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Influence of cured zinc and iron on growth and yield of summer groundnut

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Abstract: A field experiment was conducted during summer-2015 at Agriculture Research Station, Bagalkot on medium black clay soil to study theinfluence of cured zinc and iron on growth and yield of summer groundnut in northern dry zone of Karnataka. The experiment was laid out in factorial randomized block design with three replications consisted of 16 treatment combinations involving soil application of different levels of zinc and iron (100, 75 and 50 per cent of recommended zinc and iron and without micronutrients) by curing with different organic sources (Farmyard manure, Vermicompost, Poultry manure and without curing source). Among the different treatments, treatment receiving 100 % Zn and Fe cured with poultry recorded higher plant height, number of branches per plant, total dry matter production, chlorophyll content, leaf area and leaf area index. Similarly significantly higher yield attributes and pod yield were recorded in the same treatment.

Key wards: Groundnut, Iron, Micronutrient, Zinc

Introduction

Groundnut (*Arachis hypogaea* L.) is the world's fourth most important source of edible oil and third most important source of vegetable protein. It is an annual legume, native of South America (Brazil), and grown throughout the tropical and warm temperate regions of the globe. Cultivated groundnut is also known as peanut and the seeds are referred as kernel. These kernels are used for manufacturing of confectionary nut flour, protein and peanut milk (Woodroof, 1966). About two third of the world's groundnut production is used as oil and remaining one third is consumed as food.

Groundnut productivity level of our country is far below the world average. It could be attributed to several production constraints, which includes poor and imbalanced nutrition, cultivation on marginal lands, lack of improved high yielding cultivars, uneven rainfall distribution, incidence of foliar diseases and lack of application of micronutrients.Deficiency of Zn and Fe is a well documented problem in food crops, causing decreased crop yields and nutritional quality.

Mixed application of inorganic salts of micronutrients with organic manures *viz.,* farmyard manure, poultry manure and vermicompost may serve as a source of micronutrients and complexing agents. Thus, increases use efficiency of micronutrients. On decomposition of organic manures numerous compounds like humic acid, fulvic acid and biological substances like organic acid, amino acid and polyphenols are produced which act as chelating agents that form stable complexes with native micronutrients and also prevent added inorganic micronutrients from precipitation, fixation, oxidation and leaching and results in improvement of micronutrients use efficiency.

Material and methods

The field experiment was conducted at Agricultural Research Station, Bagalkot during summer season of 2015 which is situated in northern dry zone of Karnataka and located between $16^{0}18'$N latitude and $75^{0}7'$East longitude and at an altitude of 532 m above mean sea level.

The soil of the experimental site is mediumblack in nature and the texture of the soil is clayey. The experiment was laid out in factorial Randomized Complete Block Design with 16 treatment combinations. The treatments comprise of different Zn and Fe levels (100 %, 75 %, 50 % of recommended Zn and Fe and no micronutrients) cured with different organic sources (farmyard manure, varmicompost, poultry manure and without curing sources).

Seeds of groundnut (var. Dh-86) were sown by using marker with a row spacing of 30x10 cm and seed rate of 150 kg ha^{-1}. Fertilizers were applied as per recommendation (25:75:25 kg N: P_2O_5: K_2O ha^{-1}, respectively + FYM 7.5 t ha^{-1} RDF) for summer groundnut. The zinc and iron were applied at the time of sowing as per treatments after curing with organics. The curing was done by thoroughly mixing the organics (Farmyard manure, vermicompost and poultry manure) with zinc and iron as per the treatment, and was kept for one week incubation, and then applied while sowing. The statistical analysis was carried out based on mean values. The level of significance used in 'F' and 'T' test was P= 0.05 (Gomez and Gomez, 1984).

Results and discussion

The plant height of groundnut increased significantly with application of 100 per cent Zn and Fe (13.2 17.6 and 24.7 cm at 60, 90 DAS and at harvest, respectively) over other treatments (Table 1). The improvement in plant height due to Zn and Fe application could be attributed to proper nourishment of crop, which resulted in optimum growth. The increase in plant height caused higher number of primary branches at all the stages of crop growth. Application of 100 per cent Zn and Fe recorded significantly higher number of branches $plant^{-1}$ at all growth stages which was significantly superior over other treatments (Table 1).

