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Impact of continuous use of chemical fertilizers on soil fertility and productivity for the main crops of Sidhi district of eastern M.P.

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ABSTRACT

Complete soil analysis was carried out taking 5 pedons each of five blocks of district Sidhi during cropping season and after harvesting (for summer and Kharif 2010) to establish the status of nutrients, result so obtained clearly showed that the application of recommended dose of N.P. and K increase the crop yield, application of 100% N.P.K. Substantially improved the available N.P.K. over its initial value there by indicating significant contribution towards sustaining the soil health. On the other hand omission of S and Zn in 100% N.P.K. treatment caused a continuous depletion in soil 'S' status over initial value. A declining trend from its initial value of available 'K' status was also observed as a continuous cropping. This indicates considerable mining of available 'K' from the soil. Hence indicating the need to raise the level of 'K' fertilizer application to meet the demand of crops. Additions of Zn also indicated considerable increase in crop production. However, the fertility of soil appears to be adversely affected due to the imbalanced use of nutrients i.e. N. P. or N, alone. Thus the balanced use of fertilizers continuously necessary for sustaining soil fertility and productivity of crops. However there is an apprehension that the use of chemical fertilizer over the years might may impair the soil fertility. In continuous cropping, use of imbalanced nutrients through inorg. Fertilizer can not only sustain the desired level of crop production[12] hence integration of inorganic fertilizer with organic manure will not only sustain the crop production but also will be effective in improving soil health and enhancing the nutrient use efficiency[13]. As information is lacking on the effect of continuous fertilization and cropping on soil properties and crop production on the soil of Sidhi district of eastern M. P. hence the present study was undertaken.

INTRODUCTION

The district Sidhi located in the eastern part of M.P. where tribals are dominantly resides, both traditional and advanced system of cultivation is followed. The agriculture is the main source of their livelihood.

Wheat (triticum aestivum) Rice (Oryza satival) and soybean (Glycine maxl) are the most prevalent crops followed in a substantial area of various blocks of district Sidhi of eastern M.P. Continuous use of fertilizer nutrients on soil, provide the valuable information about the nutrient status of soil during cropping period and after harvesting and hence it become easy to manage soil properties in a way to have increased production of crops.

Although there is an apprehension that the use of chemical fertilizer over the years might may impair the soil fertility this because of imbalanced application of

nutrients through inorg. Fertilizer, hence, the complete soil analysis during and after harvesting the crops helps for the complete soil fertility management for increasing the crop yield.

Under soil fertility management it has been suggested[12] that combination of Inorg. Fertilizer with organic manures will not only sustain the crop production but also will be effective in improving soil health and enhancing the nutrient use efficiency[13].

MATERIALS AND METHODS

The study was conducted in all the five blocks of Sidhi district located in north eastern part of M.P. with a geographical area of 10536 sq. km. administratively it has five blocks namely Sidhi, Rampur Naikin, Majhauli, Kusumi and Sihawal the elevation ranges from 243 m to 607 m. from sea level.

Out of total geographical area the net sown area is 49786 hac. Non sown area is 54890 hac. Not useful area for agriculture is 111251 hac. And forest area is 186608 hac.

Sidhi district has a semi-arid and sub-tropical climate with a dry summer and cold winter. In a winter season temperature ranges from 4^0 to 33^0 C and the relative humidity varies from 70 to 90 %. Dry season prevails during the month of March to June the highest temperature during summer is 46^0. Mansoon season extend form mid June to mid September temperature during this period varies from 25^0 to 35^0 C and relative humidity ranges from between 70 to 80 % the total average rainfall is 1248.mm.

Five soil samples each from five blocks were collected and analyzed for physical and chemical properties following standard procedure (TABLE-1). The soil of the experimental field is medium black having about 57 % clay belonging to Kheri series of fie montmorillonitic hyperthermic family of typic Haplustert.

The soil profile of district sidhi having clay soil, clay loam sandy loam and literate while topography having hilly areas, plain areas and undulating areas.

The available nitrogen was estimated through alkaline permanganate method as suggested by[14], Available phosphorus was determined by Olsen method and available potassium was estimated by flame photometer after extraction with neutral normal ammonium acetate solution (PH 7.0). The available Zinc and Iron (fe) were extracted using DTPA and their concentration were determined using atomic absorption spectro photometer.

