International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(6): 391-396
www.biochemjournal.com
Received: 11-03-2024
Accepted: 17-05-2024

KV Rabari
Agricultural Research Station, SD Agricultural University, Aseda, Gujarat, India

JM Patel
2Bio-Science Research Centre, S. D. Agricultural University, Sardarkrushinagar, Gujarat, India

DL Sundesha
Agricultural Research Station, SD Agricultural University, Aseda, Gujarat, India

Corresponding Author:
KV Rabari
Agricultural Research Station, SD Agricultural University, Aseda, Gujarat, India

Response of iron and zinc application on growth, yield and nutrient uptake by groundnut

KV Rabari, JM Patel and DL Sundesha

DOI: https://doi.org/10.33545/26174693.2024.v8.i6Se.1315

Abstract
Groundnut cultivation covers around 108 countries in world due to its economic and nutritional importance consisting 20 to 25% protein, 45 to 50 percent oil, 5 percent fiber and ash and 20 percent carbohydrate and attains third position in vegetable protein source for human consumption. Now a day's yellowing and interveinal chlorosis is main problem in cultivation of groundnut due to deficiencies of iron and zinc in the soil. Soil application and foliar application of micronutrient shows beneficial effect on crop yield and soil fertility status. An experiment was conducted at Agricultural Research Station, Sardarkrushinagar Dantiwada Agricultural University, Aseda, Gujarat during three kharif season of years 2020, 2021 and 2022. Groundnut variety GG 20 (Gujarat Groundnut 20) was sown at second fort night of June of every season of the consecutive three years with line sowing method in randomized block design with ten treatments. Effect of different treatment on plant height at 30, 60, 90 DAS and at harvest remained un affected in all three years as well as on pooled results. Soil application of application of $FeSO_4$ @ 15 kg/ha + $ZnSO_4$ @ 8 kg/ha (T_7) recorded significantly higher number of pods per plant, pod yield (2734 kg/ha), while T_3: $ZnSO_4$ @ 8 kg/ha recorded higher haulm yield (4290 kg/ha) but remained statistically at par with treatment T_7. Significantly higher uptake of total nitrogen, phosphorus and potassium, were recorded under the treatment T_7: $FeSO_4$ @ 15 kg/ha + $ZnSO_4$ @ 8 kg/ha and remained at par with the treatments T_3 and T_9. higher total nutrient uptake during all the season well as on pooled basis, however it remained statistically at par with the treatments T_{10} on pooled of three years. The total uptake of Zn was recorded significantly higher in the treatment T_3, T_7, T_9 and T_3 in year 2020, 2021, 2022 and pooled year respectively.

Keywords: Iron sulphate, zinc sulphate, nutrient content, uptake of nutrient, groundnut

Introduction
Groundnut (*Arachis hypogaea* L.) is leguminous crop and widely cultivated in the tropics and subtropics between 40 °N and 40°S latitudes. It is also referred as king amongst oilseeds and known with different names *viz*., earthnut, peanut, monkeynut, goober peas, manilanut, pindas, and jacknut. Groundnut cultivation covers around 108 countries in world due to its economic and nutritional importance consisting 20 to 25% protein, 45 to 50 percent oil, 5 percent fiber and ash and 20 percent carbohydrate and attains third position in vegetable protein source for human consumption. Groundnut covers 32.7 million hectares area, 53.9 million tones production and productivity of 1648 kg/ha globally (FAOSTAT, 2021) [1]. Globally, India stands first in groundnut area and second largest producer in the world. With annual all-season coverage of 54.2 lakh hectares, globally, India ranks first in Groundnut area under cultivation and is the second largest producer in the world with 101 lakh tonnes with productivity of 1863 kg per hectare in 2021-22 (agricoop.nic.in). In *kharif* 2022-23, groundnut production was 85.82 lakh tonnes in India (2nd advance estimates). Groundnut is cultivated mostly 90 percentages in *kharif* season in India. Gujarat is the largest producer contributing 36 percent of the total production of groundnut followed by Rajasthan (17%), Tamil Nadu (7.5%). Andhra Pradesh contributes 5.13 percent and Telangana contributes 3.23 percent to total groundnut production. Micronutrients are required in less amount but most essential for healthy growth, developments and reproduction of plants i.e. boron, chlorine, copper, iron, manganese, molybdenum, nickel and zinc. Micronutrients deficiency is widely in plants and animals due to high pH, low organic matter, salt stress, continual drought and imponderables application of fertilizers (Singh *et al.* 2003) [2].

