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CHANGE IN ORGANIC CARBON CONTENT AND YIELD ATTRIBUTES OF POTATO (*SOLANUM TUBEROSUM*) THROUGH THE APPLICATION OF DIFFERENT LEAF LITTERS.

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ABSTRACT

Carbon has become crucial from view point of atmosphere as well as lithosphere. The largest exchange of carbon take place between atmosphere and the vegetation, since about half the carbon fixed by plants is respired back and the net primary production is only about 60 Pg C/ha /year. The global pool of carbon is described in the following figures. In soil although soil carbon is not directly related to the plant nutrition yet the plant nutrition is governed by the C status of soil. It plays pivotal roles in several processes of the soil ecosystem including nutrient cycling, soil structure, formation, C-sequestration, water retention detoxification of anthropogenic chemicals and energy supply to soil microorganisms. The nature, content composition and behaviour of organic matter in soil are fundamentally important for growth of crops under diverse climatic conditions. The organic matter applied to soil is subjected to decomposition depending on the soil and environmental conditions. The experiment was laid out in a randomized Block Design. As regards to the treatments three levels each of Chinar, Juglens, Morus, poplar and Salix leaves were employed in C5, C10 and C20; J5, J10 and J20; M5, M10 and M20; and P5, P10 and P20 and S5,S10 and S20 respectively. The total number of

combinations worked out to 16 increasing control. The crop was harvested on 28-10-2015. The crop stands very good. The stems were thick and the plants grew to a height of over 86.80cm.

KEYWORDS: Agro-forestry, Solanum, Carbon, Leaf, ppm.