The land suitability for growing main crops of Sidhi district was evaluated by matching the crop requirement with soil site characteristics using criteria developed. The soil were grouped into S_1 (highly suitable),

TABLE 1 : Important Physical and chemical properties of Soil

Sr. No.	Horizon	Depth (cm)	PH (1:2.5)	EC (dsm^{-1})	Org.e. g (kg^{-1})	$CaCo_3$ ($K_5$1)	Sand mm	silt mm	Clay mm	CEC (Cmol (p+) Kg^1	Base saturation %
1.						**Pedon 1 (Sidhi) :**					
	(i)	0-15	8.2	0.21	11.9	42	15.2	22.9	56.8	54.3	>100
	(ii)	15-30	8.3	0.19	10.2	40	13.8	21.3	65.2	58.4	>100
2.						**Pedon 2 (Rampur Naikin) :**					
	(i)	0-15	8.5	0.18	10.2	35	50	15	45	50.3	>100
	(ii)	15-30	8.5	0.17	8.6	33	54	16	40	45.8	>100
3.						**Pedon 3 (Majhauli) :**					
	(i)	0-15	8.6	0.25	10.8	25	55	14.5	25	42.6	>100
	(ii)	15-30	8.5	0.21	9.2	28	45	27.2	28	47.9	>100
4.						**Pedon 4 (Kusumi) :**					
	(i)	0-15	8.4	0.20	11.2	27	46.4	15.3	30	29.4	>100
	(ii)	15-30	8.5	0.20	8.9	26	51.2	16.9	28	27.8	>100
5.						**Pedon 5 (Sihawal) :**					
	(i)	0-15	8.6	0.19	8.9	28	18.2	21.7	50.1	32.9	>100
	(ii)	15-30	8.5	0.18	7-8	30	15.4	19.8	48.9	30.2	>100

S_2 (moderates suitable), S_3 (marginal suitable) and N (not suitable) as per FAO guideline (FAO 1993) considering the soil site limitations the main crops of Sidhi district (that is wheat, Rice and Soybean) is cultivated on all type of soil with higher amount of nutrients.

RESULT AND DISCUSSION

The Physical and chemical properties

The Physical and chemical properties of various soil sample (Pedon 1, 2, 3, 4, 5) of all five blocks was analyzed (TABLE 1) the results so obtained. Clearly showed that soils are moderately alkaline (PH 8.3 to 8.6) non saline (electrical conductivity 0.22 to 0.55 ds m^{-1}) soil of Sidhi Majhauli and Rampur naikin block are highly fertile (CEC 40 to 58-4 C mol (p+) Kg^{-1} Soil). Where as soil of Kusumi and Sihawal blocks are less fertile (CEC 27.8 to 32.9 C mol (p+) Kg^{-1} Soil).

Soil organic Carbon (OC)

The organic Carbon content (ranged between 4.0 to 7.5 g Kg^{-1} (TABLE 2 and 3) of soil has increased significantly and attained a maximum value of 7-5 g kg^{-1} in the fertilizer treatment that has received 100 % NPK.

Increasing level of fertilizer application has helped in increasing the organic carbon content which is due to increased contribution from the Biomass as it is also observed that with increasing level of fertilizer application the crop yield has increased. similar finding have been reported by[7, 10] attributing similar reasons.

Further, according to[12] it is suggested that NPK fertilizer along with organic manure plays an important Role in maintaining and improving soil health.

Available Nitrogen

Continuous use of nitrogenous fertilizer increases the available nitrogen status of soil (TABLE 3) data indicate that the available nitrogen content ranged from 195 to 270 kg ha^{-1} and that the highest value of available N was formed after fertilizer treatment of 100 % NPK. This showed an substantial increase in N content these results are in line with finding of[6] who observed that available N content in soil increased significantly with the use of recommended dose of fertilizer. It is also observed that, without use of fertilizer, reduces the available N status due to removal of nutrients with continuous cropping.

Available Phosphorus

The result obtained from this experiment indicate (TABLE 3) that imbalanced use of fertilizer reduced the available P content in the soil. Further the application of 100 % NPK with the help of available organic carbon in the soil, help to increase P status of Soil as reported by[8].

Available Potassium

The data shown (in TABLE 3) indicate significant increase in K status with the application of 100 % NPK fertilizer. Although continuous omission of K in crop nutrition caused mining of its native pools that caused reduction in the crop yield according to[9]. However the highest available K status of soil found associated with 100 % NPK treatment. This is because of higher rates of K application in the said treatment.

