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RESEARCH PAPER

Integrated nutrient management in groundnut (*Arachis hypogaea* L.) for higher production during rainy season

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Abstract **:** A study was carried out for two consecutive years during rainy season of 2002 and 2003 at Zonal Agricultural Research Station, Mainpuri, C.S. Azad University of Agriculture and Technology, Kanpur. The main objective was to find out the suitable dose of sulphur + calcium for integration with recommended dose of 20 kg N+ 30 kg P_2O_2 +45 kg K_2O ha^{-1} and 10 t FYM ha^{-1} to revive groundnut production on nutrient deficient soils during rainy season. The summarized results of two years experiment indicate that groundnut responded to the application of 20 kg N + 30 kg P_2O_5 + 45 kg K_2O + 52.5 kg S + 70 kg Ca +10 t FYM ha^{-1}, which registered significantly higher pod yield (30.60 q ha^{-1}) over lower installments of sulphur and calcium in the integration of RDF + 10 t FYM ha^{-1}. Application of highest tested dose of 60 kg S + 80 kg Ca ha^{-1} with RDF + 10 t FYM ha^{-1} confined the pod yield of groundnut (30.74 q ha^{-1}) compared to RDF + 10 t FYM +52.5 kg S + 70 kg Ca ha^{-1}. The growth and yield traits noted in groundnut under different integrated doses of nutrients were concordant to the pod yield of groundnut.

Key Words **:** Sulphur, Calcium, Gynophores, Pops, Black heart, Integrated nutrients management, Groundnut

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INTRODUCTION

Groundnut (*Arachis hypogaea*) is an important *Kharif* season oilseed crop of Uttar Pradesh, India. The riverine alluvial soil of Uttar Pradesh having loamy sand, sandy loam and light loam texture is famous for rainy season groundnut cultivation but area and production of groundnut are declining in U.P. Efforts to arrest decline in area and production did not succeed due to biotic and abiotic reasons. The biotic, abiotic and economic reasons drastically interrupted the area of groundnut. Among the abiotic reasons imbalance use of fertilizers, mild deficiency of P, S, Ca and Fe and severe deficiency of Zn in the soil are major factors, which are directly responsible for the low production of groundnut during rainy season.

Groundnut is an exhaustive crop and depending upon the yield, it removes large amount of macro and micro nutrients. An average groundnut crop, with 20 to 25 q ha^{-1} of economic yield, requires, 160-180 kg N, 20-25kg P, 80-100 kg K, 60-80 kg Ca, 15-20 kg S, 30-45 kg Mg, 3-4 kg Fe, 300-400g Mn, 150-200 g Zn, 140-180 g B, 30-40 g Cu and 8-10 g Mo (Singh, 1999). The Ca, K, P and S between macro nutrients and Fe and B between micro nutrients are involved in the kernel filling and oil synthesis and, hence, are required in higher quantity. Thus, a strong need was felt to develop a suitable nutrient management technology for groundnut cultivation with available resources to revive groundnut production in the state, is the subject matter of this paper.

MATERIALS AND METHODS

A field trial was carried out for two consecutive years during rainy season of 2002 and 2003 at Zonal Agricultural Research Station, Mainpuri, C.S. Azad university of Agriculture and Technology, Kanpur. The soil of experimental site was sandy loam having pH 8.5, organic carbon 0.45 per cent, total

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nitrogen 0.04 per cent, available phosphorus 10 kg ha^{-1} and available potash 278 kg ha^{-1}, therefore, the fertility status of experimental soil was low. Groundnut crop was grown under eight integrated doses of nutrient {RDF(20 kg N + 30 kg P_2O_5+45 kg K_2O ha^{-1})+10t FYM+ 0 kg S + 0 kg Ca, RDF+10 t FYM + 15 kg S +20 kg Ca, RDF +10 t FYM+22.5 kg S +30 kg Ca, RDF + 10 t FYM + 30 kg S+ 40 kg Ca, RDF + 10 t FYM+37.5 kg S +50 kg Ca, RDF +10 t FYM+ 45kg S+60 kg Ca, RDF+10 t FYM +52.5 kg S+ 70 kg Ca and RDF + 10 t FYM + 60kg S+ 80 kg Ca ha^{-1} } in RBD with three replications. The FYM was applied 25 days before of groundnut planting and inoculated with verimcompost @ 0.5 t /10 t FYM just to prepare the vermicmpost *in situ* and increased the demography of earthworms in the experimental field. FYM applied in the experimental field contained 0.30 per cent N, 0.15 per cent P_2O_5 and 0.30 per cent K_2O. Similarly, verimcompost used as a inoculants was comprised of organic matter 16.98 per cent, total nitrogen 1.50 per cent, phosphorus 0.30 per cent, potassium 0.46 per cent, sodium 0.15 per cent, calcium 0.10 per cent, copper 8.5 ppm, iron 7.3 ppm, zinc 10.5 ppm and sulphur 448 ppm. The full dose of NPK and half doses of S and Ca were given at sowing and remaining half doses of S and Ca were top dressed and mixed in to soils at flower initiation stage. Well powdered 30 - mesh gypsum was applied to groundnut. The requirement of 15 kg S + 20 kg Ca, 22.5 kg S +30 kg Ca, 30 kg S + 40 kg Ca, 37.5kg S +50 kg Ca, 45 kg S+ 60kg Ca 52.5 kg S+ 70 kg Ca and 60 kg S + 80 Kg Ca met from 80, 120, 160, 200, 240, 280 and 320 kg gypsum ha^{-1}, respectively. The groundnut cv. DH 86 was planted in rows 30cm apart with 8 cm plants to plants distance. Kernels were seeded on July 21, 2002 and July 22, 2003, harvested after 87 days on October 16, 2002 and October 17, 2003. Well dried pods were graded, weighed and stored after 15 days of harvesting at 7-8 per cent moisture content.

