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Fertility Assessment of Major Maize Growing Soils of Kupwara District, J and K, India

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ABSTRACT

Background: The assessments of the available nutrient status of maize growing soils are essential to generate baseline information regarding efficiency of nutrient availability in order to improve yield and maintain soil health. The information generated would be useful for the subsequent research and developmental activities in these areas and shall guide in assessing the possible cause of low yield and quality of maize production.

Methods: Fertility assessment of major maize growing soils for district Kupwara was carried out during 2016. Twenty (20) composite surface soil samples at representative sites were collected and investigated for the available nutrient status and chemical properties

Result: The soils were slightly acidic to slightly alkaline in reaction (6.1-7.4). The soils of the study area were high in organic carbon content (0.7 to 1.4%), were low in soluble salts (0.11-0.35 dSm^{-1}) and calcium carbonate content (0.08 to 0.15%). The available nitrogen, phosphorous and potassium were ranged from 295.24 to 510.00 kg ha^{-1}, 10.03 to 20.36 kg ha^{-1}, 131.00 to 165.30 kg/ha, respectively. The pH of the soils determined has a negative and significant correlation with available nitrogen (r = -0.915*) and phosphorous (r = -0.931*). A significant and negative correlation of calcium carbonate was observed with available nitrogen (r = -0.871*) and phosphorous (r = -0.906). The organic carbon content shows significant and positive correlation with available nitrogen (r = 0.936*), phosphorous (r = 0.986*), respectively.

Key words: Correlation, Fertility, Maize, Soil health.

INTRODUCTION

Maize crop can be grown successfully in wide range of soils from sandy loam to clay loam. However, soils with good organic matter content with neutral pH are considered good for higher productivity. Under rain fed production system, low productivity of crops is linked to the water stress, virtually no use of organic manures, poor recycling of crop residues and low use of nitrogen and phosphorus that leads to negative balance of nitrogen and phosphorus (Rego *et al.* 2003). Fertilizers played a vital role in agriculture production and productivity in India, but continuous and imbalanced use of chemical fertilizer creates problem in the production potential and deterioration of soil health. Use of chemical fertilizer in combination with organic matter is required to improve the soil health (Bajpai *et al.* 2006). Soil nutrient evaluation is a leading key for describing and understanding the status and qualities of the major nutrients in soil (Geissen *et al.* 2009). Assessing soil physico-chemical properties are used to understand the potential status of nutrients in soils of different land uses (Wondowosen and Sheleme, 2011). The decline in soil fertility followed by land degradation and low agricultural productivity are caused by land use change particularly from natural ecosystem to agricultural lands in general and to crop cultivation under poor management practices Chimdi *et al.* (2012). Soil testing program is beneficial to formulated specific fertilizer recommendation (Alaie and Gupta 2019). In order to sustain the productivity and promote the health of the soil fertilizer application on soil test based and combined use of organic and chemical fertilizers is imperative. There is hardly any soil on earth provided so adequately with nutrients, that high yield can be obtained over prolonged period without any fertilization. It is, therefore, necessary to replenish the soil with balanced fertilization (Singh and Biswas, 2000). Soil fertility information at district level will benefit the farmers in determining site specific nutrient management to maintain soil health (Alaie, 2018). The studies on nutrient status of maize growing soils are essential to generate information regarding efficiency of nutrient availability of soils in order to improve yield and maintain soil health. The information generated of the study area would be beneficial for research and developmental activities and shall guide in assessing the nutrient status and possible cause of low yield and quality of maize production.

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MATERIALS AND METHODS

The UT of J and K is situated in the north western portion of the India has an area of about 222,870 sq. Km. Kupwara, an efficient cropping zone for maize, is located within a latitude of 34.396°E and longitude 74.296°N and a map of the study area as depicted in Fig 1. Twenty composite surface soil samples of district, Kupwara were collected at representative sites. The soil samples collected thereof were investigated for chemical properties and the available nutrient status. The soil samples were air dried, crushed and sieved through 2 mm sieve. The pH of the soil was measured in 1: 2.5 soil water suspensions with the help of digital pH meter (Jackson, 1973). The electrical conductivity of soil water extract was measured in 1:2.5 soil water suspensions by conductivity meter (Jackson, 1973). The calcium carbonate was estimated by rapid titration method (Piper, 1966). Organic carbon was determined by rapid titration method (Walkley and Black, 1934). Available nitrogen was determined by alkaline permanganate method given by (Subbiah and Asija, 1956). Available phosphorus was determined by Olsen's method Olsen *et al.* (1954). Available potassium was determined on a Flame Photometer after extraction with neutral normal ammonium acetate (Jackson, 1973).

Table 1: Soil sampling sites of maize growing soils of district, Kupwara.

