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SYNERGISTIC EFFECT OF FARMYARD MANURE ON PLANT ORGANIC CARBON IN FODDER MAIZE (*Zea mays L.*) CROP FIELD

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Abstract: The experiment was conducted to study the influence of inorganic fertilizer (Treatment 1) and the synergistic effect with organic fertilizer (Treatment 2) on Plant Organic Carbon (OC) in Fodder Maize (*Zea mays L.*) in North eastern (Tiruvannamalai and Vellore district) and Western Zones (Coimbatore and Erode district) of Tamil Nadu. In each district, two villages were randomly selected totaling to eight experimental sites for the study. The plant OC has shown a steady increase from 30th to 60th day for both the treatments and significantly higher ($P < 0.05$ or 0.01) plant OC was observed for T2 than T1 in all villages on 30th and 60th day. The results of the study concluded that use of inorganic fertilizers alone or synergistically with organic fertilizers resulted in increase of plant organic carbon in fodder maize treated plots. Moreover, farm yard manure could serve as a viable option for carbon mitigation.

Keywords: Farmyard manure, Fodder Maize, Inorganic fertilizer, Plant Organic carbon.

Introduction

Organic manure and inorganic fertilizer are the most common materials applied in agricultural management to improve soil quality and crop productivity (Verma and Sharma, 2007). Continuous use of inorganic fertilizers leads to deterioration in soil chemical, physical, and biological properties, and soil health. The negative impacts of chemical fertilizers, coupled with escalating prices, have led to growing interests in the use of organic fertilizers as a source of nutrients. Judicious use of combinations of organic and inorganic resources is a feasible approach to overcome soil fertility constraints. Combined organic and inorganic fertilization could enhance carbon storage in soils and reduce emission from N fertilizer use, while contributing to high productivity in agriculture (Pan *et al*., 2009). Hence the present study was undertaken to determine the effect of inorganic fertilizer and synergistic effect of inorganic fertilizer with organic fertilizer (farm yard manure) on plant organic carbon in Fodder Maize (*Zea mays* L.) in two agroclimatic zones of Tamil Nadu.

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Materials and Methods

Composite soil samples were collected at a depth of 0-15 cm in all the experimental villages prior to the study and analysed for the physico chemical properties. The field experiment was carried out using the Annual fodder crop, Fodder Maize (*Zea mays* L.) in 2 agroclimatic zones of Tamil Nadu. viz., Western and North Eastern zone. In each zone two districts viz., Coimbatore and Erode districts (Western Zone) and Tiruvannamalai and Vellore districts (North Eastern zone) were selected and in each district, two villages were randomly selected for field experiments totaling to eight experimental sites (Table 1) for the study. The land was ploughed twice by a tractor with chisel ploughing followed by harrowing and the field was brought to fine tilth, leveled with a wooden plank and laid out in to proper plot size (6 x 4 m).The experiment was laid out with six replications per treatment in all the study fields. Fodder maize was planted at 60 x 30 cm intervals on either side of the ridges. The experiment consisted of two treatments viz., Treatment 1 (T1) which is control with recommended dose of NPK fertilizers (60 N, 40 P_2O_5 and 20 K_2O kg/ha) alone and Treatment 2 (T2) which included Farmyard Manure (Organic – Recommended dose - 12.5 t/ha) along with NPK fertilizer (inorganic – Recommended dose). All the cultural practices were followed as per the recommended package of practices. Fodder samples were collected at random just above the ground level at 30^{th} day and on 60^{th} day. The samples were shade dried and kept in oven at 60-70°C till constant weight was obtained. Finally the dried samples were ground to fine powder and subjected for chemical analysis of organic carbon by using Analytikjena multi N/C 2100S carbon analyzer, with furnace temperature of 950°C, NDIR detector and oxygen as supportive gas. The data collected were subjected to 't' test to find out the significant difference between treatments for all villages. In addition, One-Way ANOVA was performed using SPSS 13.0 to evaluate the significant difference between districts and zones. Also interpretation of data was done as per the procedure described by Gomez and Gomez (1984).

Results and Discussion

The mean values of plant organic carbon (OC) in Fodder Maize varied between 48.86 to 53.17%, 50.19 to 54.17% (on 30^{th} day) and 49.81 to 50.98% to 56.37 to 55.24% (on 60^{th} day) for T1 and T2 respectively for all the villages. Also the Plant OC has shown a steady increase for both treatments during the experimental study. Highly significant ($P<0.01$) difference in plant OC for Fodder Maize were recorded for all the villages between treatments, T1 and T2 except V1 and V8 where significant ($P<0.01$) difference in plant OC were observed on 60^{th} day of the trial period.