INTRODUCTION

Environment has different meanings for different people. Most definitions include the physical, chemical and biological components that influence the life of an organism, Etymologically the term environment means surroundings Therefore environment can simply be defined as ones surroundings; which includes everything around the organisms i.e. biotic and Abiotic components (P.D. Sharma, 2009). The global environment consists of three segments, *viz,* atmosphere, hydrosphere and lithosphere. Geologically speaking, the lithosphere is the top crust on the earth on which the continents and oceans basins rest. It is thickest in the continental region where it has an average thickness of 40km and thinnest in the oceans where it may have a maximum thickness of 10 to 12 km. But environmental science is interested only in the upper few feets of the soil. This soil is not simply one thing but made up of several components which all together make soil complex. The soil solution contains almost all the essential minerals as carbonates sulphates, nitrates chlorides and organic salts of Ca, Mg, Na, K etc. are found dissolved in water (S. Deswal and A. Deswal, 2009). Carbon in soil is found in both organic and inorganic forms. In most soils the majority of C is held as soil organic carbon (SOC). Soils are the largest carbon reservoirs of the terrestrial carbon cycle. Soil if managed properly, can serve as a sink for atmospheric carbon dioxide. Worldwide about 1500 Pg carbon is stored in first 30 cm of soil (Batjes, 1996), for India it is only 9 Pg (Bhattacharya *et al.*, 2000) soils contain 3.5% of the earth's carbon reserves, compared with 1.7% in the atmosphere, 8.9% in fossil fuels, 1.0% in biota and 84.9% in oceans (Lal, 1995). Carbon has become crucial from view point of atmosphere as well as lithosphere. The largest exchange of carbon take place between atmosphere and the vegetation, since about half the carbon fixed by plants is respired back and the net primary production is only about 60 Pg C/ha /year. The global pool of carbon is described in the following figures. In soil although soil carbon is not directly related to the plant nutrition yet the plant nutrition is governed by the C status of soil. It plays pivotal roles in several processes of the soil ecosystem including nutrient cycling, soil structure, formation, C-sequestration, water retention detoxification of anthropogenic chemicals and energy supply to soil microorganisms. The nature, content composition and behavior of organic matter in soil are fundamentally important for growth of crops under diverse climatic conditions. The organic matter applied to soil is subjected to decomposition depending on the soil and environmental conditions. Humic substances formed in soil; act as highly reactive natural polymers. Fundamental groups in humic substances also depend on the agro-climatic conditions (Walker *et aL*, 2004). Dynamic characteristics such as microbial biomass, soil enzymes and soil respiration respond more quickly to the changes in crop management practices and type of cultivation than physio-chemical properties of soils (Chander *et al.*, 1997 and Batra, 2004). The ancient agriculture is an outcome of dynamic developments since generations that gradually replaced the organic forming possibly all over the world. The time for this change was different for different countries and regions. As a result, decline or stagnation in crop yields is reported from one part or the other including India even with adoption of the recommended technologies (Bhandari *et al.*, 2002 and Ladha, 2003). The major factors affecting the loss and restoration of soil organic carbon include land use change, management practices, like cropping intensity, reduced or no tillage, fertilizer and manure application (Sommerfeld et *al.*, 1988). Labile carbon pool of carbon is the fraction of SOC that has the most rapid turnover rates and therefore, its oxidation drives the fluex of carbon dioxide from soils to atmosphere. Also the labile carbon pool is one which is readily decomposable, easily oxidizable and susceptible to microbial attack and is sensitive to management induced changes in soil organic carbon. This pool fuels the soil food web and greatly influences the nutrient cycling for maintaining the quality of soil and its productivity (Mujumder, 2006). Recent studies have shown that the temperature sensitivity for resistance organic matter pools does not differ significantly from that of labile pool and that both types of both will therefore respond similarly to global warming (Fang et *al.*, 2005). Agro-ecosystems play a central role in the global C cycle and contain approximately 12% of the world terrestrial C. The terrestrial (plant and soil) C is estimated at 2000 ± 500 Pg which represents 25% of global C stocks (DOE, 1999). The sink option for CO_2 mitigation is based on the assumption that this figure can be significantly increased if various biomasses are judiciously and/or manipulated. It is clear that forests have tremendous potential for C sequestration (1-3 Pg year^{1}) so as to reduce GHG concentrations in the atmosphere. In this connection agro-forestry systems will have a great impact on the flux and long-term storage of C in the terrestrial biosphere (Dixon, 1995) as the area of the world under agro-forestry will increase substantially in the near future undoubtly. The amount of C sequestered largely depends on the agro forestry system put in place, the structure and function of which are, to a great extent, determined by environmental and socio-economic factors. Other factors influencing carbon storage in agro-forestry systems include tree species and system management. Brinja l(solenum melongena) belongs to the genus solenum under solanaceae family. Brinjal is a herbaceous plant growing to 1-3 m in height with woody stem. Brinjal is a moderately tolerant crop to a wide pH range. A pH of 5.5-6.8 is preferred. Though brinjal plants do well in more acidic soils with adequate nutrient supply and availability. brinjal is moderately tolerant to acid soil that is pH of 5-5. The soils with proper water holding capacity, aeration, free from salts are selected for cultivation. Soils extremely high in organic matter are not recommended due to high moisture content of this media and nutrient deficiencies. But as always, the addition of organic matter to mineral soils will increase yield. All crops including brinjal absorb carbon dioxide during growth and release it after harvest. The goal of agricultural carbon removal is to use the crop and its relation to the carbon cycle to permanently sequester carbon within the soil. This is done by selecting farming methods that return biomass to the soil and enhance the conditions in which the carbon within the plant will be reduced to its elemental nature and store in a stable state agricultural sequestration practices may have positive effects on the soil, air, water and expand food production. On degraded croplands, an increase of 1 ton of soil carbon pool may increase crop yield by 20 to 40 kilograms perhectare *(Usman et al.2003)* Keeping in view the aspects, present investigations entitled "Change in organic carbon content and yield attributes of potato (lpomoea Batitus) through the application of different leaf litters", is therefore under taken with the following objectives:- (i) To evaluate the effect of leaf litters on the yield of brinjal crop. (ii) To analyse the effect of leaf litters on organic carbon, labile and water soluble carbon in soil.

MATERIALS AND METHODS

This chapter deals with the details of the experiment and the other points dealt with to a briefer degree are the experimental site, laboratory analysis, the climate and cropping history of the field. The experiment was conducted during the Kharief season of 2015. The seeds were sown on April 2015.

Experimental site

The present investigation entitled "Response on carbon pools and yield attributes of brinjal *(solinum malongena)* crop through application of different leaf litter", was conducted in the village of Batapora District, Budgam. Jammu and Kashmir.

Climate and weather conditions

Kashmir is situated at an elevation of 6070 ft from sea level at 34.5°N and 74.49°E longitude. This region has a moderate climate with both the extremes to temperature i.e. summer and winter. In the winter temperature sometimes falls very low up to -5°C in December-January and hot in summer with temperature reaching up to 36°C in June and July. The average rainfall in this area is above

28 inches. The average weekly rainfall, minimum and maximum temperature recorded during experimental period is given in table 3.1.

