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A Case Study

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Assessment of effect of liming and integrated nutrient management on groundnut under acidic soil condition of West Tripura

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Summary

Lime application and integrated nutrient management is often recommended to increase the crop productivity on acidic soils. To ascertain the individual and synergistic effects of lime, NPK and farm yard manure (FYM) application on ground nut productivity, a field experiment was undertaken on acid soils of west Tripura. Application of recommended dose of NPK (20:60:42 kg/ha of NPK) along with lime (10 % of actual LR was followed) resulted in 153 per cent yield increase over control whereas, FYM@ 5 ton/ha along with combined application of lime with recommended NPK boosted the yield improvement upto 210 per cent over control (Farmers' practice). Results of this study suggest that liming along with integrated nutrient management practices, if adopted properly, can lead to more than two-fold increase in ground nut productivity on acidic soils of West Tripura and other districts of the states of Tripura with similar soils. Post harvest soil analysis also showed improved status of organic C, N and P in treated plots, but available K status declined emphasising the need for close monitoring and appropriate K application in such soils.

Key words : Liming, Integrated nutrient management, Groundnut

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Introduction

Soil acidity affects nearly 50 per cent of the world's potentially arable land, particularly in humid tropics (von Uexkull and Mutert, 1995). In India, approximately one-third of the cultivated land is affected by soil acidity (Mandal, 1997). Majority of these soils are concentrated in north-eastern region of India, with nearly 65 per cent of its area being under extreme forms of soil acidity (pH below 5.5) (Sharma and Singh, 2002). Crop productivity on such soils is mostly constrained by aluminium (Al) and iron (Fe) toxicity, phosphorus (P) deficiency, low base saturation, impaired biological activity and other acidity-induced soil fertility and plant nutritional problems (Patiram, 1991; Kumar *et al.*, 2012). The levels of soil acidity along with its associated impacts on soil fertility and crop productivity are expected to further intensify in a changing climate (Oh and Richter, 2004; Kumar, 2011a and b). Soil acidity management and crop productivity improvement on such soils is, therefore, important for enhancing food security globally and regionally. The state Tripura is an agriculturally important state in northeast India, with typically high levels of soil acidity and very high rainfall. Acidity–induced soil fertility problems coupled with traditionally minimal use of mineral fertilizers are often held responsible for low levels of crop productivity in the state. Lime application along with integrated nutrient management is often recommended to increase the phyto-availability of essential nutrients and ameliorate the other acidity-induced fertility constraints on such soils (Haynes, 1984; Patiram, 1991; Kumar *et al.*, 2012). It is, therefore, imperative to ascertain the yield benefits of individual as well as combined application of lime, chemical fertilisers and organic manure in a particular edapho-climatic condition. Same was evaluated in a field experiment (with ground nut as a test crop) on acid soils of West Tripura, India. Additionally, also evaluated the effectiveness on lime and integrated nutrient management, either alone or in combination with other nutrient management practices.

Resource and Research Methods

A field experiment was conducted at East Ramchandraghat village of Khowai Block under Undivided West Tripura District with three treatments, *viz.*, T_1: Furrow application of lime (10 % of actual LR) + RD of NPK, T_2: T_1+FYM 5 ton/ha T_3: Farmer's practice, which replicated three times and arranged in the Randomized Block Design. Soil samples were collected randomly in the fields for analysis of nutrients and organic carbon and other physical properties (Table A).

Table A : General physico-chemical properties of experimental soil

Soil properties	Values/description
Soil texture	Sandy loam
Soil pH	5.2
Organic carbon (%)	0.28
Available P by bray's method (kg/ha)	12.65
Available N_2 (kg/ha)	326
Available K_2O (kg/ha)	128.8

N, P, and K were applied through urea, single super phosphate (SSP) and muriate of potash (MOP), respectively. Half of the N along with full doses of P and K was applied before sowing, while remaining half of the N was applied in two equal splits at seedling and 30 days after sowing. Lime was applied 15 days before sowing and properly mixed with the soil. All recommended agronomic practices were followed during crop growth and the grain yield was recorded after harvesting the crop at maturity.