It is evident from the results that the plant organic carbon increased gradually from 30th day to 60th day during the study period. In general, as plant grows there would be absorption of carbon-dioxide from the atmosphere which was stored in leaves, stems and also in the root. In initial stages of plant growth, there will be less absorption due to lower biomass of the plant. During harvesting stage due to abundant growth and due to maturation of the plant large amount of carbon would have been accumulated and hence the concomitant increase of carbon content was noticed from 30th to 60th day (Shehzad *et al*., 2012). Significantly higher ($P < 0.05$ or 0.01) plant organic carbon was observed for T2 than T1 for all the villages on 30th and 60th day. The significant increase in T2 over T1 may be attributed to the effect of farm yard manure which contained readily metabolizable carbon and N which increased the root biomass and root exudates which played a vital role in contributing to its biomass increase (Enke liu *et al*., 2010). Moreover the benefits of organic matter from farm yard manure provided N, P, and K supply resulting in improvement of microbial activity, better supply of macro and micro nutrients such as S, Zn, Cu and B which were not supplied by inorganic fertilizers and due to lower losses of nutrients from the soil (Bhattacharya *et al*., 2008). Increased biomass and activity by the farm yard manure, mineral fertilization would have increased the root biomass which provided organic matter for microorganisms. Farm yard manure provided abounding organic matter for the growth of microorganisms which favored increased yield (Gong *et al*., 2009).

The results of the study concluded that use of inorganic fertilizers alone or synergistically with organic fertilizers resulted in significant buildup of plant organic carbon in fodder maize treated plots. Also the farm yard manure helped in increasing the plant organic carbon of the fodder maize test crop which in turn could achieve higher carbon sequestration potential, fodder yield which has a beneficial effect on carbon mitigation.

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Table 1
Plant Organic Carbon (in %) in Fodder Maize in Western and North Eastern zone of Tamil Nadu

District	Villages	30th day		t value	60th day		t value
		T1	T2		T1	T2	
		Mean ± S.E	Mean ± S.E		Mean ± S.E	Mean ± S.E	
CBE	V1	50.90 ± 0.46^{bc}	52.55 ± 0.18^{cd}	3.35^{**}	52.74 ± 0.24^{de}	$53.93 \pm 0..30^{de}$	3.07^{*}
	V2	51.70 ± 0.52^{c}	53.04 ± 0.27^{c}	2.28^{*}	53.10 ± 0.19^{e}	54.58 ± 0.33^{e}	3.86^{**}
ERO	V3	53.17 ± 0.25^{d}	54.17 ± 0.32^{d}	2.46^{*}	55.24 ± 0.22^{g}	56.37 ± 0.13^{g}	4.34^{**}
	V4	51.94 ± 0.25^{cd}	53.07 ± 0.30^{c}	2.88^{*}	54.30 ± 0.27^{f}	55.46 ± 0.15^{f}	3.83^{**}
TVM	V5	49.90 ± 0.11^{ab}	51.05 ± 0.28^{ab}	3.85^{**}	51.93 ± 0.25^{c}	53.09 ± 0.21^{c}	3.53^{**}
	V6	49.66 ± 0.67^{ab}	51.69 ± 0.44^{bc}	2.52^{*}	52.12 ± 0.23^{cd}	53.46 ± 0.34^{cd}	3.30^{**}
VLR	V7	48.86 ± 0.39^{a}	50.19 ± 0.02^{a}	3.42^{**}	49.81 ± 0.23^{a}	50.98 ± 0.11^{a}	4.62^{**}
	V8	48.94 ± 0.55^{a}	50.82 ± 0.39^{ab}	2.79^{*}	50.78 ± 0.29^{b}	51.85 ± 0.35^{b}	2.31^{*}
	F value	12.67^{**}	20.29^{**}		52.78^{**}	48.10^{**}	

Means bearing same superscripts within columns do not differ significantly
* - Significant (P<0.05) ** - Highly Significant (P<0.01)

(V1 – Kondaiyampalayam, V2- Idigarai, V3 – Velankattuvalasu, V4 – Velliyampalayam, V5 – Vannankulam, V6 – Kolathur, V7- Saduperi V8 – Thirumani)