Villages	Sample sites
Haripora shath	L_1
Yaru Kecher	L_2
Kargama	L_3
Marathgam	L_4
Chotpura	L_5
Dorishpora	L_6
Handwara	L_7
Batkoot	L_8
Machipora	L_9
Baderher	L_{10}
Nag redii	L_{11}
Warpura	L_{12}
Lachipora	L_{13}
Khaipora	L_{14}
Waripur	L_{15}
Kulangam	L_{16}
Chogul	L_{17}
Hanga	L_{18}
Babgund	L_{19}
Tulwari	L_{20}

RESULTS AND DISCUSSION

Soil reaction

The data presented in Table 2 indicated that pH ranged from 6.10 to 7.48 with mean value of 6.96. In general, the soils were slightly acidic to slightly alkaline in reaction. The pH of the soils in the study area was within the range as reported by (Thangasamy *et al.* 2005; Alaie and Gupta, 2019). Relatively higher pH value was found at Tulwari village which could be ascribed due to comparatively less leaching loses of bases. The lower value of soil pH might be due to higher microbial oxidation that produces organic acids, which provide H^+ ions to the soil solution that lowers its soil pH value as same results were reported by Chimdi *et al.* (2012).

Electrical conductivity

The data (Table 2) revealed that the electrical conductivity varied from 0.11 to 0.35 with the mean value of 0.20 dSm^{-1}. Similar findings were reported by Mandal *et al.* (2005); Alaie and Gupta, (2019). It was observed that all soils are non-saline in nature as the electrical conductivity of soils was lesser than 4 dS m^{-1}, indicating the presence of very low amount of soluble salts in all the locations.

Calcium carbonate

The calcium carbonate content varied from 0.08 to 0.15 per cent with mean value 0.10 per cent (Table 2). The data revealed calcium carbonate content was higher at location 20

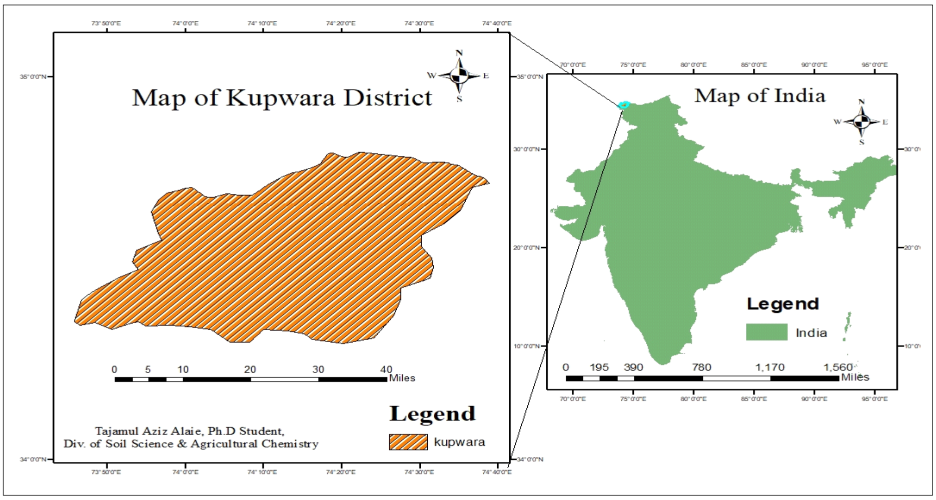

Fig 1: Map of Kupwara district.

Table 2: Chemical properties of maize growing soils of district, Kupwara.

S. no.	pH (1:2.5)	EC (dSm^{-1})	$CaCO_3$ (%)	O.C (%)
L_1	7.13	0.19	0.10	1.13
L_2	7.00	0.21	0.10	1.20
L_3	6.62	0.14	0.09	1.38
L_4	7.18	0.17	0.10	1.02
L_5	6.10	0.17	0.08	1.47
L_6	6.57	0.22	0.08	1.38
L_7	6.95	0.35	0.09	1.22
L_8	6.23	0.31	0.08	1.41
L_9	6.78	0.26	0.09	1.31
L_{10}	6.95	0.22	0.10	1.21
L_{11}	7.33	0.21	0.11	0.87
L_{12}	6.91	0.22	0.09	1.24
L_{13}	7.15	0.11	0.10	1.12
L_{14}	6.44	0.28	0.08	1.41
L_{15}	7.42	0.16	0.12	0.76
L_{16}	7.32	0.21	0.11	0.87
L_{17}	7.47	0.20	0.12	0.75
L_{18}	7.24	0.18	0.11	0.95
L_{19}	6.89	0.10	0.09	1.31
L_{20}	7.48	0.12	0.15	0.72
Mean	6.96	0.20	0.10	1.14
Range	6.10-7.48	0.11-0.35	0.08-0.15	0.72-1.47
C.D ($p \leq 0.05$)	0.022	0.018	0.006	0.020

and lower was at location 5. In general soils are non-calcareous in nature. The calcium carbonate content of the soils in the study area is within the ranges as reported by Thangasamy *et al.* (2005). The low content of calcium carbonate in the surface soils can be attributed due to leaching of calcium carbonates to sub-surface layer of soils. These findings are in agreement with the work of (Handoo, 1983), who also found low calcium carbonate in surface soils while working on soils of Kashmir valley.