Table 3.1: Meteorological data (May to September 2015)

Weeks	Temperature ^{0}C		Rainfall (mm)
	Maximum	Minimum	
May			
1 Week	20.5	10.8	6
2 Week	20.6	11.7	7
3 Week	21.3	12.2	6
4 Week	23.7	12.9	6
June			
1 Week	25.7	13.7	10
2 Week	27.7	14.5	7
3 Week	29.1	14.6	5
4 Week	29.9	16.8	5
July			
1 Week	30.2	18.4	8
2 Week	30.7	18.7	7
3 Week	30.9	19.3	5
4 Week	30.8	19.0	8
August			
1 Week	30.3	18.4	4
2 Week	29.8	17.3	4
3 Week	29.1	17.8	4
4 Week	30.9	17.8	6
September			
1 Week	28.8	16.3	5
2 Week	27.8	16.8	6
3 Week	28.7	15.7	5
4 Week	28.6	15.5	5

Characteristics of soil

In this region soil is mostly alluvial in nature with low clay and high sand percentage. Soil sample were collected with the help of soil agar from the experimental site at a depth of 15-20 cm. The soil sample which was then analysed at Department of soil Science, Share Kashmir University of agriculture science and technology (Kashmir).

Table 3.2 Physio chemical properties of soil.

S. No.	Particulars	Value
1.	pH	7.7
2.	Available organic carbon	0.47
3.	Sand	60%
4.	Clay	14%

5.	Slit	26
6.	Soil texture	Sandy loam

Experimental details

Design and treatment				
Levels of Chinar leaves	**Levels of Juglens leaves**	**Levels of Morus leaves**	**Levels of Poplar leaves**	**Levels of Salix leaves**
C_5 = 5 tone of Chinar leaves per hectare	J_5 =5 tone of Juglens leaves per hectare	M_5 = 5 tone of Morus leaves per hectare	P_5=5 tone of Poplar leaves per hectare	T_5=5 tone of Salix leaves per hectare
C_{10} = 10 tones of Chinar leaves per hectare	J_{10} = 10 tone of Juglens leaves per hectare	M_{10}= 10 tone of Morus leaves per hectare	P_{10}=10 tone of Poplar leaves per hectare	T_{10}=10 tone of Salix leaves per hectare
C_{20} = 20 tones of Chinar leaves per hectare	J_{20}=20 tones of Juglens leaves per hectare	M_{20} = 20 tone of Morus leaves per hectare	P_{20}=20 tone of Poplar leaves per hectare	T20 = 20 tones of Salix leaves per hectare

Treatment Combinations							
T1 = C5	T2 = C10	T3 = C20	T4 = J5	T5 = J10	T6 = J20	T7= M5	T8 = M10
T9 = M20	T10 = P5	T11 = P10	T12 = P20	T13 = S5	T14 = S10	T15 =S20	T16= Control

Details of crop cultivation		
Crop= Brinjal *(Solarium melongena)*	Spacing= Row to row - 50 cm	Plant to plant - 50 cm
Variety= Zaith Vangan (vernicular)	Duration of crop =180 day	Design of experiments = (3 x 3 factorial) R.B.D

Dimension details			
Total number of treatments:-16	Total number of replications:-3	Total number of plots:-48	Individual plot size:-1.5 x 1.5
Area of each plot:- 2.25 m^2	Length of experimental field:- 29.1m	Width of experimental field:- 7.3m	Width of bund:- 0.3m
Width of sub-irrigation channel:-0.5m		Net cultivated area:- 108.m^2	Gross area:- 212.48m^2

Analysis of variance (ANOVA)

Analysis of treatment for all the treatment in Randomized Block Design was carried out. For testing the hypothesis the following ANOVA table was used.

Table: 3.3 Skeleton of ANOVA

Source of variation	d. f.	S.S.	M.S.S	F. Cal	F (Table) at Result 5%
Due to replication	(r-1)	R.S.S.	R.S.S. / r-1	R.S.S. / M.E.S.S.	