Table 1.Growth and growth parameters of groundnut as influenced by application of cured zinc and iron

Treatments	Plant height (cm)	Number of branches plant^{-1}	TDM (g plant^{-1})	Chlorophyll content at 90 DAS (SPAD Value)	Leaf area (dm^2)	LAI
Factor I : Levels of micronutrient (M)						
M_1: Application of recommended $ZnSO_4$ and $FeSO_4$ each @ 25 kg ha^{-1}	22.11	8.12	43.04	40.11	13.9	4.6
M_2: Application of 75% ofM_1	21.25	7.41	36.65	37.83	12.3	4.1
M_3: Application of 50% ofM_1	20.75	6.93	32.48	36.09	10.4	3.5
M_4: Control (without micronutrients)	19.93	6.23	27.03	33.23	8.3	2.8
S.Em ±	0.43	0.22	0.12	0.46	0.2	0.06
C.D. (p=0.05)	1.24	0.64	0.36	1.34	0.5	0.2
Factor II: Source of curing material (S)						
S_1: Farmyard manure	20.85	7.13	35.34	37.16	11.5	3.8
S_2: Vermicompost	21.16	7.41	35.97	37.26	11.5	3.8
S_3: Poultry manure	21.35	7.43	36.25	37.45	11.6	3.9
S_4 : Control (without organic source)	20.68	6.72	31.64	35.38	10.4	3.5
S.Em ±	0.43	0.22	0.12	0.46	0.2	0.06
C.D. (p=0.05)	NS	NS	0.36	1.34	0.5	0.2
Interaction						
S_1M_1	24.5	8.4	44.1	40.7	14.2	4.7
S_1M_2	23.6	7.5	37.6	38.3	12.9	4.3
S_1M_3	22.4	7.1	32.7	36.4	10.7	3.6
S_1M_4	21.8	6.7	27.0	33.2	8.2	2.7
S_2M_1	24.9	8.4	44.5	40.8	14.3	4.8
S_2M_2	23.5	8.0	37.9	38.4	12.6	4.2
S_2M_3	22.8	7.6	34.3	36.5	10.8	3.6
S_2M_4	21.5	6.6	27.2	33.3	8.4	2.8
S_3M_1	25.3	8.8	45.5	41.0	14.3	4.8
S_3M_2	24.0	8.1	38.3	38.4	12.6	4.2
S_3M_3	23.0	7.5	33.6	36.7	11.0	3.7
S_3M_4	21.4	6.9	27.6	33.7	8.5	2.8
S_4M_1	23.9	7.8	38.0	38.0	12.8	4.3
S_4M_2	23.1	7.2	32.8	36.2	11.2	3.7
S_4M_3	22.1	6.7	29.3	34.7	9.3	3.1
S_4M_4	21.5	6.6	26.4	32.7	8.2	2.7
S.Em ±	0.68	0.43	0.25	0.93	0.34	0.11
C.D. (p=0.05)	NS	NS	0.71	NS	NS	NS

TDM – Total dry matter production

RDF (25:75:25 N: P_2O_5: K_2O kg ha^{-1}) + Farmyard manure 7.5 t ha^{-1} (common for all the treatments)

The pre-requisite for getting higher yields in any crop is higher total dry matter production and it's partitioning into various parts, coupled with maximum translocation of photosynthates to sink. The total dry matter production of groundnut differed significantly due to micronutrients application. Application of 100 per cent Zn and Fe recorded significantly higher total dry matter production at all growth stages (Table 1). This may be due to the favorable effect of higher dry matter distribution in leaves, stem and pods. The dry matter accumulation in leaves, stem and pods depends upon the photosynthetic ability of the plant at various stages of the growth and can be analyzed through leaf area and dry matter accumulation in leaves.

The chlorophyll content was influenced significantly with the application of micronutrients. Among different levels of micronutrients application, 100 per cent Zn and Fe along with RDF recorded higher chlorophyll content (30.72, 37.02, 40.11 and 37.29 at 30, 60, 90 DAS and at harvest respectively) as compared to control (Table 1). Zinc and iron could be involved in synthesis of chlorophyll by taking part in the regulation of cytoplasmic concentrations of nutrients.

The results of the present investigation revealed that, the curing source poultry manure recorded higher total dry matter production, leaf area, leaf area index and chlorophyll content at all the growth stages (Table 1) compared to control, and it was on par with other curing sources. This could be due to the fact that curing source made better availability of nutrients by complexing which prevented losses of nutrients in soil by different means. Cured nutrients are responsible for the higher growth attributes and in turn growth indices. Similar observations were made by Meena *et al.* (2008) with use of different organics as curing sources.

The total dry matter accumulation was significantly higher with application of 100 per cent Zn and Fe cured with poultry manure at all crop growth stages (30, 60, 90 and at harvest). This might be due to higher available zinc and iron throughout the crop growth period that caused higher metabolic activity and more photosynthesis.

The higher pod (3023 kg ha^{-1}) and haulm (4792 kg ha^{-1}) yields were recorded with application of 100 per cent Zn and Fe over the lower Zn and Fe levels. The overall increase in pod yield was to the tune of 33 per cent over control. The higher pod yield could be attributed to higher total dry matter accumulation due to higher uptake of nutrients and their translocation to the reproductive parts which resulted in improvement in yield attributes like number of pods $plant^{-1}$,100 pod weight, test weight and shelling percentage (Table 2). The difference in yield attributes could be due to variations in translocation of photosynthates from vegetative to reproductive parts and improvement in growth parameters like leaf area, leaf area index, dry matter accumulation and other growth indices. These results are in agreement with the findings of Arunachalam *et al.* (2013) and Meena *et al*. (2007) in groundnut.

