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Impact of Continuous use of Chemical Fertilizer

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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 (Tiwari et al. 2002) 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 (Verma et al. 2005). 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.

I. INTRODUCTION

The district Sidhi located in the eastern part of M.P. where tribes 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 sativa) 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 after harvesting the crops helps for the complete soil fertility management for increasing the crop yield.

Under soil fertility management it has been suggested (Tiwari et al. 2002) that combinational 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 (veram et al. 2005).

II. MATERIALS AND METHODS

The study was conducted in all the five blocks of Sidhi district located (feg. 1) in north eastern part of M.P. with a geographcial area of 10536 sq. km. administratively it has five blocks namely Sidhi, Rampur Naikin, Majhauli, Kusim and Sihawal the elivation ranges from 243 m to 607 m. from sea level. Out of total geographical area the net sown area in 49786 hac. Non sown area is 54890 hax. 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 from 4^0 to 33^0 C and the relative humidity varies from 70 to 90 %. Dry season prevails durinthe month of March of June the highest temperature during summer is 46^0. Mansoon season extend form mid June to mid septerber tempruture dring this peridod varios 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) Black 1965, Jacksan 1973) (table-1). The soil of the experimental field is medium black having about 57 % clay belonging to Kheri series of fie mantmorillonitic hyperthermic family of topic Haplustert. The soil profile of district sidhi having clay soil, clay loam sandy loam and literate white topography having hilly areas, plain areas and Vindicating areas. The available nitrogen was estimated through alkaline permanganate method as suggested by subbiah and Asija (1956), Availbale phusphorus was determined by Olsen method (Olsen et al. 1954) 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 (Lindsay and Norvel 1978) 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 by Naidu et al. 2006. The soil were grouped into S_1 (highly suitable), 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 height amount of nutrients.

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_s1)	Sand mm	silt mm	Clay mm	CEC (Cmol (H) 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	7100
	(ii)	15-30	8.3	0.19	10.2	40	13.8	21.3	65.2	58.4	7100
2.	**Pedon 2 (Rampur Naikin) :**										
	(i)	0-15	8.5	.18	10.2	35	50	15	45	50.3	7100
	(ii)	15-30	8.5	.17	8.6	33	54	16	40	45.8	7100
3.	**Pedon 3 (Majhauli) :**										
	(i)	0-15	8.6	.25	10.8	25	55	14.5	25	42.6	7100
	(ii)	15-30	8.5	0.21	9.2	28	45	27.2	28	47.9	7100
4.	**Pedon 4 (Kusum) :**										
	(i)	0-15	8.4	0.20	11.2	27	46.4	15.3	30	29.4	7100
	(ii)	15-30	8.5	0.20	8.9	26	51.2	16.9	28	29.8	7100
5.	**Pedon 5 (Sihawal) :**										
	(i)	0-15	8.6	0.19	8.9	28	18.2	21.7	50.1	32.9	7100
	(ii)	15-30	8.5	0.18	7-8	30	15.4	19.4	19.8	48.9	7100

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	.94
Rampur Naikin	5.2	193	10.9	178	10.8	.98
Majhauli	5.6	198	11.3	194	12.2	.89
Kusmi	4.9	196	10.8	182	10.7	.92
Sihawal	4.2	193	10.8	185	11.4	.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 charges ($Kg\ ha^{-1}$)			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	193	11.3	194	269	28.3	265	71.00	17.0	71.0	Inc.	Inc.	Inc.
Kusmi	196	10.8	182	267	276	268	71	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 .

III. RESULT AND DISCUSSION

1. **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 of obtained. Clearly showed that soils are moderates 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).
2. **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 Rawankar et all (2001) and Gathala et al. (2007) attributing similar reasons.

   Further, according to (Tiwari et al. 2002) it is suggested that NPK fertilizer along with organic manure plays an important Role in maintaining role in maintaining and improving
3. **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 Bhardwaj and Oman war (1994) and Singh et al. (2009) who observed that available N content in soil increased significant 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.
4. **Available Phosphorus :** The result obtained from this experiment indicate (table 3) that imbalanced use of fertilizer reduced that 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 Parmar and Sharma (2002).
5. **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 Prasad et al. (1996), Dwivedi et al. (2007). 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.
6. **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 continous use of diammonium phosphate as P source which resulted in S deficiency in 100 % NPK covering reduction in crop yields (Santhy et al. 1998). 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 Tiwari et al. (2002) and Singh et al. (2009) from their studies.
7. **Available Zinc :** Available Zn content as shown in (table 2) may be increased by owing zinc sulphate along with 100 % NPK as reported by Dwivedi et al. (2007) similar finding have also been reported by Singh et al. (2009).
8. **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 incensement 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 40 prevent K mining (Mahapatra et al. 2007).

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 confired only to the upper layer of profile hence. Apparent P balance increased with increase in the quntity of P applied from 100 % NPK.

IV. 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 balance 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 in recommended for its higher dose.

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