The variances for error were found homogeneous. Hence, the pooling of the data for each character was done for the two years by the standard method, suggested by Cochran and Cox (1957).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect of RDF+FYM+S+Ca on growth parameters:

The main shoot height did not show significant response due to integration of different doses of sulphur + calcium in the integration of RDF + 10 t FYM ha^{-1} but a increasing trend was observed upto highest tested dose of sulphur + calcium. The maximum height of main shoot was recorded with the integration of 60 kg S +80kg Ca in the integration of RDF+10 t FYM ha^{-1} but this highest dose of combination confined the height of main shoot over the lower dose of RDF+10 t FYM +52.5 kg S + 70 kg Ca ha^{-1}. Braches $plant^{-1}$ showed significant increasing trend with increasing levels of S + Ca upto 60 kg S + 80 kg Ca ha^{-1} but this higher dose stagnated further improvement in braches $plant^{-1}$ over lower dose of 52.5 kg S + 70 kg Ca ha^{-1} (Table 1). It might have been owing to better utilization of resources under improved S supply, as it plays multiple role in plant metabolism being an essential constituent of S containing amino acids and as such of protein, vitamins, acetyl CO-A, ferrodoxin and glutathione. Similarly, calcium maintained the cell integrity and membrane permeability, activated the number of enzymes for cell division and taken part in protein syntheses and carbohydrate transfer. These results are in close conformity with findings of Dayanand and Meena (2000) and Singh *et al*. (2005).

Effect of RDF+FYM+S+Ca on yield contributing characters:

Yield traits *i.e.* filled pod $plant^{-1}$, filled pod weight $plant^{-1}$, kernel weight $plant^{-1}$ and 100-kernel weight increased significantly upto 52.5 kg S +70 kg Ca ha^{-1} in the integration of RDF + 10 t FYM ha^{-1} in comparison to lower installments of S +Ca when integrated with RDF + 10t FYM ha^{-1}. Application of higher dose of 60 kg S + 80 kg Ca in the integration of RDF + 10t FYM ha^{-1} confined the all yield traits compared with integrated dose of RDF + 10 t FYM + 52.5 kg S +70 kg Ca ha^{-1} (Table 1). Kernels pod^{-1} showed insignificant response due to different levels of nutrients combination. Improvement in vegetative structures for nutrient absorption and photosynthesis, strong sink strength through development of reproductive structures and production of assimilates under influence of applied S maintained balance source-sink might have resulted in increased yield attributes. Similarly Ca played an important role in the reproductive development of groundnut. This is probably because in the absence of both xylem and phloem supply of Ca, the penetrating gynophores have modified themselves into absorbing organs of Ca from the immediate fruiting zone. Thus developing pods absorbed Ca directly from the soil and the adequate supply of Ca reduced the 'Pops' or blackened plumule inside the seed know as 'Black heart' and yielded the sound pods, this is in close agreement with the finding and recommendation of Rao and Shaktawat (2000), Devakumar and Giri (1998) and Dayanand and Meena (2000).

