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Gaurav U Karad
Junagadh Agricultural University, Junagadh, Gujarat, India

Dr. MB Viradiya
Dept. of Soil Science and Agril. Chemistry, B.A. College of Agriculture, A.A.U., Anand, Gujarat, India

Atul B Pawar
Junagadh Agricultural University, Junagadh, Gujarat, India

Correspondence
Dr. MB Viradiya
Dept. of Soil Science and Agril. Chemistry, B.A. College of Agriculture, A.A.U., Anand, Gujarat, India

Effect of integrated nutrient management on crop yield and passive pools of soil organic carbon under groundnut-wheat sequence in LTFE soil

Gaurav U Karad, Dr. MB Viradiya and Atul B Pawar

Abstract
The effect of integrated nutrient management (INM) on crop yield and passive pools of soil organic carbon (SOC) under groundnut-wheat cropping sequence of a *Haplustepts* was studied in a long-term field experiment initiated during *kharif* 1999 at the Instructional Farm, JAU, Junagadh, Gujarat. Effect of varying doses of N, NP, NPK with FYM, Zn, S and *Rhizobium* on passive pools of SOC *viz*., humic acid, fulvic acid and humin after 12th year of groundnut-wheat crop sequence was studied. The result revealed that application of 50% NPK + FYM @ 10 t ha^{-1} to groundnut and 100% NPK to wheat significantly increased crop yield and humic acid, fulvic acid and humin. Integrated use of FYM with chemical fertilizers or use of FYM alone exerted significant effect on the passive pools of soil organic carbon. The crop yield and among forms was positively and highly significantly correlated with passive pools.

Keywords: Integrated nutrient management, soil organic carbon, passive pools

Introduction
Sustainable agriculture involves successful management of resources for increase agricultural production to satisfy changing human needs, while maintaining or enhancing the environment and natural resources (FAO, 1989) [1]. Integrated nutrient management (INM) or integrated nutrient supply (INS) system aims at achieving efficient use of chemical fertilizers in conjunction with organic manures. Long term fertilizer experiments involving intensive cereal based cropping systems reveal a declining trend in productivity even with the application of recommended levels of N, P and K fertilizers (Mahajan *et al*., 2002; Mahajan and Sharma, 2005) [7, 8]. The crop productivity increases from the combined application of chemical fertilizers and organic manures. Such combination contributed to the improvement of physical, chemical and biological properties and soil organic matter and nutrient status. In sustainable agriculture the organic matter is a single property which influences soil fertility, soil formation, soil biology, physical and chemical properties, organo-chemical, biotic and hydrothermal characteristics of a soil (Malewar *et al.*, 1998) [9] and (Katyal, 2000) [3]. The nature, content, composition and behaviour of organic matter in soil are fundamentally important for growth of crop under diverse climatic conditions.

Soils of Saurashtra region belongs to different soil groups. It's very difficult task to predict about its fertility make-up. As the soil fertility is decreasing day by day due to low use of farmyard manure and consequently increase in use of chemical fertilizers, our aim is to study the trend of soil status in long run. The organic matter is decreasing in our soil. Therefore such study will generate useful information on managing soil health. Organic matter fractions from the soil of long-term field experiment will provide a platform for predicting the organic matter status of these soils.

At JAU, Junagadh LTFE has been in progress since last 12 years (Initial year 1999-2000 before groundnut, 4th year 2003 after wheat, 8th year 2007 after wheat, 12th year 2011 after wheat). It consists of organic manuring and inorganic fertilization treatments. Estimation of SOC gave estimate of soil organics build-up. The semi-arid climatic condition in this region limits improvement in the status of SOC even after the decade of FYM addition but it might have changed passive pools of fractions of SOC. With this in mind and in depth study of the integrated nutrient management on soil organic carbon fraction under groundnut-wheat sequence under LTFE of Haplustepts soils In view of the growing concern for sustaining management of organic matter of soils.

