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Effect of organic, inorganic manure and lime application on soil physiochemical properties and yield of maize in acidic soil of mid hill of Arunachal Pradesh

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Abstract
This study was aimed to determine the effects of organic and inorganic manures and lime application on growth and yield of maize and their impacts on soil physico-chemical characteristics. Vermicompost, and biofertilizers were applied as organic nutrient source while urea, diammonium phosphate (DAP) and Murate of potash (MOP) were used at different concentrations as inorganic nutrients source viz., T1: Unfertilized control; T2: Vermicompost (7 tha^{-1}) T3 Lime applaction 3 $tha^{-1}year^{-1}$ T4 50% RDF with lime application T5 50% RDF T6 100% RDF T7 Biofertilizers. Results showed that growth and yield of maize were substantially improved by fertilizer application alongside organic manures whereas soil total organic C and available N, P, K contents increased when inorganic fertilizers were applied alone or in combined with organic manures. However, soil pH and soil bulk density decreased due to application of vermicompost. The highest plant height, were obtained in application 100% RDF at Vegetative stage while at the time of harvesting highest plant height was obtained in 50% RDF with lime application The highest yield was obtained in 100% RDF followed by the application of 50% RDF with lime application. Conclusively, integration of inorganic fertilizers with organic manures can be used with optimum rates to improve crop productivity on sustainable basis.

Keywords: Lime application, acidic soil yield of maize & mid hill of Arunachal Pradesh

Introduction
Maize (*Zea mays* L.) is one of the most versatile emerging crops having wider adaptability under varied agro-climatic conditions. Globally, maize is known as queen of cereals. It is cultivated nearly 150 m ha in about 160 countries having wider diversity of soil, climate, biodiversity and management practices that contributes 36% (782 mt) in the global grain production. The United States of America (USA) is the largest producer of maize contributes nearly 35% of the total production in the world and maize is the driver of the US economy. The USA has the highest productivity (> 9.6 t ha^{-1}) which is double than the global average (4.92 tha^{-1}). Whereas, the average productivity in India is 2.43 tha^{-1}(https://farmer.gov.in)
In India, maize is the third most important food crops after rice and wheat. In addition to staple food for human being and quality feed for animals, Maize serves as a basic raw material as an ingredient to thousands of industrial products that includes starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetic, film, textile, gum, package and paper industries etc.
The maize is cultivated throughout the year in all states of the country for various purposes including grain, fodder, green cobs, sweet corn, baby corn, popcorn. The predominant maize growing states that contributes more than 80% of the total Maize production are Andhra Pradesh (20.9%), Karnataka (16.5%), Rajasthan (9.9%), Maharashtra (9.1%), Bihar (8.9%), Uttar Pradesh (6.1%), Madhya Pradesh (5.7%), Himachal Pradesh (4.4%) (https://farmer.gov.in). Apart from these states' maize is also grown in Jammu and Kashmir and North-Eastern states. Hence, the Maize can be grown successfully in variety of soils ranging from loamy sand to clay loam. However, soils with good organic matter content having high water holding capacity with neutral pH are considered good for higher productivity. Being a sensitive crop to moisture stress particularly excess soil moisture and

salinity stresses; it is desirable to avoid low lying fields having poor drainage and also the field having higher salinity. Therefore, the fields having provision of proper drainage should be selected for cultivation of Maize.

In North east part of India due to high rainfall there soil becomes highly acidic in nature, even less than 4.5 pH also been reported. Hilly terrain and low pH is two most important constraint of north east to for achieving the optimum and sustainable crop yield. With the majority of agricultural soils nationally at low soil pH status, the under application of lime and organic manure and bioferilizers is likely costing farmers dearly in terms of crop yield at same time the improve the soil quality. Lime is a soil conditioner and corrects soil acidity by neutralizing the acids present and allowing the micro-organisms and earthworms to thrive and break down plant residues, animal manures and organic matter. This helps to release stored soil nutrients such as nitrogen (N), phosphorus (P), potassium (K), sulphur (S) and micro-nutrients for plant uptake.

Material and methods

The study was conducted in West Siang district of Arunachal Pradesh (Fig.1) longitude 93.57^0 E to 95.23^0 E & Latitude 27.69^0 N to 29.20^0 N.) At an altitude of approximately 680 m. The mean annual precipitation approximately 2100 mm, with nearly 79% falling between May and September; the mean annual temperature is 20.2ºC, with a maximum monthly mean value of 26.2ºC (August) and a minimum monthly mean value of 11.9ºC (January).

