.612	7.584	15.68	26.79
T2: RDF (12.5-25-00 NPK kg/ha)	33.85	51.03	5.598	6.887	7.749	15.92	28.77
T_3: RDF + Panchagavya (2%)	41.56	63.95	6.344	8.692	10.00	20.27	40.44
T_4: RDF + Cow urine (2%)	34.15	53.80	5.950	7.326	8.299	18.36	33.03
T_5: RDF + Vermi bed wash (2%)	34.41	54.74	5.534	7.217	8.021	18.26	32.78
T_6: RDF + Novel (1%)	39.68	59.26	6.198	8.116	8.813	19.50	39.86
T_7: RDF + Urea (2%)	38.74	57.16	5.803	7.191	7.848	17.88	36.72
T_8: RDF + 19-19-19 (1%)	41.48	60.62	6.269	8.287	9.641	18.70	40.30
T_9: RDF + Nano Urea (2ml/lit)	33.22	53.06	5.399	6.890	7.669	17.59	32.11
SEm (±)	2.18	3.03	0.30	0.37	0.55	0.94	1.77
CD at 5%	6.54	9.09	NS	1.11	1.64	NS	5.32
CV (%)	10.39	9.41	8.79	8.58	11.29	9.06	8.90

Yield attributes and yield

Significantly yield attributes of groundnut *viz*., higher number of pods/plant (18.43), seeds/pod (2.56) and Shell percentage (72.16%) were recorded with T_3 (RDF + 2% Panchagavya) which was statistically at par with T_8 (RDF + 1% 19-19-19) and T_6 (RDF + 1% Novel). Foliar spray of Panchagavya twice during flowering and pegging stages significantly increase yield attributers of groundnut. This might be due to enhanced photosynthetic activity and higher uptake of nutrients and there by increased plant dry matter production in the pod setting phase which might have improved the pod development.

Significantly the highest seed yield (1384 kg/ha) and haulm yield (2146 kg/ha) of groundnut was observed under T_3 (RDF + 2% Panchagavya), which was statistically at par with, T_8 (RDF + 1% 19-19-19) and T_6 (RDF + 1% Novel). On the other hand, significantly lowest seed yield (901 kg/ha) and haulm yield (1797 kg/ha) was noted with T_1 (Control).

The increase in seed yield with application of foliar nutrient

treatments was mainly due to cumulative effect of significant increased in the growth and yield attributing component like, plant height, number of branches per plant, pods per plant and seeds per pod. The overall improvement in all the growth and yield attributing components may be due to adequate supply of nutrients with easy availability to plant at most critical growth period resulted into better growth and yield attributing characters. The better growth of crop ultimately diverted more energy under sink source relationship which helped in providing more yield. The present findings are found in agreement with Kulkarni *et al*. (2016) [16], Shekh *et al*. (2018) [11], Chongre *et al*. (2019) [5], Sutar *et al*. (2019) [14], Chaudhary *et al*. (2022) [3], Chavda *et al*. (2023a) [4] and Mathukia *et al*. (2023) [8].

Table 2: Impact of foliar nutrition spray of yield attributes and yield of groundnut

Treatments	Number of pods/plant	Number of seeds/pod	Seed yield (kg/ha)	Haulm yield (kg/ha)	Shell (%)
T_1: Control	19.98	13.91	901	1797	58.22
T_2: RDF (12.5-25-00 NPK kg/ha)	20.28	14.26	943	1947	59.82
T_3: RDF + Panchagavya (2%)	23.78	16.72	1384	2620	72.16
T_4: RDF + Cow urine (2%)	22.17	15.30	1155	2146	64.45
T_5: RDF + Vermi bed wash (2%)	22.04	15.27	1151	2141	63.60
T_6: RDF + Novel (1%)	25.55	17.41	1223	2437	68.36
T_7: RDF + Urea (2%)	22.26	15.37	1076	2129	62.48
T_8: RDF + 19-19-19 (1%)	23.96	16.18	1249	2557	70.76
T_9: RDF + Nano Urea (2ml/lit)	21.90	15.17	1065	2003	60.79
SEm (±)	1.09	0.68	70.9	156.1	2.09
CD at 5%	3.27	2.03	212	467	6.28
CV (%)	8.41	7.57	10.9	12.3	5.62

Table 3: Impact of foliar nutrition spray of quality parameters and economics of groundnut

Treatments	Quality Parametes				Return (₹/ha)		BCR
	Protein content (%)	Protein yield (kg/ha)	Oil Content (%)	Oil yield (kg/ha)	Gross return	Net return	
T_1: Control	21.25	190.49	44.34	398.48	96401	56049	2.39
T_2: RDF (12.5-25-00 NPK kg/ha)	23.73	223.92	46.04	432.49	101306	59325	2.41
T_3: RDF + Panchagavya (2%)	23.99	331.94	50.58	701.77	147200	104664	3.46
T_4: RDF + Cow urine (2%)	23.86	275.54	49.71	569.91	122628	80497	2.91
T_5: RDF + Vermi bed wash (2%)	23.81	274.17	48.29	556.13	122204	79923	2.89
T_6: RDF + Novel (1%)	23.90	292.18	48.85	594.78	130802	87509	3.02
T_7: RDF + Urea (2%)	23.75	255.44	47.73	515.77	114976	72907	2.73
T_8: RDF + 19-19-19 (1%)	23.95	298.89	49.22	609.69	133955	90286	3.07
T_9: RDF + Nano Urea (2ml/lit)	23.71	252.44	47.02	499.11	113158	70839	2.67
SEm (±)	0.68	16.27	1.36	36.41			
CD at 5%	NS	48.78	NS	109.15			
CV (%)	5.02	10.59	4.93	11.63			

Quality Parameters

Based on the data provided in Table 3, it can be concluded that different foliar nutrition did not result in any significant changes in the protein and oil content of groundnut. However, it is worth nothing that the numerically the highest protein content (23.99%) and oil content (50.58%) recorded T_3 (RDF + 2% Panchagavya) and lowest protein content (21.25%) and oil content (44.34%) were recorded with treatment T_1 (Control).

As regards to foliar nutrition, significantly higher protein yield (331.94 kg/ha) and oil yield (701.77 kg/ha) was registered under treatment T_3 (RDF + 2% Panchagavya), which was statistically at par with T_8 (RDF + 1% 19-19-19) and T_6 (RDF + 1% Novel). Higher protein and oil yield was mainly due to higher seed yield which intern improved the protein and oil yield. The results of the present investigation are in conformity with the findings of Shekh *et al*. (2018) [11], Choudhary *et al*. (2018) [6], Sutar *et al*. (2019) [14] and Chaudhary *et al*. (2022) [3].

Economics

An appraisal of data given in Table 3 indicated that maximum net return (1, 04, 664 ₹/ha) with treatment T3 (RDF + 2% Panchagavya) with BCR (3.46) followed by T8 (RDF + 1% 19-19-19) with net return (90,286 ₹/ha) and BCR (3.07), while lowest net return (56,049 ₹/ha) observed in control with BCR (2.39). Similar results were also reported by the Chavda *et al*. (2023a) [4], Mathukia *et al*. (2023) [8] and Sriram *et al*. (2023) [13].

Conclusion

Based on one year field experiment, it can be concluded that groundnut should be accomplished with application of recommended dose of fertilizer (12.5-25-00 NPK kg/ha) along with foliar nutrition 2% Panchagavya at flowering and pegging stages for getting profitable seed yield wise quality of seed and maintaining soil health.

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