According to Arunachalam *et al.* (2013) [3] zinc deficiency in soils of India is most likely to occur to the tunes of from 49 to 63% by the year 2025 due to most of marginal land taking under the cultivation. Zn deficiency in groundnut caused irregular mottling and yellowing interveinal chlorosis in the upper leaves, if it severe then leads to chlorotic condition of entire leaflets, the wider strip of the leaflets differentiated Zn from Fe deficiency. Zinc is most effective in activating several enzymes and biosynthesis of growth promoting hormones like auxin which plays important role in development of plant cells and improve dry matter. By these ways, it results in high source to sink which ultimately increase the yield. Chlorosis in groundnut as appearance of papery whitish yellow bud leaves is another problem of cultivating groundnut in alkaline calcareous soils where bicarbonate ions hinder the uptake and translocation of iron in the plant (Patel *et al.*, 1993) [4]. Now a day's yellowing of groundnut is common occurrence resulted in poor yield. It is might be due to deficiency of the iron and zinc in the soil. As per the survey report of micronutrient in Banaskantha, around 55% soil of the north Gujarat are found deficient in iron and 20% deficient in zinc, which support the occurrence of chlorosis in the plant in order to correct deficiency of iron and zinc, this experiment was planned. The DTPA-extractable Fe, Mn, Zn and Cu were in the range of 2.74 to 21.98; 4.22 to 25.02; 0.20 to 2.76 and 0.12 to 3.16 mg kg-1 with a mean value of 6.72, 10.15, 0.60 and 0.60, respectively (Desai *et al.* 2018)[5].

Materials and Methods

An experiment was conducted at Agricultural Research Station, Sardarkrushinagar Dantiwada Agricultural University, Aseda, Gujarat during three *kharif* season of years 2020, 2021 and 2022. Groundnut variety GG 20 (Gujarat Groundnut 20) was sown at second fort night of June of every season of the consecutive three years with line sowing method in randomized block design with ten treatments *viz.*, T_1: Water spray, T_2: $FeSO_4$ @ 15 kg/ha, T_3: $ZnSO_4$ @ 8 kg/ha, T_4:Foliar spray of $FeSO_4$ @1%, T_5:Foliar spray of $ZnSO_4$ @ 0.5%, T_6:Foliar spray of $FeSO_4$ @1% + Foliar spray of $ZnSO_4$ @ 0.5%, T_7: $FeSO_4$ @ 15 kg/ha + $ZnSO_4$ @ 8 kg/ha, T_8:$FeSO_4$ @ 15 kg/ha + Foliar spray of $ZnSO_4$ @ 0.5%, T_9 – $ZnSO_4$ @ 8 kg/ha + Foliar spray of $FeSO_4$ @1%, T_{10}: Foliar spray of multi-micronutrient (grade-IV) arranged in three replications. The experiment field was prepared by applying farm yard manure @ 5 t/ha followed by ploughing at 15 days before sowing and second times ploughing followed by planking were done for smoothing the plot for sowing. Iron sulfate and Zinc sulfate application were made as per the treatment before sowing at time of field preparation along with FYM. Pre emergence herbicide (Pendimethalin @ 1 kg a.i/ ha) was applied at next day after sowing (DAS) with knapsack sprayer fitted with flat-fan nozzle using 400liter water/ha. The half dose of nitrogen and full dose of phosphorus were applied through urea and di ammonium phosphate as basal at the time of sowing and remaining nitrogen was top dressed at 30 days after sowing (DAS). Foliar sprays of nutrients were made at 30 and 45 days after sowing of crop. The observation of plant height at 30, 60, 90 DAS and at harvest was recorded in cm from tip of longest branch to collar region. The other bio metric observation like; number of pods per plant, 100 kernel weight(g), pod yield (kg/ha) and haulm yield (kg/ha) were recorded after harvesting and proper sun drying (4 days after harvesting). The soil samples and plant samples were collected from each net plot area and after prepared for the laboratory studies for different macro and micronutrient content. Data were statistically analyzed using analysis of variance (ANOVA) procedure according to Gomez and Gomez (1984) [6]. The mean differences were compared using LSD at 5%.

Results and Discussion

Growth attributes

Effect of different treatment on plant height at 30, 60, 90 DAS and at harvest remained un affected in all three years as well as on pooled results of three years. The soil of experimental plot was high enough to meet the macronutrient demand for proper vegetative growth of plants.

The findings was confirmed by Das KC (1992) [7], Majumdar and Venkatesh (2001) [8], Meena *et al.* (2007) [9], Sonawane, *et al.* (2010) [10], Elayaraja and Singaravel (2014) [11], Habbasha *et al.* (2014) [12], Saha *et al.* (2015) [13], Gowthami (2015) [14], Rahevar *et al.* (2015) [15], Kamalakannan (2017) [16], Sharma *et al.* (2017) [17], Sale *et al.* (2017) [18] Nakum *et al.* (2019) [19], Sabra *et al.* (2019) [20], Gowthami and Ananda (2019)[21], Nandi *et al.* (2020) [22], Abhigna *et al.* (2021) [23].