Materials and Methods

A long term field experiment on integrated nutrient management under groundnut - wheat sequence was initiated in the year 1999-2000 at the Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh. Junagadh is situated at 21.5^0 N latitude and 70.5^0 E longitudes with altitude of 60 meters above the mean sea level on the Western side at the foothills of mountain Girnar in South Saurashtra agro-climatic zone of Gujarat state. The climate of the experimental site is sub-tropical. The maximum and minimum temperatures are 36.8 and 22.5 ^{0}C. The mean annual rainfall of the region varies from 650 to 750 mm. The soil of the experimental field is clayey in texture and medium black calcareous in nature, having field capacity and permanent wilting point 41 % and 20% respectively. Organic matter is 0.65 %, $CaCO_3$ 48 %, Available N, P_2O_5 and K_2O is 106.06, 28.16 and 272.00 respectively. Cation exchange capacity 27.30 [cmol (P^+) kg^{-1}]. The experiment consisted of 12 treatments replicated four times in a randomized block design. These are: T_1 - 50 % NPK of recommended dose to Groundnut-Wheat sequence; T_2- 100% NPK of recommended dose to Groundnut-Wheat sequence; T_3 - 150% NPK of recommended dose to Groundnut-Wheat sequence; T_4 - 100% NPK+ $ZnSO_4$ @ 50 kg ha^{-1} once in three year to groundnut only; T_5 - NPK as per soil test; T_6 -100% NP of recommended dose to Groundnut-Wheat sequence; T_7 - 100% N of recommended dose to Groundnut-Wheat sequence; T_8 - 50% NPK + FYM @ 10 t ha^{-1} to Groundnut and 100% NPK to wheat; T_9 - Only FYM @ 25 t ha^{-1} to Groundnut only; T_{10} - 50% NPK + Rhizobium + PSM to groundnut and 100 % NPK to wheat; T_{11} - 100% NPK of recommended dose to Groundnut-Wheat sequence. (P as SSP); T_{12} - Control; The recommended dose of fertilizers for groundnut 12.5 kg/ha N, 25 kg/ha P, and for wheat 120* kg/ha N, 60 kg/ha P_2O_5 and 60* kg/ha K_2O; (*50% as basal dose and 50% at 21 DAS.). The fertilizers used were Urea, Diammonium phosphate, and muriate of potash, ($T_{11:}$ P source issingle super phosphate) and zinc sulphate. Groundnut GG-20 and wheat GW- 496 were raised as test crop in the cropping system.At the harvest of wheat crop of year (2011), soil samples (0-15 cm) were drawn to assess theorganic carbon by rapid titration method (Walkley and Black 1936), humic acid, fulvic acid and humin (Stevenson 1965).

Results and Discussion

Groundnut Yield

The pod and haulm yields of groundnut were significantly influenced by various treatments in 8th and 12th year and pooled result. The average maximum pod and haulm yield were recorded under application of 50 % NPK of RD + FYM @ 10 t ha^{-1} to groundnut and 100 % NPK to wheat (T_8). And this treatment was statistically at par with T_3. The pod and haulm yield of groundnut were not influenced significantly by various treatments of experiment in 1st year as well as in 4th year pooled, but numerically higher pod and haulm yield were recorded under T_8 in 4th year result. (Table 1). Whereas in 1st year, numerically higher pod yield was recorded under (T_6) 100 % N P of recommended doses in Groundnut-wheat sequence and numerically higher haulm yield under T_2 (100 % N P K of RD in G'nut-wheat sequence). The combined application of organic and inorganic fertilizers in continuous manner, might have sustained the crop yield.

Table 1: Groundnut pod and haulm, wheat grain and straw yield in 1st, 4th, 8th, and 12th year pooled of LTFE