Available Sulphur

Continous growing of crops without application of S containing fertilizer caused decline in available S in the soil (TABLE 3). It may be attributed to continuous use of diammonium phosphate as P source which resulted in S deficiency in 100 % NPK causing re-

TABLE 2 : Fertility Status of Soil of Various Blocks of Sidhi District (After harvest 2010)

Blocks of Sidhi District	OC (g kg^{-1})	Available nutrient (Kg ha^{-1})				Available Zn (Kg ha^{-1})
		N	P	K	S	
Sidhi	4.8	195	12.2	180	11.6	0.94
Rampur Naikin	5.2	193	10.9	178	10.8	0.98
Majhauli	5.6	198	11.3	194	12.2	0.89
Kusmi	4.9	196	10.8	182	10.7	0.92
Sihawal	4.2	193	10.8	185	11.4	0.97

TABLE 3 : Fertility Status of Soil of Various Blocks of Sidhi District (After fertilizer treatment)

Blocks of Sidhi District	Applying Available Pack of Fertilizer	OC (g kg^{-1})	Available nutrient (Kg ha^{-1})		
			N	P	K
Sidhi	100 % NPK	7.5	268	28.5	270
Rampur Naikin	100 % NPK	6.93	270	27.9	269
Majhauli	100 % NPK	6.8	269	28.3	265
Kusmi	100 % NPK	7.3	267	27.6	268
Sihawal	100 % NPK	7.5	265	27.8	267

TABLE 4 : Nutrient Balance of Soil (Blocks wise)
(After harvesting and after fertilizer treatment 2010)

Blocks of Sidhi district	Available nutrients after harvest Initial value (Kg ha^{-1})			Available nutrients after fertilizer treatment (Kg ha^{-1})			Apparent nutrient changes (Kg ha^{-1})			Increase/ Decrease in nutrient		
	N	P	K	N	P	K	N	P	K	N	P	K
Sidhi	195	12.2	180	268	28.5	270	73.00	16.3	90.0	Inc.	Inc.	Inc.
Rampur Naikin	193	10.9	178	270	27.9	269	77.00	17.0	91.0	Inc.	Inc.	Inc.
Majhauli	198	11.3	194	269	28.3	265	71.00	17.0	71.0	Inc.	Inc.	Inc.
Kusmi	196	10.8	182	267	27.6	268	71.00	16.8	86.0	Inc.	Inc.	Inc.
Sihawal	193	10.9	185	265	27.8	267	72.00	16.9	82.0	Inc.	Inc.	Inc.

duction in crop yields[15]. But an appreciable increase in available S content was found in the treatment receiving continuously full dose of P through single super phosphate which contain 12 % S in addition to 16 % $P_2 O_5$. Further the application of recommended dose of fertilizer with organic manure significantly raised available S status of soil followed by 100% NPK treatment. Similar finding have also been reported by[12] from their studies.

Available Zinc

Available Zn content as shown in (TABLE 2) may be increased by adding zinc sulphate along with 100 % NPK as reported similar finding have also been reported.

Nutrient Balance

It is always desirable to calculate the apparent nutrient balance to attain the desired level of production without depleting the native resource and ensuring the maintenance and improvement in soil fertility.

Nutrients balance as shown in TABLE 4 clearly indicate increasement in NPK status after 100%: NPK fertilizer treatment in soil. But in case of continuous cropping the status of NPK will reduced significantly hence the dose of NPK needs to be increased. Keeping in view the overall soil fertility management for the soil for the particular crop. Although the crop like Soybean which is a leguminous crop having biological nitrogen fixation ability through which the N management is possible but such facilities are not available for K. therefore much attention is required for potassic fertilizer in soil to maintain K status of soil and to prevent K mining[1].

Apparent nutrient changes in soil after fertilizer treatment in comparison to after harvest of crop were computed and presented in (TABLE 4), observed that the addition of fertilizer of 100 % NPK helped in maintenance of the available N and K under continuous cropping. The maximum available N status was observed in 100 % NPK in 270 Kg ha^{-1} (TABLE 4) from its initial value 196 kg ha^{-1}.

Since P is relatively immobile in soil as compared to N and K and it was confined only to the upper layer of profile hence. Apparent P balance increased with increase in the quntity of P applied from 100 % NPK.

CONCLUSION

It is concluded that under continuous cropping and fertilization with 100 % NPK not only sustained the higher yield of crops but also improved the soil fertility. The findings indicate that balanced use of fertilizer alone resulted in significant build up a organic carbon and available NP and S. Although due to continuous cropping available K status even after containing fertilizer treatment declines form its initial value considerably which started soil mining of available K. Hence K containing fertilizer is recommended for its higher dose.

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