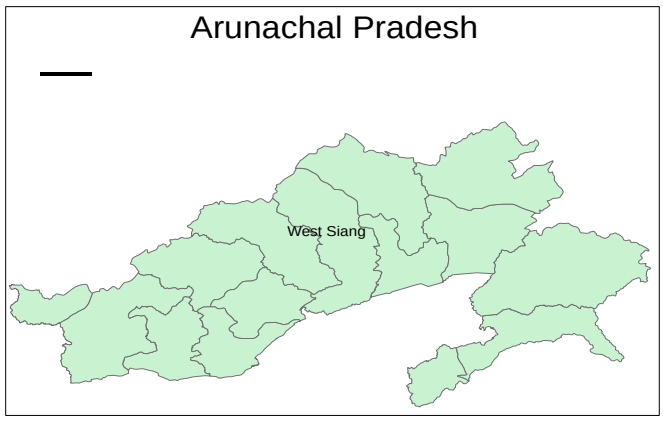

Fig 1: Study Area

The field was laid out in randomize complete block design (RCBD) which is replicated three (3) times on a gross plot size of 5.0 m × 4 m. The organic nutrient sources used were vermicompost and biofertilizer whereas the inorganic sources are Urea, Di-ammonium phosphate (DAP) and Muriate of potash (MOP). Seven treatments involving a combination of various nutrients from different sources (organic and inorganic) were used which include T1: Unfertilized control; T2: Vermicompost (7 t ha^{-1}) T3 Lime applaction 3 t $ha^{-1}year^{-1}$ T4 50% RDF with lime application T5 50% RDF T6 100% RDF T7 Biofertilizers). Maize Variety RCM 61 was used as experimental material for sowing purpose at a depth of 3-5 cm using a spacing of 60 cm × 15 cm using 30 kg ha^{-1} recommended dose of sowing seed.

The recommended dose of organic fertilizer (Vermicompost & FYM) used was 7 tha^{-1} and this were uniformly incorporated into the soil one month before sowing as per treatments in each plot. Furthermore, the recommended dose of inorganic fertilizer (RDF) used was 120:60:40 NPK kg ha^{-1}, whereas half (1/2) of urea along with complete DAP and MOP were applied at sowing time as basal doses and the remaining urea was applied as top dressed at 36 and 70 days after sowing (DAS) respectively as a split doses. Plant height (cm) and leaf area (LA) were measured and recorded, whereas at maturity period the yield plant (g) was measured and recorded. However, after crop harvesting the soil sample from trial field was analyzed for determination of soil physic-chemical properties (organic carbon and NPK) and the measured data were subjected to Analysis of variance (ANOVA) and their means was separated using Duncan multiple Range Test (DMRT) at 5% level of significance.

Result and discussion

Effect of organic and inorganic sources of nutrients on soil physical

Properties

Soil physical properties

Soil bulk density (BD)values in different treatments ranged from (Table 1) 0.97 to 112 Mg m^{-3}. Bulk density of soil was significantly influenced by the application of organic and inorganic fertilizer. The lowest BD was recorded in the T2 which comprising 100% nutrient supplied through application of vermicompost with the rate of 7tha^{-1} whereas the highest BD was recorded in the control treatment. This treatment also showed significantly higher water holding capacity (WHC) whereas the lowest WHC was recorded in the control. Control is at par with the 50% RDF application further the control is at par with the T4 and T5 which comprising application of 50% RDF with lime application and 50% RDF respectively. Similar result was recorded in the available water capacity. Available water content highest was recorded in the T6 comprising 100% RDF application of inorganic fertilizers. Sharma and Gupta (1998) [8] noticed decrease in soil bulk density to 1.23 Mg $m^{-3}$with application of 50 per cent N, P_2O_5 and K_2O + 50 per cent N through FYM after the harvest of maize crop under agro-climatic conditions of Rajouri. Sujata *et al.* (2008) [9] reported lower soil bulk density (1.19 and 1.26 Mg m^{-3}, at 0-15 and 15-30 cm soil depth, respectively) with the application of organic manure at 1 t ha^{-1}. The treatment with vermicompost at 3.67 tha^{-1} recorded also similar soil bulk density values at 0-15 and 15-30 cm soil depth. Reduction in bulk density of soil was also reported by Choudhary and Kumar (2013) [4] with the application of FYM 10 t $ha^{-1}$and cow dung manure at 10 t ha^{-1}. Bhriguvanshi (1988) [3] was also reported the application of FYM resulted in improvement of water holding capacity compare to other inorganic application treatment sandy loam (54.2%) and clay loam (57.8%) soil.