Treatment	Groundnut pod yield (kg ha^{-1})				Groundnut haulm yield (kg ha^{-1})				Wheat grain yield (kg ha^{-1})				Wheat straw yield (kg ha^{-1})			
	1st year	4 Year Pooled	8 Year Pooled	12 Year Pooled	1st year	4 Year Pooled	8 Year Pooled	12 Year pooled	1st year	4 Year Pooled	8 Year Pooled	12 Year Pooled	1st year	4 Year Pooled	8 Year Pooled	12 Year Pooled
T_1	962	972	929	836	1790	2104	2233	2061	1589	1626	2039	2079	2696	2234	2704	2675
T_2	984	1042	1001	906	2018	2272	2395	2231	1908	2049	2467	2580	3090	2540	3325	3330
T_3	916	1032	1041	946	1758	2366	2532	2336	1878	2137	2525	2692	2847	2672	3441	3447
T_4	1048	1060	1012	917	1985	2158	2365	2214	1806	1952	2343	2512	2650	2425	3164	3224
T_5	929	1050	993	894	1676	2088	2282	2132	1856	2010	2472	2560	2819	2472	3237	3253
T_6	1101	988	890	787	1969	2343	2382	2139	1718	1907	2343	2448	2696	2287	3043	3067
T_7	927	950	855	749	1693	2048	2104	1905	1111	1185	1448	1515	1921	1461	2042	2052
T_8	916	1060	1093	1001	1888	2292	2614	2442	1898	2290	2887	3137	2766	2509	3911	4055
T_9	875	1006	995	915	1693	2154	2458	2301	1289	1937	2587	2824	2141	2185	3205	3356
T_{10}	963	1028	981	882	2002	2247	2364	2173	1419	1872	2307	2435	2581	2283	3111	3127
T_{11}	1017	1062	983	879	1871	2272	2421	2220	1608	1995	2435	2555	2963	2559	3268	3289
T_{12}	968	902	782	727	1725	2062	2059	1938	1309	1322	1677	1781	2072	1624	2119	2202
S.Em.±	74	38	33	23	131	83	68.93	50.42	107	104	88	69	155	110	121	86
C.D. at 5 %	NS	NS	95	65	NS	NS	194	139	309	296	249	191	448	318	343	240
C.V. %	15.3	10.5	12.5	12.1	14.2	9.1	12.0	11.3	13.2	11.5	10.8	10.1	11.9	13.2	11.5	10.8
Mean	968	1013	963	870	1839	2201	2351	2174	1616	1857	2294	2427	2603	2271	3048	3090

Wheat Yield

The grain and straw yields of wheat were significantly affected by various fertilization treatments of LTFE in 1st, 4th, 8th and 12th years as well as in pooled results. Significantly the average maximum grain and straw yield of wheat were obtained under treatment of 50 % NPK of RD in groundnut-wheat sequence + FYM @ 10 t ha^{-1} in groundnut and 100 % NPK to wheat (T_8). During 4th, 8th, 12th and pooled result (Table.1), whereas, significantly the highest grain and straw yield were recorded under T_2 (100 % N P K of RD) in first year result. Although the year x treatment interactions was significant, the treatment T_8 invariably recorded the highest value on long term basis both for grain and straw yield of wheat. The combined application of organic and inorganic fertilizers in continuous manner, might have sustained the crop yield.

Soil organic carbon status

Results presented in table 2 indicated that the organic carbon of soil was significantly increased by application of FYM @ 25 t ha^{-1} (T_9) in 12th year and was at par with T_8. Significantly the highest organic carbon (8.04 g kg^{-1}) was observed under treatment T_9 and it was remained at par with treatment T_8. Among the chemical fertilizer treatments, the maximum increase in organic carbon was recorded with 100% NPK (T_2), followed by treatment T_5, while the minimum organic carbon was observed under treatment T_7 (6.29 g kg^{-1}). Reason attributed is the direct incorporation of organic matter, better root growth and more plant residues addition after harvest of crops. These findings are in agreement with the observation of Kumar and Yadav (2003) [5] and Varalakshmi *et al.*, (2005).

The organic carbon content of the soil significantly increased with the application of FYM @ 25 t ha^{-1}(T_9) over control (T_{12}). This shows that use of FYM alone also helps in increasing the organic carbon content of the soil. The findings are in conformity with Tiwari *et al*. (2002) [14]. The increase in organic carbon content due to use of organic manure can be attributed to higher contribution of organic matter, crop stubbles and residues to the soil. Katyal *et al*. (2003) [4] studying the soil fertility status also found application of FYM to be highly essential for maintenance of organic carbon, reducing the pH and increase CEC of soil. Such improvements in chemical properties have also been observed in long term fertilizer experiments. The similar result was finding by Sharma *et al.* (2007) [7] and Verma *et al*. (2009) [16].

Table 2: Status of organic carbon and passive pools in 1st and 12th year of LTFE Soils in groundnut-wheat sequence.