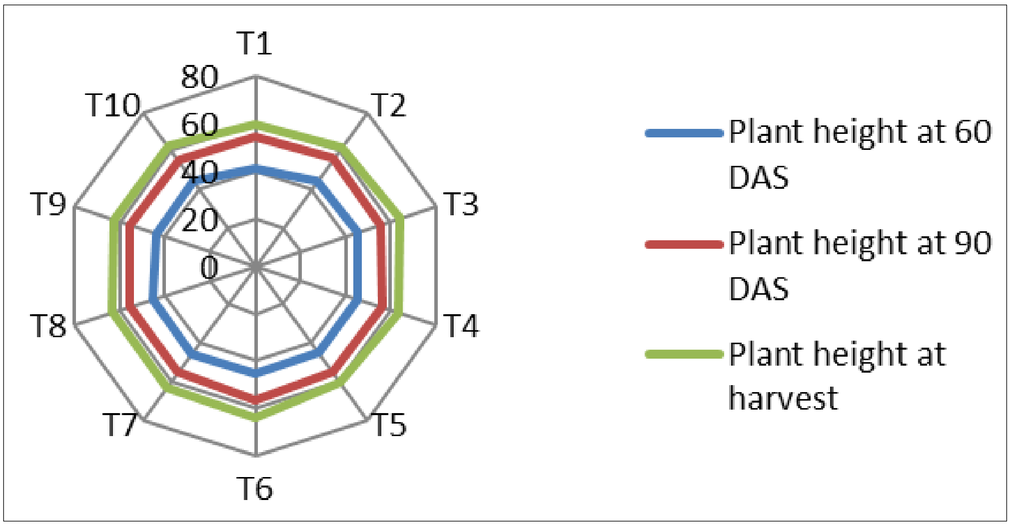

Fig 1: Effect of micronutrient application on plant height of groundnut

Yield attributes

No. of pods per plant and 100 kernel weight (g)

Number of pods per plant affected by application of different treatment. During year 2020, 2021, 2022 and on pooled data shows that soil application of application of $FeSO_4$ @ 15 kg/ha + $ZnSO_4$ @ 8 kg/ha (T_7) recorded significantly higher number of pods per plant and remained at par with treatment T_9: $ZnSO_4$ @ 8 kg/ha + Foliar spray of $FeSO_4$ @ 1% and T_3: $ZnSO_4$ @ 8 kg/ha. These micronutrients enhance cell division, cell elongation process and photo synthetic activity leading to production and accumulation of more carbohydrates and auxins which favours retention of more flowers ultimately leading to more number of reproductive parts per plant and yield. The similar results were recorded by Pareek and Poonia (2011) [24], Irmak *et al.* (2015) [25] and Poonia *et al.* (2022) [26]. However, harvest index was failed to manifest significant influence with application of different treatment of foliar spray. Effect of different treatment on 100 kernel weight remained non significant.

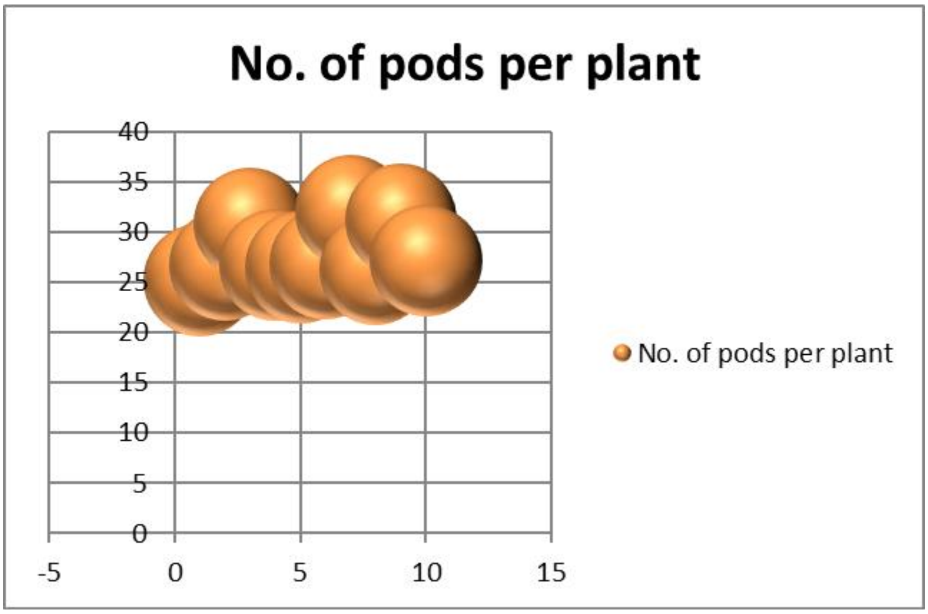

Fig 2: Effect of micronutrient application on pods per plant

Yield

Pod yield (kg/ha) and haulm yield (kg/ha)

The pod yield of groundnut significantly affected by various treatments. During the year 2020 treatment T_3: $ZnSO_4$ @ 8 kg/ha recorded significantly higher pod yield (2641 kg/ha) and remained at par with the treatment T_5, T_6, T_7 and T_9, while treatment T_7 that is soil application of application of $FeSO_4$ @ 15 kg/ha + $ZnSO_4$ @ 8 kg/ha recorded significantly higher pod yield in year 2021 (2741 kg/ha), 2022 (2892 kg/ha) as well as on pooled results (2734 kg/ha) and remained at par with the treatment T_9: $ZnSO_4$ @ 8 kg/ha + Foliar spray of $FeSO_4$ @1% and T_3: $ZnSO_4$ @ 8 kg/ha. The lower pod yield was recorded under the water spray (2231 kg/ha).

