

Lime Application for Higher Productivity of Potato (*Solanum Tuberosum L.*) and Managing Soil Acidity in Ri-Bhoi District of Meghalaya

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ABSTRACT

*An experiment was conducted at the farmers' field during the year 2017-2018 and 2018-2019 to manage the soil acidity by application of lime for increasing the productivity of potato (*Solanum tuberosum L.*) in Ri-bhoi district of Meghalaya. The experiment consists of three treatments (T1: lime @ 400 kg/ha in furrows + 50% recommended dose of fertilizers (RDF: N: P₂O₅: K₂O::120: 120: 60 kg/ha) + 1 ton/ha vermicompost, T2: 100% recommended dose of fertilizers and T3: Farmers practice (imbalance fertilizer with 30:20:20 NPK kg/ha). The on farm trials were conducted in randomized block design and replicated at five locations in three villages with a total area of 2 ha of land. The results of the trials revealed that application of lime @ 400 kg/ha in furrows + 50% recommended dose of fertilizers + 1 ton/ha vermicompost gave significantly higher yield followed by 100% recommended dose of fertilizers + 1 ton/ha vermicompost and farmers practice (imbalance fertilizer with 30:20:20 NPK kg/ha). The yield increased significantly in both the year (210 q/ha in 2017-18 and 240 q/ha in 2018-19) compared to the farmers practice (154 q/ha in 2017-18 and 156 q/ha in 2018-19) with BC ratio of 2.32 and 2.64, respectively. Moreover, improved and significantly higher soil nutrient status was recorded with improvement in soil pH in both the years. So, the integrated use of lime in furrows along with NPK fertilizer can be effectively used for increasing the productivity of potato and maintaining the soil acidity in Meghalaya.*

Key words: *On farm trial; Lime; Potato; Yield; Productivity; Soil;*

Soil acidity is one of the major constraints in crop production through-out the world (*Singh and Sanjay-Swami, 2020*). In India, about one-third of the cultivated land is affected by soil acidity (*Mandal, 1997*). Among the arable land of India around 25 M ha land comes under pH less than 5.5 in the top layer of soil and 23 M ha is having pH between 5.6 to 6.5. Northeast India experiences high soil acidity due to high rainfall achieved in entire region. According to *Sharma and Singh (2002)*, almost 65% of area in Northeast India is suffering from severe soil acidity i.e. pH below 5.5. This is also a prime factor for low productivity of major crops in this area as availability of the nutrients is a problem in this type of soil. Severe deficiencies of phosphorus, calcium, magnesium, molybdenum and

toxicities of aluminum and iron are reported in acidic soils. So, soil acidity management is very much important in Northeast India for increasing productivity of the crops. Integrated use of balanced inorganic fertilizers in combination with lime and organic manures improves the soil physical environment that is suitable for achieving higher productivity of crop in intensive cropping system of North-eastern hilly region of India (*Saha et al., 2010; Sanjay-Swami et al., 2020*).

Meghalaya consist of 2.24 m ha of acidic soil. Most of the farmers in this hilly state depend on agriculture for their livelihood. However, the productivity of crops is very low in this region primarily because of low use of organic and inorganic fertilizer coupled with soil acidity problem (*Kumar et al. 2012; Sanjay-Swami and*

Singh, 2019). Lime is a good source of acid neutralizer for improving soil pH. The most commonly used liming material to the soil is agricultural limestone with low cost for amelioration of acidic soils having pH less than 5.5 (Das, 2018). Potato (*Solanum tuberosum* L.) is a major crop of Meghalaya. Application of lime in acidic soil for cultivating potato crop can create a suitable environment for microbial growth which helps to increase the microbial activities for nutrient release from the bound soil and make it available for crop production. Organic matter application in the form of farm yard manure (FYM) or compost is also useful to control the soil acidity as it improves the buffering capacity of the soil and improves the availability of P and reduces the toxicity of Fe and Al. Considering the above facts in view, an on farm trial (OFT) was conducted at the farmers' field during the year 2017-2018 and 2018-2019 to investigate the influence of lime application in furrows along with reduced rate of organic and inorganic fertilizers to improve the productivity of potato crop and managing soil acidity problem in the farmers' field of Ri-Bhoi district of Meghalaya.