Table 1: Effect of organic and inorganic nutrient on soil physical parameters.

Treatments	Bulk Density (Mg/m3)	Porosity (%)	WHC (%)	AWC (%)
Unfertilized control	1.12	53.65	53	31
Vermicompost (7 t/ha)	0.97	63.16	63	41
Lime applaction 3 Tonn/ha /year	1.15	56.58	56	33
50% RDF with lime application	1.09	55.07	55	39

50% RDF	1.11	54.35	54	36
100% RDF	1.01	61.70	61	44
Biofertilizers	1.09	54.87	54	35
SEm	0.001	0.56	0.55	
LSD	0.15	3.45	3.45	

Soil chemical properties

The effect of treatment was significantly influenced the pH (Table 2) of the soil the treatment T3 and T4 comprising application of lime along with 50% nutrient from vermicompost and inorganic fertilizers respectively showed significant improvement in soil ph in comparison to the other treatment and the highest ph was recorded in lime application along with 50% RDF and lowest was recorded in the control. The application of lime in the treatment showed higher pH compare to the treatment with no lime application.

Soil Organic Carbon (SOC) The application of organic and inorganic manure significantly influence the soil organic carbon status of soil the soil the highest SOC was recorded in the treatment comprise application of 100% nutrient through vermicompost followed by the treatment with 100% RDF through inorganic fertilizers (Table. 2) lowest SOC was recorded in treatment with biofertilizer application which was at par with the control.

Effect of organic and inorganic fertilizers on available nutrient content of soil

Major nutrients

The available nitrogen status of soil was significantly influenced by various treatments. It ranged from 225.6 to 297.78 kg ha^{-1}. The highest available nitrogen content of soil was recorded in the treatment receiving 100% nutrient through inorganic fertilizers, and lowest was recorded on the control. There was no direct evidence reflected to that lime application influenced the availability of Nitrogen. Where as in the availability of Phosphorous (Table 2) the treatment comprising the lime application showing improved availability of P compare to the other treatment without lime application. The application of lime resulting in increased solubility to the readily soluble P in the soil solution the increase the availability of P. the application of organic amendment also increase the available P this observation is with the consistant with Lee *et al*. 2004. The available potash was significantly influenced by the application of nutrient and 100% RDF was found the highest followed by 50% RDF with lime application. And remaining all the treatment is at par to each other hence there was direct evidence of application of lime application on the availability of K was found. Kumar *et al*. 2007 [6] was also reported that Significantly higher uptake of nitrogen, phosphorus and potassium by maize crop were noticed under treatment receiving vermicompost @ 2.5 t ha-1 over on a clay loam soil under agro-climatic conditions of Raichur. In a field experiment conducted by Sujata *et al.* (2008) [9] at Dharwad on a black clayey soil with initial available N, P and K content, application of poultry manure at 1 tha^{-1} resulted in higher uptake of N, P and by maize crop followed by application of vermicompost at 3.67 tha^{-1}

Table 1: Effect of organic and inorganic nutrient on soil chemical parameters.

Treatments	pH	SOC (gkg^{-1})	Avail N ($Kgha^{-1}$)	Avail P2o5 ($Kgha^{-1}$)	Avail K ($Kgha^{-1}$)
Unfertilized control	5.12	9.01	225.61	10.61	335.61
Vermicompost (7 t/ha)	5.16	10.28	278.25	13.25	338.25
Lime applaction 3 Tonn/ha /year	6.33	9.33	265.08	20.08	349.58
50% RDF with lime application	6.59	9.29	266.59	21.59	361.59
50% RDF	5.19	9.06	263.06	18.06	344.56
100% RDF	5.28	10.12	297.78	15.28	369.78
Biofertilizers	5.33	8.83	267.33	18.33	337.33
SEm	0.019	0.58	42.9	0.78	51.23
LSD	0.542	0.95	25.94	3.5	28.37

Effect of organic and inorganic fertilizers on plant growth parameters.