The effect of different treatment on haulm yield remained non-significant in individual year but remained significant on pooled results of three years. The higher haulm yield was recorded under the treatment T_3: $ZnSO_4$ @ 8 kg/ha (4290 kg/ha) and remained at par with the treatment T_7: $FeSO_4$ @ 15 kg/ha + $ZnSO_4$ @ 8 kg/ha, while lower haulm yield was recorded under the treatment of water spray. Increase in pod and haulm yield might be attributed to the beneficial and favourable effect of soil and foliar application of iron and zinc which enhance their role in biological activity, synthesis of IAA, metabolism of auxins, stimulating effect on photosynthetic pigments and enzyme activity which in encourage vegetative growth due to cell elongation and cell division while in case of reproductive growth, it increase retention of flowers and ultimately increase number of pods per plant and pod yield. The similar results were recorded by Nakum *et al.* (2019) [19], Sonawane and Nawalkar (2010) [10], Manasa S. (2013) [27], Arunachalam *et al.* (2012) [3], Saha *et al.* (2015) [13], Habbasha *et al.* (2014) [12], Elayaraja D. (2014) [11]. Maharnor *et al.* (2018) [29], Nakum *et al.* (2019) [19], Poonia *et al.* (2022) [26], Moosavi and Ronaghi (2011) [29], Pareek, and Poonia, (2011) [24] and Sale *et al.* (2017) [18].

Nitrogen, phosphorus and potassium content (%) in kernel, shell and haulm and its uptake (kg/ha)

Effect of different treatments on nitrogen content remained non-significant on individual as well as on pooled results of three years. Phosphorus content in kernel not significantly affected in individual year but gives significant results on pooled. Significantly higher phosphorus content in kernel was recorded under the treatment T_6 (0.493%) and remained at par with treatment T_3, T_4 and T_{10} while lower value was recorded under the treatment T_2. Phosphorus content in shell and haulm remained non-significantly affected by different treatments. Potassium content in kernel remains non-significantly affected by different treatments. Potassium content in haulm remained significant on pooled data of three years and recorded higher under the treatments T_4 (1.195%) and remained statistically at par with the treatments T_2, T_5, T_6 and T_8. Potassium content in haulm remained non-significant during individual year but remained significant on pooled data bases of three years. The higher value of potassium was recorded under the treatment T_7 (1.233%) and remained at par with the treatments T_2, T_4, T_5, T_6, T_8, T_9 and T_{10}.

Effect of different soil and foliar application of micronutrient on uptake of major nutrient remained significant. Significantly higher uptake of total nitrogen, phosphorus and potassium, were recorded under the treatment T_7: $FeSO_4$ @ 15 kg/ha + $ZnSO_4$ @ 8 kg/ha and remained at par with the treatments T_3 and T_9. This might be due to soil and foliar applied micronutrient improve the photosynthetic ability and by improving the cell elongation it improve absorption of macronutrient. Habbasha *et al.* (2014) [12], Elayaraja D. (2014) [12]. Gobarah *et al.* (2006) [31], Polara *et al.* (2009) [32], Maharnor *et al.* (2018) [29], Meresa and Tsehaye (2020) [33].

Fe and Zn content in kernel, shell and haulm (mg/kg) and its uptake (g/ha)

Fe content remained significant on individual as well as on pooled results of three years. Significantly higher value of Fe content in kernel was recorded by T_2 (66.72 mg/kg) and remained at par with the treatments T_7 and T_8. Fe content in shell was recorded significantly higher under treatment T_7 (1056 mg/kg) and remained at par with the treatments T_2, T_4 and T_8. Significantly higher value of Fe content in haulm was recorded by T_8 (716.3 mg/kg) and remained at par with the treatments T_7 while lower value was recorded under treatment T_1. Zinc content remained significantly affected by various treatments on individual as well as on pooled results of three years. Significantly higher value of Zn content in kernel was recorded by T_7 (36.68 mg/kg) and remained at par with the treatments T_3, T_8, T_9 and T_{10}. Zn content in shell was recorded significantly higher under treatment T_3 (24.96 mg/kg) and remained at par with the treatments T_7 and T_9. Significantly higher value of Zn content in haulm was recorded by T_{10} (20.87 mg/kg) and remained at par with the treatments T_3, T_5, T_7 and T_9 while lower value was recorded under treatment T_1.

