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PB-9

Zn-Biofortification in Groundnut Through Various Zn-Sources

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Introduction

Zinc is an essential nutrient for human health and plenty of peoples in India, with vegetarian food habits, are at the risk of its deficiency mainly due to consumption of low Zn food crops grown on Zn-deficient soils (Singh et al 2017). Groundnut is a good source of Zn and consumption of high Zn density groundnut may be a solution to ensure adequate level of Zn uptake in India (Lal and Singh, 2007; Singh et al 2017). However, in India, as the groundnut crop is mostly grown on marginal soil, its productivity and seed Zn density is low, leading to less per capita availability of Zn. Application of zinc-sulphate increases Zn concentration in seed through bio-fortification (Singh and Chaudhari, 2015). As there are a number of Zn sources available, an effort was made to test various Zn sources for its biofortification in seed.

Methodology

In a field experiments, in a medium black calcareous clayey soil with 1.4 mg/kg DTPA Zn at ICAR_DGR, Junagadh, five zinc containing chemicals (zinc sulphate, Zn-EDTA, zinc chloride, zinc oxide and zinc acetate) at 2 kg Zn/ha were applied (50 % as soil and 50 % as foliar spray on plant) during summer season and their response on pod yield and seed-Zn content was determined (using AAS) in 10 groundnut cultivars.

Results and Discussion

The data on yield and other parameters though showed slight variation in the response, all the Zn-sources (zinc sulphate, Zn EDTA, zinc chloride, zinc oxide and zinc acetate) arrested the excess plant growth reducing haulm yield and increased harvest index, shelling and 100 seed wt. The maximum increase in pod yield was due to zinc sulphate and zinc acetate. However, all the Zn-sources increased Zn concentrations in seeds of all the groundnut cultivars.

On an average application of Zn, increased 18 % Zn in the seed though it varied with cultivars and Zn-sources. The Zn concentrations in seed of groundnut cultivars grown under various Zn-sources ranged 40-75 mg kg^{-1} Zn with a mean value of 56 mg kg^{-1}. Application of zinc sulphate and Zn-acetate showed superiority over other Zn-sources, with least response of zinc oxide.

More than 9 million tons of groundnut pod is produced in India of which about 50 % is consumed in various forms as food and snacks, right from raw to roasting, frying, salting or boiling where Zn fertilizers, through increased yield and Zn content in seed, may play a major role in combating the Zn malnutrition in rural India.

Conclusion

Thus application of 2 kg/ha Zn is recommended to increase the groundnut seed yield and its Zn content. Further, based on the availability, any one of these could be used, the commercial Zinc-sulphate was cheap and hence identified as the preferred Zn-source.

PB-11

Foliar Application of Zinc-Sulphate Enhances Photosynthetic Efficiencies and Productivity of Groundnut

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Introduction

The groundnut productivity, in India, is fluctuating between 1300-1750 kg ha^{-1} during the last 5 years mainly due to its rain-fed (84 % area) cultivation in light textured soils where deficiency of iron and zinc is of common occurrence. However, the productivity is above 1900 kg ha^{-1} during *Summer* season. Application of Fe and Zn fertilizers ameliorate these deficiencies and recommended (Singh et al 1993). As the Zn plays an important role in the photosynthetic processes and involved in several enzyme systems, its influence was studied on photosynthetic efficiencies and productivity in a number of groundnut cultivars.

Methodology

Sixty groundnut cultivars were grown in the field during *Summer* 2013 in a calcareous soil, at the Directorate of groundnut (DGR), Junagadh India under control and Zn applied (three foliar spray of 0.2% zinc sulphate at 40, 55 and 70 days after emergence) conditions and subject to measurement of net Photosynthetic rate (P_N, µmol m^{-2} s^{-1}), transpiration rate (*E*, mmol m^{-2} s^{-1}), stomatal conductance (g_s, mmol m^{-2} s^{-1}) and several other physiological parameters during 60-65 DAE using a portable photosynthesis system (*Model LI-6400*, *LI-COR*, USA). All the measurements were made in between 08:00–11:30 h in the third leaf from the main axis at ambient temperature, PAR 1,650 µmol (photon) m^{-2} s^{-1} inside the cuvette, and CO_2 concentration 390 µmol m^{-2} s^{-1}.