Organic carbon

The organic carbon content varied from 0.72 to 1.47 per cent with mean value of 1.14 per cent (Table 2). In general soils were high in organic carbon percentage. The status of organic carbon was medium to high. The high organic carbon percentage in these soils might be due to low rate of mineralization because of lower soil temperatures. The organic carbon content in the soils in the present investigation is within the ranges as reported by (Umadevi *et al.* 2000; Alaie and Gupta, 2019).

Nutrient status of soils

Available nitrogen

The available nitrogen content of soils varied from 295.24 to 510.00 kg ha^{-1} with mean value of 414.55 kg ha^{-1} represented in Table 3. The soils were medium to high in available nitrogen content and in some locations available nitrogen content was highest this might be due to higher organic carbon content. These findings were in good agreement with the findings of (Bhola and Mishra, 1998; Alaie *et al.* 2020).

Available phosphorous

The available phosphorous content of soils varied from 10.03 to 20.36 kg ha^{-1} with mean value of 15.74 kg ha^{-1} represented in Table 3. The status of soils were medium to high in available phosphorous which could be attributed due to favorable soil reaction and formation of organo-phosphate complexes and coating of iron and aluminum particles by humus as also justified in the research works of (Rao *et al.* 2008; Alaie *et al.* 2020).

Available potassium

The available potassium content varied from 131.00 to 165.30 kg ha^{-1} with mean value of 144.72 kg ha^{-1} represented in Table 3. The soils were medium to high in available potassium. The higher values of potassium could be attributed to illitic nature of these soils which is further supported by the dominance of illitic clay in these soils Thangasamy *et al.* (2005). Similar findings were reported by (Gupta *et al.* 1998; Bhola and Mishra, 1998).

Correlation studies of available macro nutrients with chemical properties of the soils

The correlation coefficient values (r-values) of pH, electrical conductivity, calcium carbonate and organic carbon of the soils with the available macro nutrients have been worked out (Table 4), revealed that the pH has a negative and significant correlation with available nitrogen (r= -0.915*), phosphorous (r= -0.931*). A significant and negative correlation of calcium carbonate was observed with available

Table 3: Available nutrient status of maize growing soils of district, Kupwara.

S. no.	N (Kg ha^{-1})	P (Kg ha^{-1})	P (Kg ha^{-1})
L_1	410.22	14.77	139.28
L_2	441.22	16.10	140.36
L_3	481.35	19.05	159.00
L_4	366.73	13.17	137.19
L_5	510.53	20.36	165.30
L_6	485.34	19.10	162.76
L_7	452.00	17.77	141.26
L_8	508.36	20.03	165.34
L_9	480.45	19.03	157.19
L_{10}	450.23	17.02	141.18
L_{11}	317.25	12.13	133.77
L_{12}	462.43	18.01	142.38
L_{13}	391.34	14.23	137.26
L_{14}	492.32	20.00	163.82
L_{15}	316.25	11.02	132.00
L_{16}	322.33	12.16	134.26
L_{17}	298.76	10.04	131.23
L_{18}	336.24	12.68	136.24
L_{19}	472.35	18.02	143.59
L_{20}	295.24	10.03	131.00
Mean	414.55	15.74	144.72
Range	295.24-510	10.03-20.36	131.00-165.30
C.D ($p \leq 0.05$)	0.019	0.021	0.020

Table 4: Correlation coefficient of maize growing soils of district, Kupwara.

Soil properties	Available nutrients		
	N	P	K
pH	-0.915*	-0.931*	0.039
EC	0.333	0.404	0.356
$CaCO_3$	-0.871*	-0.906*	0.214
OC	0.936*	0.986*	0.282
CEC	0.946*	0.369	0.869*

*Significant at 1% level.

nitrogen (r= -0.871*), phosphorous (r= -0.906). The organic carbon content showed significant and positive correlation with available nitrogen (r = 0.936*), phosphorous (r = 0.986*), respectively. The availability of nitrogen decreases with the increase in pH because of leaching of nitrogen as ammonium in alkaline conditions. A significant and negative correlation between pH and nitrogen has been supported by findings of (Singh and Ahuja, 1990; Narboo, 1994).The availability of phosphorous decreases with the increase in soil pH due to its conversion to insoluble phosphates. The significant negative relationship between pH and phosphorous has been supported by findings of Patiram *et al.* (1990).

Conflict of interest: None.

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