Productivity of groundnut as influenced by integrated use of lime, organics, inorganic fertilizers, and biofertilizers in acidic soil of Tripura

ABSTRACT:

A field experiment was carried out on acidic soil of Khowai district of Tripura during 2017 and 2018 to study the effect of application of various combinations of lime, farmyard manure (FYM), poultry manure (PM), and rhizobium with the recommended doses of NPK on groundnut (*Arachis hypogaea* L.) productivity. The experiment was conducted in a completely randomized block design with 13 treatments; each replicated thrice. Results indicated that application of the recommended dose of NPK @ 20:60:40 kg ha^{-1} along with lime @ 1/5th Lime Requirement (LR), PM @ 5 t ha^{-1} and seed treatment with *Rhizobium* @ 20 g kg^{-1} of seed significantly increased the seed yield compared to the recommended dose of NPK alone as well as other treatments combinations. Thus, the integrated use of a recommended dose of NPK @ 20:60:40 kg ha^{-1} in combination with lime @ 1/5th LR, PM @ 5 t ha^{-1}, and seed treatment with *Rhizobium* @ 20 g kg^{-1} of seed may be recommended to the farmers in achieving higher groundnut productivity with better return in acidic soils of Tripura.

Keywords: Groundnut, yield, lime, organic manure, fertilizers, biofertilizers, acid soil

INTRODUCTION:

Soils of Tripura state of India are acidic, ranging from slightly acidic (6.1 to 6.5) to highly acidic (< 4.5). The productivity of soils is low as these acid soils suffer from deficiency of phosphorus, calcium, magnesium, molybdenum, boron, and toxicities of aluminium and iron (Bhat al., 2010; Kundu, 2017; Kundu, 2020). The addition of lime to these soils neutralizes soil acidity and creates a favorable environment for microbial activity, nutrient release, and plants' availability (Sharma and Sarkar, 2005). But knowledge of the application of lime is very minimum among the farming community of the state. Most of the state's land remains fallow after paddy harvesting, which can be brought under cultivation with reasonable management practices that can improve the state's farmers' economy and increase the state's cropping intensity. There is tremendous potential to introduce crops like groundnut after rice in this aspect. Groundnut being

a legume-oilseed crop, its P, S, and Ca requirement is relatively high. Liming with integrated nutrient management (INM) is a better option to alleviate this nutrient deficiency. The combined use of organic and inorganic sources of plant nutrients pushes the production and profitability of field crops and helps maintain the soil fertility status (Kannan et al. 2013). Kanwar *et al*. (1983), while studying the nutrient and fertilizer response of groundnut, concluded that with balanced use of fertilizer for groundnut production can be increased considerably. Despite the economic significance and maximum yield of groundnut, very minimum information is available on the effect of combined use of lime, biofertilizer, organic and inorganic sources of nutrients on groundnut productivity grown in acid soil of Tripura, India. Under this background, the present investigation was undertaken to study the effect of combined use of lime, organics, inorganic fertilizers, and bio-fertilizers in increasing the yield of groundnut in acidic soils of Tripura.

MATERIALS AND METHODS:

The field experiments during 2017 and 2018 were carried out at the Chebri Village of Khowai district of Tripura, India located at an altitude of 23m mean sea level, latitude 23.84 N, longitude 91.27E to study the effect of application of various combinations of lime, farmyard manure (FYM), poultry manure (PM), and rhizobium with the recommended doses of NPK on groundnut (*Arachis hypogaea* L.) productivity. The experiment was conducted in a completely randomized block design with 13 treatments, each of which was replicated thrice. The following treatment combinations were undertaken: T_1: Control (only recommended dose of NPK (20:60:40 kg/ha); T_2: Liming @1/10th LR (limestone) + RDF; T_3: Liming @1/5th LR (limestone) + RDF; T_4:Liming @1/10th LR (limestone) + RDF + FYM @ 5t/ha [T_2 + FYM]; T_5: Liming @1/5th LR (limestone) + RDF + FYM @ 5t/ha [T_3 + FYM]; T_6 : Liming @1/10th LR (limestone) + RDF + PM @ 5t/ha [T_2 + PM]; T_7: Liming @1/5th LR (limestone) + RDF + PM @ 5t/ha [T_3 + PM]; T_8 : Liming @1/10th LR (limestone) + RDF + Rhizobium (seed treatment @ 20g/kg seed) [T_2 + Rhizobium]; T_9 : Liming @1/5th LR (limestone) + RDF + Rhizobium (seed treatment @ 20g/kg seed) [T_3 + Rhizobium]; T_{10} : Liming @1/10th LR (limestone) + RDF + FYM @ 5t/ha + Rhizobium (seed treatment @ 20g/kg seed) [T_4 + Rhizobium]; T_{11} : Liming @1/5th LR (limestone) + RDF + FYM @ 5t/ha + Rhizobium (seed treatment @ 20g/kg seed) [T_5 + Rhizobium]; T_{12} : Liming @1/10th LR (limestone) + RDF + PM @ 5t/ha + Rhizobium (seed treatment @ 20g/kg seed) [T_6 + Rhizobium]; T_{13} : Liming @1/5th LR (limestone) + RDF + PM

@ 5t/ha + Rhizobium (seed treatment @ 20g/kg seed) [T_7 + Rhizobium]. Liming material ($CaCO_3$) was applied on the basis of Lime Requirement (LR) 15 days earlier to the sowing. Organic manures were applied before sowing as per the treatments. Bio-fertilizers were applied as seed treatment before sowing. Row to row and plant to plant spacing of 45 cm and 15 cm were maintained. Seed yield per hectare in both the year 2017 and 2018 were recorded.