Results and Discussion

The photosynthetic efficiencies in groundnut in term of P_N, *E*, g_s and water use efficiency (WUE, P_N/E) during peak podding stages (60-65 DAE) clearly demonstrated that, foliar application of Zn influenced the physiological parameters which helped in increasing production of groundnut. Accordingly, the groundnut cultivars were shorted out for various parameters and divided into zinc responsive and non-responsive one. Foliar application of Zn increased P_N in 31 groundnut cultivars (1 to 12 %), *E* in 36 cultivars (1 to 10 %) and water use efficiency (WUE) in 28 cultivars (1 to 10%), but decreased stomatal conductance in 35 cultivars (1 to 10 %).

More than 50 % of the Indian soil show Zn deficiency in groundnut and the calcareous soils, where this crop was grown, are characterized by high bicarbonate content with deficiency of Zn. The recent physiological studies of mini-core peanut accessions showed a large variability (Singh et al. 2014) which will help in developing new cultivars. Though there was a variable response of Zn application in groundnut cultivars, majority showed positive response exhibiting high P_N which indicates usefulness of these in Zn-deficient areas and the responsive one which can be highly useful in future breeding programme. The cultivars Tirupati 2, ICGV 86031 and CO1 were highly responsive to Zn application and increased all physiological traits.

Conclusion

The groundnut crop grown in calcareous soil face Zn-deficiency, where foliar application of 0.2 % zinc- sulphate is recommended for increasing physiological efficiencies and overall productivity. Identification of zinc responsive groundnut cultivars with high photosynthetic efficiencies and yield is further useful in increasing productivity and in breeding programme for developing new cultivars.

SO-16

Photosynthetic Response of Peanut Cultivars to Foliar Application of Salicylic Acid under Salinity Stress

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Introduction

The peanut is a major oilseeds as well as food legume crop of the tropical and sub-tropical world where it is grown as rainfed as well as under irrigated conditions in semiarid to arid climate where bad weather conditions, drought, salinity, temperature stresses are the major factors governing the productivity particularly in Asian and African countries (Singh et al 2013). Salinity stress is one of the major abiotic stresses limiting plant growth and yield (Chakraborty et al 2013). The dry matter production is influenced by the rate of physiological processes such as photosynthesis, transpiration etc. The present study was aimed at studying the photosynthetic response under salinity stress and amelioration with salicylic acid.

Methodology

Two groundnut cultivars (TPG 41 and TMV 2) having various degree of salinity tolerance (Singh et al 2010) were studied by growing them in a pot experiments at DGR, Junagadh under three treatments (control, 50 mM NaCl salt, 50 mM NaCl salt + 1 mM Salicilic acid, SA). Photosynthetic parameters such as net photosynthetic rate (P_N umol m^{-2} s^{-1}), stomatal conductance (g_S m s^{-1}) were recorded at 30 DAS using portable photosynthesis system (LI-6400, LI-COR, USA).

Results and Discussion

The salinity decreased P_N and g_S in leaves of both of these cultivars, but some increase in both photosynthetic rate and stomatal conductance was observed with SA application under saline environment. In TPG 41 decrease in P_N and g_S were 46 and 58 %, respectively whereas in TMV 2 it was 24 and 23 %, respectively. However when SA was applied the respective increase in photosynthetic rate and stomatal conductance were 41 and 65 % in TPG 41 and 21 and 35 % in TMV 2 showed increase in respectively. Thus there is ameliorative effect of SA on salinity. The decreases rate of photosynthetic and stomatal conductance due to salinity was mainly due to the stomatal closure which limited leaf photosynthetic capacity in both the cultivars. The SA application alleviates the salt-induced decrease in photosynthesis as well as conductance.

Conclusion

The salinity decreases rate of photosynthetic and stomatal conductance limiting leaf photosynthetic capacity in both the cultivars and finally productivity. However these affect could be masked through SA application.