The uptake of Fe by kernel, shell and haulm was significantly influenced by the different treatments. The treatment receiving RDF along with combined application of 15 kg $FeSO_4$ and 8 kg $ZnSO_4$ (T_7) recorded significantly higher total nutrient uptake during all the season well as on pooled basis, however it remained statistically at par with the treatments T_{10} on pooled of three years. The total uptake of Zn was recorded significantly higher in the treatment T_3, T_7, T_9 and T_3 in year 2020, 2021, 2022 and pooled year respectively. It remained at par with the treatments T_7 and T_9 on pooled of three year, while lower value was recorded under the treatment of water spray. and remained at par with the treatment T_{10} and T_9 in first season (2017), $T_{10,}$ T_9 and T_8 in second season (2018), $T_{7,}$ T_9, T_8 and T_2 in third season (2019) and $T_{9,}$ T_{10} and T_6 in pooled. These might be due to sufficient quantity of micronutrient availability in soil as well in foliar spray improve its absorption by plant parts such as leaf membrane and root system which accumulates in dry matter and ultimately improve its content. Manasa S. (2013) [27], Meena *et al.* (2007) [33], Naveen. (2012) [34], Veeramani *et al.* (2012) [35], Aboyeji *et al.* (2020), Elayaraja D. (2014) [11]. Gobarah *et al.* (2006) [30], Polara *et al.* (2009) [31], Maharnor *et al.* (2018) [28], Meresa and Tsehaye (2020) [32], Nandi *et al.* (2020) [22] and Hanwate *et al.* (2018) [37].

Table 1: Effect of different treatment on nitrogen, phosphorus and potassium content in kernel, shell and haulm of groundnut

Treatment	N content (%)			Phosphorus content (%)			Potassium content (%)		
	Kernel	Shell	Haulm	Kernel	Shell	Haulm	Kernel	Shell	Haulm
T_1 – Water spray	3.044	0.987	1.386	0.461	0.132	0.239	0.773	1.124	1.095
T_2 – $FeSO_4$ @ 15 kg/ha	3.155	1.009	1.420	0.455	0.128	0.237	0.765	1.136	1.171
T_3 – $ZnSO_4$ @ 8 kg/ha	3.156	0.993	1.408	0.486	0.122	0.243	0.754	1.058	1.123
T_4 – Foliar spray of $FeSO_4$ @1%	3.093	1.006	1.462	0.476	0.126	0.240	0.764	1.195	1.198
T_5 – Foliar spray of $ZnSO_4$ @ 0.5%	3.288	1.022	1.497	0.464	0.125	0.244	0.758	1.150	1.218
T_6 – Foliar spray of $FeSO_4$ @1% + Foliar spray of $ZnSO_4$ @ 0.5%	3.289	1.026	1.468	0.493	0.130	0.244	0.758	1.175	1.193
T_7 – $FeSO_4$ @ 15 kg/ha + $ZnSO_4$ @ 8 kg/ha	3.349	0.989	1.454	0.470	0.127	0.265	0.748	1.120	1.233
T_8 – $FeSO_4$ @ 15 kg/ha + Foliar spray of $ZnSO_4$ @ 0.5%	3.148	0.978	1.433	0.466	0.133	0.254	0.750	1.152	1.188
T_9 – $ZnSO_4$ @ 8 kg/ha + Foliar spray of $FeSO_4$ @1%	3.170	1.022	1.440	0.468	0.127	0.236	0.759	1.063	1.220
T_{10} – Grade IV Multi micronutrient spray @ 1%	3.247	1.012	1.443	0.490	0.131	0.261	0.765	1.110	1.240
S.Em. +	0.07	0.02	0.04	0.01	0.01	0.01	0.01	0.02	0.02
CD @ 0.05	NS	NS	NS	0.02	NS	NS	NS	0.06	0.07
C.V.%	6.84	6.27	6.07	5.74	8.07	7.71	7.71	6.54	6.72

Table 2: Effect of different treatment total nitrogen, phosphorus and potassium uptakes of groundnut