Treatment	Organic carbon (g kg^{-1})		Humic Acid (mg 100 g^{-1} soil)		Fulvic Acid (mg 100 g^{-1} soil)		Humin (g 100 g^{-1} soil)	
	1st Year	12th Year	1st Year	12th Year	1st Year	12th Year	1st Year	12th Year
T_1	6.53	7.13	142.5	161.5	68.3	80.3	5.02	7.30
T_2	6.00	7.55	141.8	161.5	71.3	80.0	3.76	6.93
T_3	6.30	7.20	168.5	198.3	77.3	91.0	4.25	7.98
T_4	6.00	7.25	177.9	202.8	81.3	94.0	4.75	8.55
T_5	6.23	7.30	171.5	207.8	79.8	89.0	3.10	9.25
T_6	5.40	7.53	176.5	215.5	80.3	85.3	3.31	9.60
T_7	5.18	6.48	172.7	232.3	70.5	90.3	3.18	9.50
T_8	6.15	8.40	202.0	363.5	90.3	97.0	5.87	13.30
T_9	6.45	8.83	180.5	345.5	86.5	91.0	5.12	12.53
T_{10}	6.08	7.03	167.5	246.0	70.5	75.3	3.60	11.25
T_{11}	5.78	7.33	179.6	258.5	73.5	82.3	4.78	10.63
T_{12}	6.15	6.90	172.5	251.8	72.5	85.3	2.83	7.78
MEAN	6.02	7.41	171.1	237.0	76.8	86.7	4.13	9.55
S.Em.±	0.56	0.24	7.2	12.1	4.7	4.4	0.34	0.46
C.D. at 5 %	NS	0.69	20.9	34.9	13.6	12.7	0.98	1.34
C.V. %	18.4	6.4	8.5	10.2	12.3	10.2	16.5	9.7

Passive pools fraction

Humic Acid

The humic acid content in soils of different treatments under the LTFE in the years 2000 and 2012 are presented in Table 2. During 2000, treatment T_8 (50 % N P K of recommended dose in G'nut -Wheat sequence + FYM @ 10 t ha^{-1} G'nut and 100 % N P K to Wheat) increased significantly humic acid 202.0 (mg 100 g^{-1} soil) in the years 2012 same treatment produced significantly higher value (363.5 mg 100 g^{-1} soil) and was at par with treatment T_9. Same result was found on the passive fraction of SOC revealed that humic fraction varied widely from 190 to 260 mg 100 g^{-1} soil, in various treatments. Higher value of humic fraction was observed unde application of NPK through fertilizers + 10 t FYM ha^{-1}. (Ravankar *et al.,* 2004) [10].

Fulvic Acid

The fulvic acid content in soils of different treatments under the LTFE in the years 2000 and 2012 are presented in Table 2, revealed that in the year 2000 treatment T_8 (50 % N P K of recommended dose in G'nut -Wheat sequence + FYM @ 10 t ha^{-1} G'nut and 100 % N P K to Wheat) increased significantly (90.3 mg 100 g-1 soil), however was at par with T_3, T_4, T_5, T_6, and T_9. In case of the year 2012 same treatment significantly increased fulvic acid it was at par with treatment T_3, T_4, T_5, T_6, T_7 and T_9. Durasov (1965) [2] revealed that finer fractions of soil separates under FYM addition that was due to lower content of fulvic acid was observed in the surface soil and its highly mobile nature probably resulted in washing away of this constitute from surface soil.

Humin

The humin content of soils of different treatments under the LTFE in the years 2000 and 2012 are presented in Table 2, revealed that in the year 2000 and 2012 treatment T_8 (50 % N P K of recommended dose in G'nut -Wheat sequence + FYM @ 10 t ha^{-1} G'nut and 100 % N P K to Wheat) significantly increased humin (5.87, and 13.30 g 100 g^{-1} soil) respectively, but it was at par with treatment T_9 (Only FYM @ 25 t ha^{-1} to G'nut only). Humin is the most resistant fraction of SOC and its contribution is the largest among other fraction. The highest concentration of humin was observed in the treatment T_8 followed by treatment T_9. Continuous addition of organic and inorganic treatments noticed increased content over control. The reason might be due to better and improved soil physical parameters and conductive environment for its fraction. The increase in the concentration of mineralization owing to the higher temperature of surface soil in tropical regions (Santhy *et al.,* 2001) [11].

Depletion per cent

In LTFE soils after a span of twelve year the humic acid showed negative depletion that means it increased (Table 3) in T_1 (50% N P K of recommended dose in G'nut -Wheat sequence) to T_9 (FYM @ 25 t ha^{-1}). Similar results were also found in case of fulvic acid percent depletion, in T_2 (100 % N P K of recommended dose in G'nut -Wheat sequence) to in T_7 (100 % N of recommended dose in G'nut -Wheat sequence).

Table 3: Depletion (%) of different forms of passive pools after 12 groundnut-wheat sequence in LTFE soils.