RESULTS AND DISCUSSION:

It was observed that there were significant differences in seed yield among the treatments imposed in both 2017 and 2018 (Table 1, Fig. 1). Among the treatments, the lowest pooled seed yield (1.61 t ha^{-1}) of groundnut was observed in T_1 where the only recommended dose of NPK (20:60:40 kg/ha) was imposed. The highest pooled seed yield of 2.98 t ha^{-1} was observed in T_{13} treatment where liming @1/5th LR (limestone) + RDF + PM @ 5t/ha + Rhizobium (seed treatment @ 20g/kg seed was imposed which was however statistically at par with T11 (RDF + 1/5 LR + FYM + Rhiz); T7 (RDF + 1/5 LR + PM) and T5 (RDF + 1/5 LR + FYM) with their seed yields of 2.88, 2.82 and 2.72 t ha^{-1}. It was observed from the experiment that significantly higher seed yield compared to control was observed in all the treatments where $1/5^{th}$ or $1/10^{th}$ of LR was applied singly or in combination with PM, FYM, RDF, and biofertilizer. It was observed that there were 16.8 % and 47.2% increase in seed yield (pooled) in T2 (RDF + 1/10 LR) and T3 (RDF + 1/5 LR) respectively compared to control where only recommended dose of NPK (20:60:40 kg/ha) was imposed. Again, there was further 10.6 and 14.8% increase in seed yield of groundnut over RDF + 1/10 LR and RDF + 1/5 LR when FYM was applied in combination RDF + 1/10 LR and RDF + 1/5 LR, respectively. However, there were 19.1% and 19.0% increase in seed yield of groundnut over RDF + 1/10 LR and RDF + 1/5 LR when PM was applied in combination RDF + 1/10 LR and RDF + 1/5 LR, respectively. Again, there was a further 14.3 and 21.5% increase in seed yield of groundnut over RDF + 1/10 LR and RDF + 1/5 LR when rhizobium (biofertilizer) was applied in combination RDF + 1/10 LR + FYM and RDF + 1/5 LR + FYM, respectively. Again, there was a further 23.4 and 25.7% increase in seed yield of groundnut over RDF + 1/10 LR and RDF + 1/5 LR when rhizobium (biofertilizer) was applied in combination RDF + 1/10 LR + PM and RDF + 1/5 LR + PM, respectively. So, it was observed that the application of lime and integrated nutrient management had a significant effect on groundnut yield. The application of organic manure is also had a positive influence on the

groundnut yield. Our results are in good confirmatory with the previous findings like Sharma and Subehia (2003), who, based on 141 field experiments across Assam and Meghalaya, reported a 14-50% increase in yield of crops in response to lime application @ 2-4 q/ha, 22-100% yield increase by the recommended dose of NPK application (i.e. 100% NPK), and 49-390% 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 go beyond the context of N, P, and K. Farmyard manure supplied nutrients and improved soil conditions to produce higher yields (Jagdev and Singh, 2000). Dharma (1996) reported that FYM might have stimulated the activities of microorganisms that make the plant nutrients readily available to the crops. Balasubramanian and Palaniappan (1994) reported that microbial inoculants combined with FYM favored groundnut production.

CONCLUSION:

Results indicated that application of the recommended dose of NPK @ 20:60:40 kg ha^{-1} along with lime @ 1/5th Lime Requirement (LR) and PM @ 5 t ha^{-1} and seed treatment with *Rhizobium* @ 20 g kg^{-1} of seed significantly increased the seed yield of groundnut compared to the recommended dose of NPK alone as well as other treatments combinations. Thus, the integrated use of a recommended dose of NPK @ 20:60:40 kg ha^{-1} in combination with lime @ 1/5th LR, PM @ 5 t $ha^{-1,}$ and seed treatment with *Rhizobium* @ 20 g kg^{-1} of seed may be recommended to the farmers in achieving higher groundnut productivity with better return in acidic soils of Tripura.