The results obtained from field study revealed that the poultry manure as curing source recorded significantly higher pod and haulm yield (2659 and 4542 kg ha^{-1}, respectively) and it was at par with vermicompost and farm yard manure, similar trend of significance was observed with regard to growth and yield parameters (Table 2).

Among the interactions significantly higher pod yield was recorded with application of 100 per cent Zn and Fe cured with poultry manure. The beneficial effect of Zn and Fe enriched with organics was clearly noticed over no application (control).Application of recommended $ZnSO_4$ and $FeSO_4$ after curing with FYM, vermicompost and poultry manure increased the pod yield by 37, 38 and 40 per cent respectively over no application of Zn and Fe. The yield is mainly determined by yield attributing parameters viz., number of pods per plant, 100 pod weight, test weight and shelling percentage. Significantly

Table 2. Yield and yieldattributes of groundnut as influenced by application of cured zinc and iron

Treatments	Number of pods $plant^{-1}$	100 pod weight (g)	Test weight (g)	Pod yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Shelling percentage
Factor I : Levels of micronutrient (M)						
M_1: Application of recommended $ZnSO_4$ and $FeSO_4$ each @ 25 kg ha^{-1}	17.13	66.58	34.56	3023	4792	70.92
M_2: Application of 75% ofM_1	15.58	63.67	32.72	2710	4613	69.75
M_3: Application of 50% ofM_1	14.21	61.25	31.96	2382	4376	69.13
M_4: Control (without micronutrients)	11.38	59.33	30.10	2022	3928	67.17
S.Em ±	0.14	0.42	0.21	28.11	76.51	0.29
C.D. (p=0.05)	0.42	1.20	0.62	81.18	220.97	0.84
Factor II: Source of curing material (S)						
S_1: Farmyard manure	14.83	62.67	32.33	2592	4467	69.54
S_2: Vermicompost	15.21	63.58	32.73	2624	4467	69.83
S_3: Poultry manure	15.29	63.67	33.03	2659	4542	70.13
S_4: Control (without organic source)	12.96	60.92	31.25	2261	4232	67.46
S.Em ±	0.14	0.42	0.21	28.11	76.51	0.29
C.D. (p=0.05)	0.42	1.20	0.62	81.18	220.97	0.84
Interaction						
S_1M_1	17.5	67.3	35.1	3122	4821	71.5
S_1M_2	16.0	62.7	32.3	2784	4659	70.0
S_1M_3	14.8	61.0	31.8	2387	4345	69.7
S_1M_4	11.0	59.7	30.1	2077	4045	67.0
S_2M_1	17.8	68.0	35.2	3091	4862	72.0
S_2M_2	16.0	65.3	33.0	2861	4704	70.3
S_2M_3	15.0	61.7	32.7	2516	4453	69.7
S_2M_4	12.0	59.3	30.1	2029	3850	67.3
S_3M_1	18.0	68.3	35.3	3219	4987	72.2
S_3M_2	16.2	65.3	34.1	2836	4738	71.3
S_3M_3	15.0	61.7	32.5	2518	4461	69.8
S_3M_4	12.0	59.3	30.2	2063	3981	67.2
S_4M_1	15.2	62.7	32.6	2658	4498	68.0
S_4M_2	14.2	61.3	31.5	2359	4352	67.3
S_4M_3	13.0	60.7	30.8	2106	4244	67.3
S_4M_4	10.5	59.0	30.1	1921	3836	67.2
S.Em ±	0.29	0.83	0.43	56.22	153.0	0.59
C.D. (p=0.05)	0.83	2.40	1.23	162.4	NS	1.69

RDF (25:75:25 N: P_2O_5: K_2O kg ha^{-1}) + Farmyard manure 7.5 t ha^{-1} (common for all the treatments) higher number of pods per plant, 100 pod weight, test weight and shelling percentage, higher dry matter accumulation and its partitioning towards sink was observed in treatment receiving 100 per cent Zn and Fe cured with poultry manure (Table 2). These results are in conformity with findings of Latha *et al.* (2002), Meena *et al.* (2008) and Sridevi *et al.* (2010).The significant effect of Zn and Fe enriched withorganicson yield and yield attributes could be due to the fact that the enhanced micronutrients availability through chelation which thereby preventing their reaction with soil mineral constituents and protecting them from fixation.

Conclusion

Soil application of recommended dose of Zn and Fe (each @ 25 kg ha^{-1}) cured with organic sources found to be more effective in further enhancing pod yield and haulm yield over straight application of recommended zinc and iron. Among different curing sources poultry manure found to be better source for curing of micronutrient.

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