Research Findings and Discussion

The findings of the present study as well as relevant discussion have been presented under following heads :

Plant height :

In general, plant height was significantly affected in all three different treatments. Plant height was taken at 30 DAS and at crop harvest. In both the cases the lowest plant height was observed at T_3: Farmers Practice, whereas highest plant height was observed at T_2:Lime+FYM@5 ton/ha + RD of NPK and, plant height obtained from T_1 is more than T_3 but less than T_2 (Table 1 and 2).

Table 1 : Plant height at 30 DAS

Treatments	Plant height (cm) @30 DAS
Lime (10 % of actual LR) + RD of NPK	15
Lime (10 % of actual LR) + RD of NPK + FYM 5 ton/ha	17
Farmer's Practice	10

Table 2 : Plant heights at harvesting stage

Treatments	Plant height (ft) @ harvesting
Lime (10 % of actual LR) + RD of NPK	2.5
Lime (10 % of actual LR) + RD of NPK + FYM 5 ton/ha	3
Farmer's practice	2

From this finding it can be concluded that lime along with FYM increased the availability of nutrients specially nitrogen which resulted in higher plant growth in groundnut. Present results are in conformity with the findings of Dharma (1996) who found that FYM might have stimulated the activities of micro-organisms that make the plant nutrients readily available to the crops. Balasubramanian and Palaniappan (1994) reported that use of microbial inoculants in combination with FYM favoured groundnut production. Asmus (1993) reported that application of FYM increased the nitrogen supply to soil. Beneficial effect of FYM in conjunction with recommended dose of fertilizers may be due to the effect of organic matter in improving physical, chemical and biological environment of soil conducive to better plant growth (Deshmukh *et al.*, 2005).

Number of leaf/plant :

Number of leaf per plant was significantly affected in all the treatments, here also T_2 showed highest number of leaf per plant. In case of T_1 leaf number was more than T_3 and but less than that of T_2 (Table 3 and 4).

Table 3 : Number of leaf/plant at 30 DAS

Treatments	Number of Leaf /plant @30 DAS
Lime (10 % of actual LR) + RD of NPK	120
Lime (10 % of actual LR) + RD of NPK + FYM 5 ton/ha	180
Farmer's practice	37

Table 4 : Number of leaf during plant harvest

Treatments	Number of Leaf /plant during plant harvest
Lime (10 % of actual LR) + RD of NPK	514
Lime (10 % of actual LR) + RD of NPK + FYM 5 ton/ha	612
Farmer's practice	470

The data an confirmatory of the previous finding of Parasuraman *et al.* (1998) who reported higher availability of plant nutrients consequently had higher growth parameters in the fertilized treatments and higher yield of groundnut. Groundnut showed a significant increase in plant height with increasing levels of N from 0 to 40 kg ha^{-1} in soils with low N status (Jakhro, 1984 and Barik *et al.*, 1994). From this finding it can concluded that lime solely or along with FYM increased the availability of nutrients, hence, increased number of leaf per plant observed in those treatments.

Pods per plant :

Available phosphorus plays a significant role in pod development, Rath *et al.* (2000) reported that application of 75 kg P_2O_5 ha^{-1} produced the highest pod yield (21.51q ha^{-1}), similarly Choudhary *et al.* (1991) reported that deletion of P application had significantly reduced the pod and haulm yields of groundnut. In acidic soil available phosphorus increased significantly with application of lime and available P. Nziguheba *et al.* (1998) also reported that addition of organic materials causes mineralization of more recalcitrant fraction of P through increased microbial activity and resultant biochemical transformation. In the current study it has been observed that pods per plant was highest in case of T_2 where lime with RDF along with FYM was applied, in case of T_1 where lime along with RDF was applied, pods per plant were lower than that of T_2, although the difference was not significant. Pods per plant were lowest in case of T_3 where no lime and FYM were applied (Table 5).