Table 1: Effect of integrated use of lime, organics, inorganic fertilizers and biofertilizers on seed yield of groundnut

Treatment	Seed yield (t/ha)		
	2017	2018	Pooled
T1: RDF	1.60	1.62	1.61
T2: RDF + 1/10 LR	1.87	1.88	1.88
T3: RDF + 1/5 LR	2.35	2.38	2.37
T4: RDF + 1/10 LR + FYM	2.06	2.09	2.08
T5: RDF + 1/5 LR + FYM	2.70	2.73	2.72
T6: RDF + 1/10 LR + PM	2.23	2.25	2.24
T7: RDF + 1/5 LR + PM	2.80	2.83	2.82
T8: RDF + 1/10 LR + Rhiz	1.96	1.98	1.97

T9: RDF + 1/5 LR + Rhiz	2.42	2.45	2.44
T10: RDF + 1/10 LR + FYM + Rhiz	2.14	2.16	2.15
T11: RDF + 1/5 LR + FYM + Rhiz	2.85	2.90	2.88
T12: RDF + 1/10 LR + PM + Rhiz	2.30	2.33	2.32
T13: RDF + 1/5 LR + PM + Rhiz	2.96	2.99	2.98
Sem	0.12	0.14	0.14
CD (0.05)	0.36	0.41	0.40
CV (%)	9.09	10.27	10.22

RDF = N:P:K @ 20:60:40 kg/ha; LR = Lime requirement @ 3.2 t/ha; FYM= Farm yard manure @ 5t/ha; Rhiz= Seed treatment with Rhizobium @ 20g/kg seed

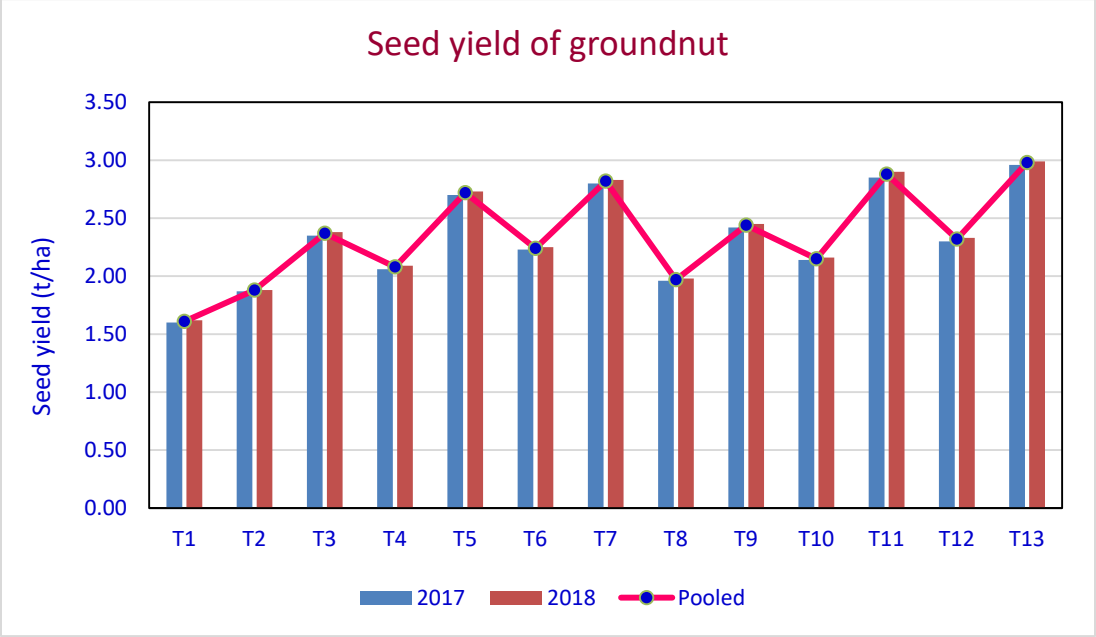

Fig. 1. Effect of integrated use of lime, organics, inorganic fertilizers and biofertilizers on seed yield of groundnut

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

REFERENCE:

Balasubramanian P. Integrated nutrient management in irrigated groundnut (Arachis hypogaea L.). Indian J. Agron. 1997; 42(4): 683-687.

Behera BK, Patro H, Ray M. Integrated Nutrient Management Practices in Summer Groundnut. Asian J. BioScience. 2017; 12:36-47

Bhat JA, Kundu, MC, Hazra GC, Mandal B. Rehabilitating acid soils for increasing crop productivity through low-cost liming material. *Science of the Total Environment*, 2010; 408, 4346-4353.

Dharma AK. Organic farming for sustainable agriculture. 1996. Agro Botanical Publishers.

Kannan LR, Dhivya M, Abinaya D, Lekshmi Krishna R, Krishnakumar S. Effect of integrated nutrient management on soil fertility and productivity in Maize. Bulletin of Enviornment Pharmacology. 2013; **2**(8): 61-67.

Kanwar JS, Nijhwan HL, Raheja SK. Groundnut nutrition and fertilizer response in India. ICAR. New Delhi. 1983; 47:166- 169.

Kundu MC. Distribution of different forms of acidity in some lateritic soils of Purulia district of West Bengal. *International Journal of Chemical Studies*, 2020; 8(2), 2690-2693.

Kundu MC. Nature of acidity in some soils of red and lateritic belt of West Bengal. *Journal of Soils and Crops*, 2017; 27(1), 39-44.

Sharma PD, Sarkar AK. Managing acid soils for enhancing productivity. Indian Council of Agricultural Research NRM Division, Krishi Anusandhan Bhavan-11 New Delhi, 2005.

Sharma S and SK Subehia. Effects of twenty-five years of fertilizer use on maize and wheat yields and quality of an acidic soil in the western Himalayas. *Experimental Agriculture* 2003; 39:55–64.