Due to treatment	(t-1)	T.S.S.	T.S.S. t-1	M.T.S.S. M.E.S.S.	(r-1) (t-1)
Due to error	(r-1) (t-1)	E.S.S.	E.S.S. (r-1) (t-1)	E.S.S. M.E.S.S.	F (t-1) (r-)(t-1)
Total	(rt-1)	T.S.S.	-	-	-

Where:- d. f. = Degree of freedom	**t = Treatment**	**M.S.S.= Mean Sum Square**
r = Replication	R.S.S.= Replication Sum Square	T.S.S.=Total Sum Square
S.S.= Sum of Square	M.R.S.S.= Mean Replication Sum Square	M.T.S.S.= Mean Treatment Sum Square
E.S.S.= Error Sum Square	M.E.S.S.= S.E. (d) x 't' error d.f. at 5% level of significance	
S.E. (d) = 2 x M.E.S.S. r		

The significance and non- significance of the treatment effect was judged with the help of 'F' variance ratio test. Calculated 'F' value was compared with the table value of 'F' at 5% level of significance. If the calculated value exceeds the table value, the effect was considered to be significant. The significant differences between the means were tested against the critical differences at 5% level of significance. For testing the hypothesis, the ANOVA table was used.

Cultural Operations:-The package of cultural operations used in raising the crop is described below:

Land preparation:-The field was prepared by one plough using soil turning plough, harrowed and finally planked for leveling, thereafter field was laid out in plots and all grasses stables and weeds were picked up from field.

Application of leaf litter:- Leaves were applied to the various plots according to the treatment schedule. The amount of leaves actually applied is given in table.

Table: 3.4. Rate of application of leaf litter

Source	Rate of application	Amount of leaves/plot
Chinar leaves	5 t/ha 10 t/ha 20 t/ha	0.75 kg 1.5 kg 3.0 kg
Juglens leaves	5 t/ha 10 t/ha 20 t/ha	0.75 kg 1.5 kg 3.0 kg
Morus leaves	5 t/ha 10 t/ha 20 t/ha	0.75 kg 1.5 kg 3.0 kg

Poplar leaves	5 t/ha 10 t/ha 20 t/ha	0.75 kg 1.5 kg 3.0 kg
Salix leaves	5 t/ha 10 t/ha 20 t/ha	0.75 kg 1.5 kg 3.0 kg

Irrigation

After the application and mixing of leaves field was irrigated through the main and two sub-irrigation channels. The irrigation breaks hard soil and make field ready for transplantation.

Transplanting of seedlings

The thirty days old seedlings of brinjal were transplanted in the main research plot. This operation was done on 01-05-2015. The planting was done on pre-marked spacing (50cm x 50cm).

Inter culture

Inter culture with the help of the inter culture equipment was done at 30 DAT, weeding was not found to be necessary but inter culture was felt would help in the aeration of the root.

Application of fertilizers:- The recommended fertilizers for brinjal *(Solanum malongena)* given below:-

The three fertilizers urea, DAP and MOP were mixed and accordingly applied to each plot. Urea (150kg/ha) DAP (80kg/ha) and MOP (60kg/ha) that is 33.75g, 18.0g and 13.5g per plot respectively.

Table-3.5- Crop calendar

S. No.	Date	Operation
1.	20.04.2015	Ploughing
2.	21.04.2015	Harrowing and planking
3.	22.04.2015	Bunds and furrow made
4.	23.04.2015	Layout of design
5.	24.04.2015	Application of leaves
6.	25.04.2015	First irrigation
7.	01.05.2015	Transplantation
8.	02.05.2015	Second irrigation(after transplantation)
9.	02.06.2015	Interculture
10.	10.06.2015	Fertilizer application
11.	12.07.2015	Third irrigation after fertilizer application
12.	10.10.2015	Harvesting

OBSERVATION

The observation record are classified as per and post-harvest observation. The observation were record at the following stages:- (i) Plant height (90 DAT) (ii) Number of Branches (90 DAT) (iii) Number of fruits per plant (95-165 DAT) (iv) Yield per plant (100-180 DAT) (v) Yield per plot (100-180 DAT).

Pre-harvest observations:- (i) Plant height: The plant height in centimeters was recorded 90 DAT. Plant height was recorded from the base to the tip of the plant. Three plants randomly selected from the observational plot were used for measuring plant height. (ii) Number of branches: Number of branches was recorded 90 DAT. Three plants randomly selected from the observational plot were used for the number of primary and secondary branches. (iii) Number of fruits per plant:-Number of fruits per plant was observed from 95-165 DAT. Five plants randomly selected from the observational plot was used for finding the number of fruits per plot. (iv) Yield per plant:-Yield per plant was observed from 100-180 DAT. Three plants randomly selected from the observational plot were used for observing yield per plant. The yield of these three randomly selected plants have been added and divided by three which gives the average yield of each plant in the observing plot. (v) Yield per plot:-The average yield observed per plant in any observation slap lot was multiplied by the total number of plants in a plot gives the total yield of that observational plot. It was observed from 100-180 DAT.