Treatment	Humic Acid	Fulvic Acid	Humin
T_1	-9.2	-17.8	-69.2
T_2	-11.1	-10.6	-77.7
T_3	-20.9	-19.2	-93.5
T_4	-16.7	-26.3	-80.1
T_5	-19.3	-25.9	-198.1
T_6	-19.9	-24.4	-182.9
T_7	-31.5	-37.3	-190.6
T_8	-92.5	-13.7	-126.7
T_9	-113.9	-11.6	-139.7
T_{10}	-23.4	-14.8	-212.9
T_{11}	-17.3	-20.0	-116.7
T_{12}	-20.4	-26.2	-87.9

Conclusion
Results reveal that the passive pools which are the most important parameters in the soil system under study for the sake of maintenance of organic matter are beneficially and significantly influenced by application of FYM.

References

1. FAO. Sustainable development and natural resource management. Food and Agriculture Organization of the United Nations, Rome, FAO Agril. Series No. 22, Chapter 3, 1989, 84-90.
2. Durasov AM. Group composition ofhumus in the chernozems of the ciscancasian, Trans- volga and west Siberian provinces. Soviet Soil Science. 1965; 11:1326-1332.
3. Katyal JC. Organic matter maintaince, main stay of soil quality. Journal of IndiaSociety of Soil Science. 2000; 48:704-716.
4. Katyal V, Gangwar KS, Gangwar B. Long-term effect of fertilizer use on yield sustainability and soil fertility in rice-wheat system in sub-tropical India. Fertlizer News. 2003; 48:43-46.
5. Kumar A, Yadav DS. Long term nutrient management on for sustainability in rice-wheat cropping system. Fertil. News. 2003; 48:27-34.
6. Liang BC, Gregorich ED and Schnitzer M. Mineral nitrogenaccumulation in soils as affected by water-soluble organic carbon extracted from composted dairy manure. Communication Soil Science & Plant Analysis (USA). 1995; 26(15-16):2711-2723.
7. Mahajan A, Choudhary AK, Bhagat RM. Integrated plant nutrient management (IPNM) system for sustainability in cereal based cropping system. Indian Farmer's Digest. 2002; 35(7):29-32.
8. Mahajan A, Sharma R. Integrated nutrient management (INM) system Concept, need and future strategy. Agrobios Newsletter. 2005; 4(3):29-32.
9. Malewar GU, Ramasawami PP, Suseela Devi L. Status, Nature and Characteristics of soil organic matter in peninsular India. Bulletin of the Indian Soc. of Soil Sci. 1998; 19:48-57.
10. Ravankar HN, Singh MV, Sarap PA. Effect of long term fertilizer application and cropping on the sustenance of soil fertility and productivity under sorghum-wheat sequence in vertisol. Indian Farmers Digest. 2004; 40.
11. Santhy P, Muthuvel P, Selvi D. Humus and impact of organic matter fractions on yield, uptake and available nutrients in a long-term fertilizer experiment. Journal of The Indian Society of Soil Science. 2001; 49(2):281-285.
12. Sharma Manmohan, Mishra B, Singh Room. Long term effect of fertilizer and manure on physico-chemical properties of a molisol. Journal of the Indian Society of Soil Science. 2007; 55:523-524.
13. Stevenson FJ. Gross chemical fractionation of organic matter. Methods of soil chemical analysis part II. (eds.) Black CA, Evans DD, White JL, Ensmingerand LE, Clark FE. American Society of Agronomy. Madison, Wisconsin, 1965, 1409-1421.
14. Tiwari A, Dwivedi AK, Dikshit PR. Long-term influence of organic and inorganic fertilization on soil fertility and productivity of soybean-wheat system in a vertisol. Journal of the Indian Society of Soil Science. 2002; 50:472-475.
15. Varlakashmi LR, Sriniwasamurthy CA, Bhaskar S. Effect of integrated use of organic manures and inorganic fertilizers on organic carbon, available N, P and K in sustaining productivity of groundnut- finger millet cropping system, Journal of the Indian Society of soil science. 2005; 53:315-318.
16. Verma ML, Charan Singh, Bhardwaj SP. Effect of bio-fertilizer and organic fertilizer on soil moisture and fertility status. Indian Journal of Soil Conservation. 2009; 37:201-205.
17. Walkley A, Black CA. An examination of the Degtjareff method for determining soil organic matter and proposed modification of the chromic acid titration method. Soil Science. 1936; 37:29-38.