Table 5 : Number of mature pods per plant

Treatments	Mature pods /plant
Lime (10 % of actual LR) + RD of NPK	56
Lime (10 % of actual LR) + RD of NPK + FYM 5 ton/ha	76
Farmer's practice	45

Pod yield :

Pod yield was significantly increased with addition of sole lime and combined application of lime and FYM along with RDF, present results are confirmatory of the previous findings of Sharma *et al.* (2006) who, based on 141 experiments in field across the Assam and Meghalaya, reported 14-50 per cent increase in yield of crops in response to lime application @ 2-4 q/ha, 22-100 per cent yield increase by recommended dose of NPK application (*i.e.,* 100 % NPK), and 49-390per cent higher yield following combined use of NPK and lime compared to control (*i.e.,* farmers' practice. This might be related to the issue of balanced nutrition of crops that goes beyond the context of N, P, and K. Farmyard manure not only supplied nutrients but also improved soil conditions to produce higher yields (Singh and Singh, 2000). Dharma (1996) found that FYM might have stimulated the activities of micro-organisms that make the plant nutrients readily available to the crops. Balasubramanian and Palaniappan (1994) reported that use of microbial inoculants in combination with FYM favoured groundnut production (Table 6).

Table 6 : Yield obtained under different treatments

Treatments	Pod yield (kg)/ha
Lime (10 % of actual LR) + RD of NPK	1130
Lime (10 % of actual LR) + RD of NPK + FYM 5 ton/ha	1728
Farmer's practice	2373

Effect on post harvest soil properties after groundnut cultivation :

The post harvest soil properties indicated that the soils had the tendency of turning more acidic where ameliorants were not applied. Lime application, either alone or with FYM, maintained higher pH in the soil by neutralizing the acidity and by buffering action of FYM.

Table 7 : Post harvest soil properties after groundnut harvesting

Treatments	pH	Organic carbon (%)	Available N_2 (kg/ha)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
Lime (10 % of actual LR) + RD of NPK	5.5	0.32	377	13.2	95.5
Lime (10 % of actual LR) + RD of NPK + FYM 5 ton/ha	5.7	0.37	368	13.9	105.67
Farmer's practice	4.9	0.22	355	10.5	122.6

The organic C status in soil had increased except under farmers' practice. Mostly the leaf shading property of the crops and FYM addition increased organic C status in soil. Ground nut is an N fixing leguminous crops, which not only benefited the crops, but also improved the residual N balance in the soil in the form of readily available NH_4 + and NO_3 --N. The available P status in soil declined significantly under farmers' practice. Irrespective of treatments, available K levels declined sharply in all the treatments except in the farmer's practice, where yield levels are half of the maximum yield achieved in the crop. This is probably due to mismatch between crop removal as well as leaching loss of K in soils under high rainfall. This suggests the need to critically assess the K recommendations for oilseeds in these area of acid soils where recommendations often do not consider yield target, crop uptake, and the possibility of nutrient leaching in a way that could a realistically achieve the twin goals of high productivity and sustained soil fertility (Table 7).

Conclusion :

Groundnut is the major oilseeds crop accounting for 45 per cent of oilseeds area and 55 per cent of oilseeds production of the country. As such this crop has to play a major role in bridging the vegetable oil gap in the country. But the current average yield level is very low as compared to what is being obtained in most of the groundnut growing other countries. In India, the reasons for low peanut yield are the use of low yield potential varieties, poor soil fertility and nutrient management. This study highlights that unproductive/less productive acid upland soils can improve crop yields through application of soil test-based nutrient rates, integrated with organic and inorganic soil ameliorants. Farmers should aim for higher yield targets through soil test and yield target-based nutrient application. Acid soils are often deficient in S, B, and Mo that can limit the expected responses of applied NPK rates. Further studies are required to look into the secondary and micronutrient deficiencies in these soils and their integration in the fertilisation schedule for betterment of the crop yield and quality.

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