Treatment	Total nitrogen uptake (kg/ha)				Total phosphorus uptake (kg/ha)				Total potassium uptake (kg/ha)			
	2020	2021	2022	Pooled	2020	2021	2022	Pooled	2020	2021	2022	Pooled
T_1 – Water spray	100.9	97.4	111.9	103.4	14.08	20.17	14.25	16.17	50.98	69.04	55.40	58.47
T_2 – $FeSO_4$ @ 15 kg/ha	117.3	116.5	115.2	116.4	15.16	21.42	14.39	16.99	57.88	76.25	58.92	64.35
T_3 – $ZnSO_4$ @ 8 kg/ha	134.0	127.1	132.6	131.2	18.59	25.52	17.40	20.50	66.00	79.20	69.24	71.48
T_4 – Foliar spray of $FeSO_4$ @1%	116.0	110.0	116.7	114.2	15.39	21.45	15.18	17.34	59.16	74.88	63.06	65.70
T_5 – Foliar spray of $ZnSO_4$ @ 0.5%	119.8	110.2	128.4	119.5	15.75	20.54	14.72	17.00	60.31	74.29	60.79	65.13
T_6 – Foliar spray of $FeSO_4$ @1% + foliar spray of $ZnSO_4$ @ 0.5%	122.2	116.2	134.6	124.3	16.50	22.14	16.00	18.21	59.09	77.37	63.87	66.78
T_7 – $FeSO_4$ @ 15 kg/ha + $ZnSO_4$ @ 8 kg/ha	138.8	131.2	144.8	138.3	19.29	26.47	17.96	21.24	70.14	86.07	71.79	76.00
T_8 – $FeSO_4$ @ 15 kg/ha + Foliar spray of $ZnSO_4$ @ 0.5%	113.9	118.9	125.8	119.5	15.38	22.92	16.33	18.21	55.97	75.30	65.03	65.43
T_9 – $ZnSO_4$ @ 8 kg/ha + Foliar spray of $FeSO_4$ @1%	124.0	126.9	137.6	129.5	16.95	24.20	16.80	19.32	65.85	80.55	73.61	73.34
T_{10} – Grade IV Multi micronutrient spray @ 1%	117.2	121.3	132.2	123.6	14.34	25.86	15.54	18.58	56.28	77.55	66.56	66.80
S.Em. +	7.60	7.23	6.19	5.74	1.15	1.43	0.76	0.64	4.14	4.22	4.68	2.25
CD @ 0.05	NS	NS	18.39	11.51	NS	4.25	2.26	1.81	NS	NS	NS	6.37
C.V.%	13.41	10.21	8.54	10.55	12.36	10.75	8.31	10.84	11.92	9.49	12.50	11.20

Table 3: Effect of different treatment on iron content in kernel, shell and haulm of groundnut

Treatment	Fe content (mg/kg)			Total iron	Zn content (mg/kg)			Total zinc
	Kernel	Shell	Haulm	uptake (g/ha)	Kernel	Shell	Haulm	uptake (g/ha)
T_1 – Water spray	55.02	909.7	581.4	2842	32.93	21.21	15.87	121.4
T_2 – $FeSO_4$ @ 15 kg/ha	66.72	1008.0	669.7	3401	32.99	21.87	17.01	133.3
T_3 – $ZnSO_4$ @ 8 kg/ha	56.34	915.1	596.8	3493	35.70	24.96	19.98	173.7
T_4 – Foliar spray of $FeSO_4$ @1%	63.08	1003.0	644.8	3299	33.11	22.11	17.39	134.4
T_5 – Foliar spray of $ZnSO_4$ @ 0.5%	57.13	953.9	600.2	3017	33.97	22.74	19.31	140.1
T_6 – Foliar spray of $FeSO_4$ @1% + Foliar spray of $ZnSO_4$ @ 0.5%	58.89	990.3	660.3	3398	34.91	22.77	19.00	146.8
T_7 – $FeSO_4$ @ 15 kg/ha + $ZnSO_4$ @ 8 kg/ha	64.02	1056.3	703.3	4000	36.68	24.16	19.32	172.3
T_8 – $FeSO_4$ @ 15 kg/ha + Foliar spray of $ZnSO_4$ @ 0.5%	66.49	1055.6	716.3	3617	35.31	22.41	18.59	145.6
T_9 – $ZnSO_4$ @ 8 kg/ha + Foliar spray of $FeSO_4$ @1%	60.52	991.9	647.9	3662	36.63	25.23	20.11	171.1
T_{10} – Grade IV Multi micronutrient spray @ 1%	62.56	962.1	658.6	3352	35.19	23.04	20.87	152.8
S.Em. +	1.15	19.88	13.90	110.11	0.56	0.57	0.63	5.02
CD @ 0.05	3.23	56.03	39.19	310.37	1.58	1.60	1.86	14.16
C.V.%	5.78	6.24	6.48	10.34	5.19	7.39	6.54	10.10

Table 4: Effect of different treatment on pod and haulm yield of groundnut

Treatment	Pod yield (kg/ha)				Haulm yield (kg/ha)			
	2020	2021	2022	Pooled	2020	2021	2022	Pooled
T_1 – Water spray	2042	2207	2445	2231	3132	4099	3239	3490
T_2 – $FeSO_4$ @ 15 kg/ha	2218	2344	2507	2356	3413	4350	3284	3682
T_3 – $ZnSO_4$ @ 8 kg/ha	2641	2666	2830	2712	4281	4725	3864	4290
T_4 – Foliar spray of $FeSO_4$ @1%	2229	2356	2470	2352	3508	4144	3353	3668
T_5 – Foliar spray of $ZnSO_4$ @ 0.5%	2319	2257	2346	2307	3574	3978	3366	3639
T_6 – Foliar spray of $FeSO_4$ @1% + foliar spray of $ZnSO_4$ @ 0.5%	2287	2356	2520	2388	3594	4269	3467	3777
T_7 – $FeSO_4$ @ 15 kg/ha + $ZnSO_4$ @ 8 kg/ha	2571	2741	2892	2734	4255	4613	3810	4226
T_8 – $FeSO_4$ @ 15 kg/ha + Foliar spray of $ZnSO_4$ @ 0.5%	2175	2480	2693	2449	3412	4222	3395	3676
T_9 – $ZnSO_4$ @ 8 kg/ha + Foliar spray of $FeSO_4$ @1%	2490	2703	2830	2674	3920	4415	3988	4108
T_{10} – Grade IV Multi micronutrient spray @ 1%	2121	2493	2460	2358	3276	4359	3442	3692
S.Em. +	124.73	118.65	123.16	70.56	309.39	263.13	223.45	154.52
CD @ 0.05	370.54	352.47	365.86	200.16	NS	NS	NS	438.35
C.V.%	9.36	8.35	8.21	8.62	14.74	10.56	10.99	12.12