METHODOLOGY

The Ri-Bhoi district lies between the North Latitudes 25.15' and 26.15' and East Longitudes 91.45' and 92.15'. The total area of Ri-Bhoi district is 2378 sq. km with a total population of 2, 58,840 (GoM, 2011). The area falls under humid subtropical with an average rainfall of 1000 mm to 2500 mm. The study area covers three villages namely Umeit, Thandangiew and Liarsluid and falls between the altitudes of 832 to 889 amsl. The area under each OFT was 0.4 ha with a total area of 2 ha. The experiment consists of three treatments viz.. T₁: Lime @ 400 kg/ha in furrows + 50% recommended dose of chemical fertilizers + 1 t/ha vermicompost, T₂: 100% recommended dose of chemical fertilizers + 1 t/ha vermicompost and T₃: Farmers Practice (imbalanced fertilizer with 30:20:20 NPK kg/ha). The experiment was conducted in randomized block design and replicated at five different farmers' field of three villages during the year 2017-2018 and 2018-2019. The potato variety Kufri Megha was used for conducting the trial. All the participating farmers were trained on all aspects of potato cultivation and soil fertility management before implementing the OFTs at their field. The data from each experimental plot were

recorded and analyzed.

The physical and chemical properties of lime used in the present investigation are given in Table 1 and 2, respectively. The composite soil samples were collected from all the plots before planting and after harvesting of potato crop for physico-chemical analysis of soil. The soil of the experimental site was sandy loam in texture and acidic in reaction. The data related to yield parameters were also collected from all the plots. The economics of the experiment was also calculated for proper conclusion of the experiment.

Table 1. Physical properties of lime used in the present investigation

Properties	Value
Water absorption	0.6%
Specific gravity (G)	2.75

Table 2. Chemical properties of lime used in the present investigation

Properties	Value
Lime (CaO)	38-42%
Silica (SiO ₂)	15-18%
Alumina (Al ₂ O ₃)	3-5%
MgO	0.5-3%
FeO + Fe ₂ O ₃	1-1.5%
Alkalies	1-1.5%
Loss of ignition (Loi)	30-32%

RESULTS AND DISCUSSION

Crop yield and economics analysis : The data presented in Table 3 revealed that the application of lime @ 400 kg/ha in furrows + 50% RDF + 1 t/ha vermicompost gives significantly higher yield (at 5% level of significance) of potato followed by 100% RDF + 1 t/ha vermicompost and the farmers practice. The yield was significantly higher in T₁ i.e. Lime @ 400 kg/ha in furrows + 50% RDF + 1 t/ha vermicompost for both the years (210 q/ha in 2017-18 and 240 q/ha in 2018-19) followed by T₂ i.e. 100% RDF + 1 t/ha vermicompost (191 q/ha in 2017-18 and 203 q/ha in 2018-19) and T₃ i.e. Farmers practice (154 q/ha in 2017-18 and 156 q/ha in 2018-19).

The input and output cost of products exist during the period of demonstrations were taken for calculating the cost of cultivation, net return and benefit cost ratio shown in Table 3. The highest B.C ratio was recorded in the T₁ i.e. Lime @ 400 kg/ha in furrows + 50% RDF + 1 t/ha

Table 3. Effect of lime application on potato productivity and economics in acid soil of Ri-bhoi district of Meghalaya

Treatments	Yield (q/ha)		%	Gross cost (Rs/ha)		Gross return (Rs/ha)		Net income (Rs/ha)		BCR					
	2017-18	2018-19		Avg.	2017-18	2018-19	Avg.	2017-18	2018-19	Avg.	2017-18	2018-19	Avg.		
T 1	210	240	225	136000	136363	136182	315000	360000	337500	179000	223637	201319	2.32	2.64	2.48
T 2	191	203	197	125000	130000	127500	286500	304500	295500	161500	174500	168000	2.29	2.34	2.32
T 3	154	156	155	111000	111750	231000	234000	232500	105500	123000	114250	2.05	2.11	2.08	
CD(pd*0.05)			8.16												