Post-harvest observations:- The post-harvest observations included soil analysis for the percentage of organic carbon, labile carbon and water soluble carbon.

Determination of organic carbon:- Organic carbon in soil was determined by using Walkley Black Method (1956).

Procedure:- Take 1 g of soil sample, passed through a 0.5 mm non-furrows sieve in a 500 ml conical flask. Add 10 ml of 1N k2Cr207 and mix the soil in the solution by gently swirling the flask. Add 20 ml of conc. H_2SO_4 and mix it by gentle rotation for about one minute, to ensure complete reaction of reagent. Allow the flask to stand for about 30 minutes. Run standardization blank in the same way. Add 20ml of water to the flask to dilute the suspension. Filter if it is expected that the end point of the titration will not be clear. Add 10ml of 85 percent orthophosphoric acid (H_3PO_4), 0.2g of sodium fluoride and 30 drops of diphenylamine indicator. Back titrate the solution with standard furrows ammonium sulphate solution. The colour is dull green at the beginning and shifts to a turbid blue as the titration proceeds. At the end point this colour sharply shifts to a brilliant green giving one drop end point. If the sample has consumed over 10 ml of potassium dichromate, the determination is to be repeated with small quantity of sample like 0.2 or 0.5g.

Calculation:-Percent organic carbon = $\frac{\text{Me Ox — me Red}}{\text{Wt. of sample x 0.76}}$ x 0.003x 100

Where, me Ox = ml $K2Cr20_7$ x NK_2cR207, me Red = ml $Fe(NH_4)2$ (SO4)2 x N Fe (NH_4) $2(SO_4)_2$ 0.003 = me weight of carbon 100 = decimal to percentage conversion factor.

Labile soil carbon:- Labile or permanganate oxidizable soil carbon (PoSc) was determined by using method of Blair *et aL*, 1995.

Procedure:- Take 3g of air-dried soil in a 50 ml centrifuge tube. Add 30 ml of 20 molar KMn04 to soil in centrifuge tube and run a blank without taking soil. Shake the contents for 15 minutes and centrifuge for 5 minutes to 2000 rpm. Transfer 2m aliquot of supernatant into 50 ml volumetric flask. Read the absorbance at 560565 nM and determine conc. of KMn04 from standard calibration curve.

Calculation:- Pose (mg kg-1) = $\frac{\text{(B-S) x 50/2 x Vol. of KMn04"1)}}{\text{1000 x weight of soil (g)}}$ x 1000x9

Where, B = Conc. (M molar) of $KMn0_4$ in blank. S = Conc. of (m molar) of KMnO4 in sample $50/_2$ = Dilution factor 9 = gm C oxidized by (m mole KMnO4).

Water soluble carbon:-The water soluble carbon in soil was determined by using the method of (McGill, 1986).

Procedure:-Take 10 g soil in a centrifuge tube and add 20 ml distilled water. Shake it for one hour and centrifuge for 20 minutes at 9000-1000 rpm. Filter the aliquot in a beaker. Take 10 ml of aliquot in 250 ml conical flask and add 2 ml 0.2N K_2Cr207. Then add 10 ml of conc. $H2SO_4$ and 5 ml orthophoric acid and keep the volumetric flask on water bath at $100^{\circ}C$ for 30 minutes. Now titrate the contents in flask with 0.01 N FAS, the end point is green. Also run a blank simultaneously.

Calculation:- W Se (ppm) = $2(B\text{-}S)/B^{*}0.2^{*}0.003^{*}20/10^{*}/10^{*}10^{4}$ Where, B = ml of 0.01 N FAS used in blank S = ml of 0.01 N FAS used in sample.

RESULTS AND DISCUSSION

The results obtained during the present study have been presented in this chapter through data, tables and graphs, whatever necessary. The treatment effect on the characters studied have been interpreted and discussed in the light of scientific evidence.