Conclusion
The farmers of North Gujarat Agro-climatic Zone IV growing *kharif* groundnut on Zn deficient light textured soil are recommended to apply 15 kg $FeSO_4$ and 8 kg $ZnSO_4.7H_2O$/ha as basal in addition to recommended dose of fertilizers (12.5-25 kg N-P_2O_5 /ha) for getting higher yield and net return.

Acknowledgement
The author is very much thank full to the Agricultural Research Station, SDAU, Aseda for carried out such research activities that are very much helpful for the farmers that are carried out micronutrient management experiment.

Reference

1. FAO. FAOSTAT. 2021.
2. Singh AL, Basu MS, Singh NB. Iron deficiency chlorosis and its management in groundnut. National Research Center for Groundnut (ICAR). Junagadh, India; c2003.
3. Arunachalam P, Kannan P, Prabhaharan J, Prabukumar G. Zinc deficiency in Indian soils with special focus to enrich zinc in peanut. African Journal of Agricultural Research. 2013;8:6681-6688.
4. Patel MS, Suthar DM, Kanzaria MV. Effect of foliar application of iron and sulphur in curing chlorosis in groundnut. Journal of Indian Society of Soil Science. 1993;41:103-105.
5. Desai D, Patel BT, Chaudhary N, Thakur P. Status of available sulphur and cationic micronutrients in cultivated soils of Banaskantha district of Gujarat. Indian Journal of Agricultural Research. 2018;52(2):203-206.
6. Gomez KA, Gomez AA. Statistical Procedures in Agricultural Research. 2nd ed. New York Chichester: Wiley; c1984. p. 680.
7. Das KC. Studies on the response of some micronutrients on growth and yield of groundnut. In: Proceedings of the Workshop on Micronutrients Seed Technology. Parbhani; c1992. p. 22-23.
8. Majumdar B, Venkatesh MS. Response of groundnut to phosphorus and zinc in relation to yield, quality and residual availability of P and Zn in acid soil of Meghalaya. Indian Journal of Hill Farming. 2001;14(1):29-32.
9. Meena RS, Yadav RS. Yield and profitability of groundnut (*Arachis hypogaea* L.) as influenced by sowing dates and nutrient levels with different varieties. Legume Research. 2015;38(6):791-797.
10. Sonawane BB, Nawalkar PS, Patil VD. Effect of micronutrients on growth and yield of groundnut. Journal of Soil Science and Crops. 2010;20(2):269-273.
11. Elayaraja D. Response of groundnut to zinc, boron and organics on the yield and nutrient availability in coastal sandy soil. International Research Journal of Chemistry. 2014;5:16-23.
12. Habbasha E, Magda SF, Mohamed H, Kramany MF, Ahmed AG. Effect of combination between potassium fertilizer levels and zinc foliar application on growth, yield and some chemical constituents of groundnut. Global Journal of Advanced Research. 2014;1(3):86-92.