Effect of RDF+FYM+S+Ca on pod yield:

Pod yield of groundnut significantly increased with each successive increment of S + Ca application upto 52.5 kg S +70 kg Ca ha^{-1} in the combination of RDF +10 t FYM ha^{-1}. Application of highest tested dose of 60 kg S + 80 kg Ca ha^{-1} with RDF + 10 t FYM ha^{-1} confined the pod yield of groundnut (30.74 q ha^{-1}) over the lower installment of 52.5 kg S + 70 kg Ca in association of RDF + 10 t FYM ha^{-1} (30.60 q ha^{-1}). Application of RDF + 10 t FYM +52.5 kg S +70 kg Ca ha^{-1} significantly

Table 1: Growth, yield traits and pod yield of groundnut (pooled data of 2002 and 2003)

Treatments	Pooled growth and yield traits							Pod yield (q ha^{-1})		
	Main shoot height (cm)	Branches $plant^{-1}$	Field pods $plant^{-1}$	Field pods weight $plant^{-1}$ (g)	Kernel weight $plant^{-1}$ (g)	Kernel pod^{-1}	100 kernel weight (g)	2002	2003	Pooled
RDF + 10 t FYM + 0 kg S + 0 kg Ca	17.96	13.73	35.10	29.13	18.65	1.94	38.16	26.21	23.24	24.72
RDF + 10 t FYM + 15 kg S + 20 kg Ca	18.00	14.05	38.22	31.73	20.31	1.98	38.66	26.95	23.91	25.43
RDF + 10 t FYM + 22.5 kg S + 30 kg Ca	18.11	14.18	38.66	32.10	20.53	2.00	39.33	27.58	24.27	25.92
RDF + 10 t FYM + 30 kg S + 40 kg Ca	18.24	14.36	40.62	33.71	21.58	2.00	40.00	28.65	25.54	27.09
RDF + 10 t FYM + 37.5 kg S + 50 kg Ca	18.45	14.46	41.33	34.31	21.96	2.00	40.33	29.48	26.45	27.96
RDF + 10 t FYM + 45 kg S + 60 kg Ca	18.53	14.61	43.99	36.50	23.35	2.00	40.66	31.42	28.42	29.92
RDF + 10 t FYM + 52.5 kg S + 70 kg Ca	18.65	14.73	45.55	37.81	24.20	2.00	41.33	32.13	29.08	30.60
RDF + 10 t FYM + 60 kg S + 80 kg Ca	18.67	14.75	45.88	38.08	24.36	2.00	41.50	32.27	29.22	30.74
S.E.	0.52	0.06	0.18	0.15	0.10	0.02	0.42	0.20	0.16	0.19
C.D. (P=0.05)	NS	0.18	0.54	0.45	0.30	N.S.	1.27	0.60	0.48	0.57

FYM = Farm yard manure; NS = Non significant

RDF = 20 kg N + 30 kg P_2O_5 + 45 kg K_2O ha^{-1}

increased the pod yield by a margin of 5.88 q ha^{-1}, 5.17 q ha^{-1}, 4.68q ha^{-1}, 3.51q ha^{-1}, 2.64q ha^{-1} and 0.68q ha^{-1} over RDF + 10 t FYM + 0 kg S + 0 kg Ca ha^{-1}, RDF + 10 t FYM + 15 kg S + 20 kg Ca ha^{-1}, RDF + 10 t FYM + 22.5 kg S +30 kg Ca ha^{-1} , RDF +10 t FYM +30 kg S +40 kg Ca ha^{-1}, RDF +10t FYM + 37.5 kg S +50 kg Ca ha^{-1} and RDF +10t FYM +45 kg S +60 kg Ca ha^{-1}, respectively. This increase may be due to best ratio of K: Ca (1:1) for higher production of rainy season groundnut *i.e.* 70 kg K_2O ha^{-1} (45 kg K_2O from RDF + 22.5 kg K_2O from 10 t FYM + 2.3 kg K_2O from inoculants of vermicompost = 69.8 kg or 70kg K_2O ha^{-1}) and 70 kg Ca ha^{-1} upsetting this balance towards K_2O in other integrated doses gave lower pod yield (Basu and Dayal, 2003). The influence of S + Ca on growth and yield attributes was found significant resulted in, the pod yield of groundnut increased significantly upto RDF + 10 t FYM + 52.5 kg S +70 kg Ca ha^{-1}. The results of present experiment are in accordance with the findings and recommendation of Singh (2004), Dayanad and Meena (2000), Singh *et al.* (2005), Rao and Shaktawat (2000) and Devakumar and Giri (1998).

Integrated application of FYM in groundnut had stimulated the uptake of plant nutrients and partly because of stimulated microbes flush and improved root growth due to congenial soil physical condition created by addition of FYM. Therefore, pod yield of groundnut pushed up significantly due to better availability of trace nutrients and good moisture retaining capacity of soil under combined application of chemical fertilizers and FYM (Singh, 2004).

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