The plant height, leaf area index and dry matter were recorded at two stage grand and harvest stage. Chlorophyll content was recorded periodically and average was done. The effect of nutrient application along with lime was significantly influenced the plant growth parameters (Table 3). The RDF 100% application showed the highest growth in the plant height at grand stage where as at harvesting stage highest plant height was recorded in 50% RDF with lime application this is might be the increase in pH influenced the availability of P and other nutrient similar result was recorded in the leaf area index. Moreover the lime application improve the yield attributes compare to the 7t/ha vermicompost application. The chrophyll content was also showed similar result. The grain weight was also showing the similar trend and highest yield was recorded in the 100% RDF application and was lowest was in the unfertilized block this is in consistant with Barod *et al*. 2012 [2]. Kler and Walia (2006) [5] reported significantly higher dry matter accumulation (132.6 q/ha) by maize crop at harvesting stage with application of FYM at and recommended chemical fertiliser alone under agro-climatic conditions of Ludhiana. At Jhalawar, application of RDF + FYM at 10 t/ha resulted in higher grain yield (3.12 t/ha) in maize. The lowest grain yield of 1.19 was registered under control plot without FYM (Tetarwal *et al*., 2011) [10].

Table 3: Effect of organic and inorganic fertilizers on plant growth parameters

Treatments	Plant Height (cm)		Chlorophyll Content	Leaf Area Index		Dry Matter (g)		Grain Weight ($gplant^{-1}$)
	Grand	Harvest	Grand	Grand	Harvest	Grand	Harvest	
Unfertilized control	71.26	166.259	49	2.38	1.38	66.38	261.38	106.38
Vermicompost (7 t/ha)	74.66	179.655	51	2.81	1.60	69.60	264.60	114.60
Lime applaction 3 Tonn/ha /year	72.07	185.569	55	3.17	2.48	72.98	282.98	137.98

50% RDF with lime application	76.38	203.879	55	3.59	2.59	74.59	296.09	151.09
50% RDF	82.07	193.793	49	3.49	2.03	74.93	275.99	148.99
100% RDF	83.79	200.069	56	3.53	2.49	75.99	284.03	156.53
Biofertilizers	76.24	181.241	50	2.24	1.24	69.24	270.24	126.24
SEm	0.42	27	2.3	0.07	0.09	1.73	33.79	29.88
LSD	5.9	5.8	NS	1.02	1.23	5.2	23.04	21.67

Conclusion

Application of lime can increase the pH of the soil, increase the availability of Phosphorous influence of the different source of nutrient on the plant growth parameters inorganic fertilizer application has influencing the growth parameters as well the availability of soil nutrient immediately whereas the organic source of nutrient affect soil nutrient and plant growth parameters comparatively with lower rate. The effect of lime application showed positive impact on growth attributes of crop, eventhouh it was not evident in the influencing the soil chemical parameters directly except pH and Phosphorpus availability. The observed positive effect of lime on maize growth was therefore likely due to its effect in increasing the pH and therefore increasing availability of most nutrients to maize.

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Reference

1. https://farmer.gov.in
2. Barod NK, Dhar S, Kumar A. Effect of nutrient sources and weed control methods on yield and economics of baby corn (*Zea mays*). Indian Journal of Agronomy. 2012; 57(1):96-99.
3. Bhriguvanshi SR. Long-term effect of high doses of farmyard manure on soil properties and crop yield. J. Indian Soc. Soil Sci. 1988; 36:784-786.
4. Choudhary VK, Suresh KP. Maize production, economics and soil productivity under different organic source of nutrients in eastern himalayan region, India, 2013.
5. Kler DS, Walia SS. Organic, integrated and chemical farming in wheat (*Triticum aestivum*) under maize (*Zea mays*)–wheat cropping system. Indian Journal of Agronomy. 2006; 51(1):6-9.
6. Kumar P, Halepyati AS, Pujari BT, Desai BK. Effect of integrated nutrient management on productivity, nutrient uptake and economics of maize (*Zea mays* L.) under rainfed condition. Karnataka Journal of Agricultural Sciences. 2007; 20(3):462-465.
7. Lee CH, Park CY, Do Park K, Jeon WT, Kim PJ. Long-term effects of fertilization on the forms and availability of soil phosphorus in rice paddy. Chemosphere. 2004; 56(3):299-304.
8. Sharma MP, Gupta JP. Effect of Organic Materials on Grain Yield and Soil Properties in Maize (*Zea mays*): Wheat (*Triticum aestivum*) Cropping System. Indian journal of agricultural Science. 1998; 68(11):715-717.
9. Sujatha MG, Lingaraju BS, Palled YB, Ashalatha KV. Importance of integrated nutrient management practices in maize under rainfed condition. Karnataka Journal of Agricultural Sciences. 2008; 21(3):334-338.
10. Tetarwal JP, Ram B, Meena DS. Effect of integrated nutrient management on productivity, profitability, nutrient uptake and soil fertility in rainfed maize (*Zea mays*). Indian Journal of Agronomy. 2011; 56(4):373-376.