% = % increase in yield over control

Table 4. Effect of lime application on soil acidity and fertility status in Ri-bhoi district of Meghalaya

Treatments	pH		Organic C (%)		Available N (kg/ha)		Available P (kg/ha)		Available K (kg/ha)				
	Before	After	Before	After	Before	After	Before	After	Before	After			
T1	4.54	5.12	1.11	1.39	310.29	383.48	123.59	29.45	40.28	136.77	152.33	165.61	108.72
T2	4.53	4.85	1.14	1.21	308.34	336.20	109.04	32.12	35.54	110.65	154.32	155.26	100.61
T3	4.51	4.57	1.13	1.15	310.54	315.55	101.61	31.16	33.24	106.68	149.54	151.54	101.34
CD(pd*0.05)	0.08		0.06		9.25		2.15		1.25				

% = % increase

vermicompost for both the years (2.64 in 2017-18 and 2.32 in 2018-19) followed by T₂ i.e. 100% RDF + 1 t/ha vermicompost (2.34 in 2017-18 and 2.29 in 2018-19) and T₃ i.e. Farmers practice (2.11 in 2017-18 and 2.05 in 2018-19). The recorded results were obtained may be due to higher yield obtained under the experimental plot compare to the farmers practice. The suitable BC ratio revealed the economic viability of the OFT and convinced the farmers to adopt the technology. This ultimately fulfilled the aim of OFT to convey the scientific technical message to farmers (Mishra *et al.*, 2007; Singh *et al.*, 2020).

Soil fertility and acidity status : Soil samples were collected before the implementation of the OFT and after the harvesting of the potato crop. The soil fertility status was significantly increased with the application of lime along with organic and inorganic combination of fertilizer from initial to final stage of the crop during both the years of experimentation. From Table 4 it was revealed that the soil was acidic in nature with high organic carbon content. The soil pH, organic carbon, available nitrogen, available phosphorus and available potassium status of soil after harvest of the crop significantly increased (at 5% level of significance) due to application of the treatment for both the year. From the results of the experiment it is seen that application of lime @ 400 kg/ha in furrows + 50 % RDF + 1 t/ha vermicompost significantly increased the nutrient content for average of both the years i.e. pH: 5.12, OC: 1.39 %, N: 383.48 kg/ha, P: 40.28 kg/ha and K: 165.61 kg/ha followed by 100% RDF + 1 t/ha vermicompost pH: 4.85, OC: 1.21, N: 336.20 kg/ha, P: 35.54 kg/ha and K: 155.26 kg/ha and farmers practice i.e. pH: 4.57, OC: 1.15, N: 315.53 kg/ha, P: 33.24 kg/ha and K: 151.54 kg/ha.

So, the integrated use of lime along with reduced rate of NPK fertilizer and vermicompost can be effectively used for increasing the productivity of potato and for sustaining the soil nutrient status for increase the farmers' income. Similar results were also reported by many researchers (Maier *et al.*, 2002; Saha *et al.*, 2010; Sanjay-Swami *et al.*, 2020). It indicates that applications of organic sources with inorganic sources along with lime were found more effective in building up soil fertility status as compared to farmers practice. Therefore, the integrated use of recommended fertilizer dose along with lime can be successfully used for maintaining and improving soil fertility as well as soil pH.

CONCLUSION

Soil acidity decreases the availability of most of the plant nutrients and also affects potato yield adversely. The technology used for the experiments were to make acidic infertile soils into productive and profitable soil on a long-term sustainable basis. The application of lime @ 400 kg/ha in furrows + 50 % RDF + 1 t/ha

vermicompost is better option for getting higher yield of potato, improving nutrient status and soil reaction in acidic soil of Meghalaya. There is urgent need to popularize this technology among local farmers for adoption. After transfer of the technology, the potato yield will certainly increased with better management of soil acidity.

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