13. Saha B, Saha S, Saha R, Hazra GC, Mandal B. Influence of Zn, B and S on the yield and quality of groundnut (*Arachis hypogea* L.). Legume Research. 2015;38(6):832-836.
14. Gowthami VSS. Studies on zinc and iron enrichment through ferti-fortification in groundnut (*Arachis hypogaea* L.) genotypes. M.Sc. (Agri.) Thesis. University of Agricultural Sciences, Raichur; 2015.
15. Rahevar HD, Patel PP, Patel BT, Joshi SK, Vaghela SJ. Effect of FYM, iron and zinc on growth and yield of summer groundnut (*Arachis hypogaea* L.) under North Gujarat agro-climatic conditions. Indian Journal of Agricultural Research. 2015;49(3):294-296.
16. Kamalakannan P. Effect of integrated plant nutrients supply through organic and inorganic sources on productivity of groundnut in loamy sand soil. Journal of Pharmacognosy and Phytochemistry. 2017;SP1:1182-1184.
17. Sharma MK, Jat RA, Ganesh SS. Effect of micronutrients and biofertilisers on morpho physiological parameters and productivity of summer groundnut (*Arachis hypogaea* L.). Indian Journal of Fertilisers. 2017;13(3):56-59.
18. Sale RB, Nazirkar RB, Ritu ST, Nilam BK. Effect of foliar spray of zinc, iron and seed priming with molybdenum on growth and yield attributes and quality of soybean in the rainfed condition of vertisol. International Journal of Chemical Studies. 2017;6:828-831.
19. Nakum SD, Sutaria GS, Jadav RD. Effect of zinc and iron fertilization on yield and economics of groundnut (*Arachis hypogaea* L.) under dryland condition. International Journal of Chemical Studies. 2019;7(2):1221-1224.
20. Sabra DM, Olfat HE, Habasha SF, Fergani MA, Mekki BB, El-Housini EA, Abou-Hadid AF. Response of growth characters, yield and yield attributes of groundnut (*Arachis hypogaea* L.) cultivars to some micronutrients foliar spraying application. International Journal of Chemical Studies. 2019;19(2):1896-1903.
21. Gowthami VSS, Ananda N. Zinc and iron fertifortification in groundnut (*Arachis hypogaea* L.) genotypes. Indian Journal of Agricultural Research. 2019;53(2):241-244.
22. Nandi R, Reja H, Chatterjee N, Bag AG, Hazra GC. Effect of Zn and B on the growth and nutrient uptake in groundnut. Current Journal of Applied Science and Technology. 2020;39(1):1-10.
23. Abhigna D, Lakshman K, Sree Rekha M, Latha M. Growth, yield and economics of groundnut (*Arachis hypogaea* L.) as influenced by micronutrient fertilization on coastal sandy soils of Andhra Pradesh. The Pharma Innovation Journal. 2021;10(9):312-315.
24. Pareek NK, Poonia BL. Effect of FYM, nitrogen and foliar spray of iron on productivity and economics of irrigated groundnut in an arid region of India. Archives of Agronomy and Soil Science. 2011;57(5):523-531.
25. Irmak S, Cil A, Yucel H, Kaya Z. Effects of zinc application on yield and some yield components in peanut (*Arachis hypogaea*) in the Eastern Mediterranean Regional. Journal of Agricultural Science. 2015;22:109-116.
26. Poonia T, Bhunia SR, Choudhary R. Effect of iron fertilization on growth, yield and economics of groundnut (*Arachis hypogaea* L.). International Journal of Economic Plants. 2022;9(1):038-044.
27. Manasa S. Effect of water soluble fertilizers on growth, yield and oil quality of groundnut in a Vertisol of Northern Transition Zone of Karnataka. M.Sc. (Agri.) Thesis. University of Agricultural Sciences, Dharwad, India; 2013.
28. Maharnor RY, Indulkar BS, Lokhande PB, Jadhav LS, Padghan AD, Sonune PN. Effect of different levels of zinc on yield and quality of groundnut (*Arachis hypogaea* L.) in Inceptisol. International Journal of Current Microbiology and Applied Sciences. 2018;6:2843-2848.
29. Moosavi AA, Ronaghi A. Influence of foliar and soil applications of iron and manganese on soybean dry matter yield and iron-manganese relationship in a calcareous soil. Australian Journal of Crop Science. 2011;5:1550-1556.
30. Gobarah ME, Mohamed MH, Tawfik MM. Effect of phosphorus fertilizer and foliar spraying with zinc on growth, yield and quality of groundnut under reclaimed sandy soils. Journal of Applied Science Research. 2006;2(8):491-496.
31. Polara KB, Sakarvadia HL, Parmar KB, Babariya NB, Kunjadia BB. Residual effect of potassium and zinc on growth, yield and nutrient uptake by groundnut in medium black calcareous soils. An Asian Journal of Soil Science. 2009;4(2):245-247.
32. Meresa H, Tsehaye Y. Interaction of phosphorus and foliar zinc on seed quality and *Aspergillus* infection on groundnut (*Arachis hypogaea* L.) genotypes in dryland area of Tanqua Abergelle, Ethiopia. International Journal of Life Sciences. 2020;8(1):59-69.
33. Meena S, Malarkodi M, Senthilvalavan P. Secondary and micronutrients for groundnut-A Review. Agricultural Reviews. 2007;28(4):295-300.
34. Naveen BT. Productivity of groundnut as influenced by different nutrient ratios of nitrogen and phosphorus. M.Sc. (Agri.) Thesis. University of Agricultural Sciences, Dharwad, Karnataka (India); 2012.
35. Veeramani P, Subrahmaniyan K, Ganesaraja V. Nutrient management for sustainable groundnut productivity in India-A Review. International Journal of Engineering Science. 2012;11(3):8138-8153.
36. Aboyeji CM, Dunsin O, Adekiya AO, Suleiman KO, Chinedum C, Okunlola FO. Synergistic and antagonistic effects of soil applied P and Zn fertilizers on the performance, minerals and heavy metal composition of groundnut. Open Agriculture. 2020;5:1-9.
37. Hanwate GR, Giri SN, Yelvikar NV. Effect of foliar application of micronutrients on nutrient uptake by soybean crop. International Journal of Pure & Applied Bioscience. 2018;6:261-265.