Plant height (cm)

There was a significant response to the main treatments and an increase in plant height at all first and second level of treatments. The maximum increase in plant height due to first level of treatment (81.07 cm) was found at T1 with 0.75 kg of Chinar leaves. The minimum increase at first level of treatments (80.03 cm) was found at T4 with 0.75 kg Juglens leaves. The average plant height at first level of treatment was 80.60 cm. At the second level of treatment maximum increase in plant height (82.33 cm) was recorded at T2 with 1.5 kg Chinar leaves, and minimum increase (81.27 cm) at T11 with 1.5 kg poplar leaves. The average plant height recorded at second level of treatment was 81.73 cm. At the third level of treatment maximum increase in plant height (86.83 cm) was observed at T9 with 3 kg of morus leaves and minimum increase (84.70cm) at 115 with 3 kg teak leaves. The average plant height at third level of treatment observed was 85.53 cm.

Table- 4.1-Effect of leaf litter on plant height (cm) at 90 DAT

Treatment	Plant height			
	R1	**R2**	**R3**	**MEAN**
T1C5	83.4	80.0	79.8	81.07
T2C10	84.6	82.3	80.1	82.33
T3C20	86.8	83.9	80.1	82.33
T4J5				
T5J10				
T6J20				
T7M5				
T8M20				
T9M20				
T10P5				
T11P10				
T12P20				
T13S5				
T14S10				
T15S20				
T0				
F-Test	**S**			
S.Ed(+-)	**1.209**			
C.D.(P=0.05)	**2.564**			

Number of branches

There was a significant response to other main treatments or first and second of treatments on the number of branches. At first level of treatment the highest number of branches (15.40) was found at T10 with 0.75 kg poplar leaves and lowest (15.20) at T13 with 0.75 kg salix leaves. Average number of branches at this level was 15.30. At second level of treatment the maximum number of branches counted was 15.73 at T5 with 1.5 kg of juglens leaves and minimum branch counted was 15.50 at T5, T11 and T14 with 1.5kg of morus, poplar and salix leaves respectively. The average branch number of this stage was 1 5.57. At third level of treatment the maximum branch number (16.40) was counted at T6 and T9 with 3 kg of juglans and morus leaves respectively and minimum (16.30) at T3, T12 and T15 with 3 kg of chinar, poplar and salix leaves respectively. The average number of branches at third level of treatment was 16.34 branches per plant.

Table -4.2-Effect of leaf litter on number at 90 DAT

Treatment	Number of Branches			
	R1	**R2**	**R3**	**MEAN**
T1C5	15.30	15.60	15.00	15.30
T2C10	15.60	16.00	15.30	15.60
T3C20	16.30	16.60	16.00	16.30
T4J5				
T5J10				
T6J20				
T7M5				
T8M20				
T9M20				
T10P5				
T11P10				
T12P20				
T13S5				
T14S10				
T15S20				
T0				
F-Test	**S**			
S.Ed (±)	**0.165**			
C.D.(P=0.05)	**0.349**			

Number of fruits per plant

There was a significant response to either third or first and second level of treatment. The maximum number of fruits counted at first level of treatment (37.22) was at T13 with 0.75kg at T4 with 0.7kg of Juglens leaves. The average fruits counted at this level of treatment were 36.53. At second level of treatment the maximum number of fruits (38.89) was counted at T14 with

1.5kg of Salix leaves and minimum (37.77) at T8 with1.5 kg of Morus leaves. The average number of fruits observed at this level of treatment was 38.30. At the third level of treatment the maximum number of fruits 45.99 was observed at T15 with 3kg of Salix leaves and minimum 41.88 at T3 with 3 kg Chinar leaves. The average number of fruits counted at this level of treatment was 43.72 fruits per plant.

Table 4.3-Effect of leaf litter on number of fruit per plant at 95-165 DAT.

Treatment	Number of fruit per plant			
	R1	**R2**	**R3**	**MEAN**
T1C5	73.33	36.33	36.00	36.55
T2C10	38.66	38.00	38.66	38.44
T3C20	42.66	41.66	41.33	41.88
T4J5				
T5J10				
T6J20				
T7M5				
T8M20				
T9M20				
T10P5				
T11P10				
T12P20				
T13S5				
T14S10				
T15S20				
T0				
F-Test	**S**			
S.Ed (±)	**0.673**			
C.D.(P=0.05)	**1.426**			

Yield per plant

The yield per plant also increased significantly at all levels of treatment. At first level of treatment the maximum yield (3.10 kg) was observed at Ti3 treated with 0.75 kg teak leaves and minimum (2.98 kg) was observed at T4 due to 0.75 kg of Chinar leaves with average yield of 3.04 kg. The second level of treatment had the highest yield 3.24 kg at T4 with 1.5 kg Salix leaves and the lowest 3.15kg at T8 due to 1.5kg of Morus leaves, with an average yield of 3.19 kg per plant.

The maximum yield due to top level of treatment was 3.83kg at T15 treated with 3 kg of teak leaves and the minimum yield 3.49 kg at T3 treated with 3 kg of teak leaves and the minimum yield 3.49kg at T3 treated with 3 kg of Morus leaves. The average yield observed at third level of treatment was 3.64 kg potatol per plant.

Table 4.4-Effect of leaf litter on yield per plant (kg) at 100-180DAT.

Treatment	Yield per plant (kg)			
	R1	R2	R3	MEAN
T1C5	3.11	3.02	3.00	3.05
T2C10	3.21	3.16	3.21	3.20
T3C20	3.55	3.47	3.44	3.49
T4J5				
T5J10				
T6J20				
T7M5				
T8M20				
T9M20				
T10P5				
T11P10				
T12P20				
T13S5				
T14S10				
T15S20				
T0				
F-Test	**S**			
S.Ed (+)	**0.058**			
C.D.(P=0.05)	**0.124**			

Yield per plot

A moderate high increase in fruit yield per plot was observed at the third level of treatment and also a significant increase at first and second level of treatment. The maximum yield due to first level of treatment was 27.79 kg at T13 with 0.75 kg teak leaves and the minimum yield (27.16 kg) at T7 with 0.75 kg morns leaves, with an average yield of 27.37 kg. At the second level of treatment the maximum yield (29.16kg) was observed at T14 with 1.5kg of teak leaves and the minimum (28.33 kg) at T8, treated with 1.5 kg of mango leaves, with an average yield of28.71 kg of potato per plot. The maximum yield due to third level of treatment (34.49 kg) at T15 with 3 kg of Salix leaves and the minimum yield (31.41 kg) at T3 due to 3 kg of Chinar leaves. The average yield per plot at third level of treatment was 32.76 kg per plot. Thus the maximum yield observed in any plot was 34.49 kg or 15.33 tons per hectare. The decrease from the average yield (17.50 tons per hectare in India) may be due to temperature variations at Kulgam Kashmir, as the potatol grows and yields best from 28 to 38°C.

Table 4.5-Effect of leaf litter on yield per plot (kg) at 100-180DAT.

Treatment	Yield per plot (kg)			
	R1	R2	R3	MEAN
T1C5	27.99	27.25	27.00	27.49
T2C10	28.89	28.49	28.89	28.76

T3C20	31.99	31.23	30.99	31.41
T4J5				
T5J10				
T6J20				
T7M5				
T8M20				
T9M20				
T10P5				
T11P10				
T12P20				
T13S5				
T14S10				
T15S20				
T0				
F-Test	**S**			
S.Ed (+)	**0.533**			
C.D.(P=0.05)	**1.131**			

Yield per hectare(tons)

The of data on yield per hectare at 100-180 DAT was recorded and found Significantly increment in yield per hectare with increase in dose of leaf litter. The maximum yield (17t) per hectare was recorded in treatment combination T15S20 comparison to treatment combination T6J20 with 16.50 tons per hectare and minimum yield (13.11t) per hectare was recorded in T0 (control). The significant difference in yield per hectare was recorded due to variation in organic carbon present in leaves of different species of trees. Available carbon is the indicator of available nitrogen in the soil and nitrogen is the major nutrients which support the vegetative growth and yield of plants.

Table 4.6-Effect of leaf litter on yield per hectare (tons) at 100-180DAT.

Treatment	**Yield per Hectare**			
	R1	**R2**	**R3**	**MEAN**
T1C5	13.82	1342	13.33	13.33
T2C10	14.26	1404	14.26	14.26
T3C20	15.77	1542	15.28	15.28
T4J5				
T5J10				
T6J20				
T7M5				
T8M20				
T9M20				
T10P5				
T11P10				
T12P20				
T13S5				
T14S10				

T15S20				
T0				
F-Test	**S**			
S.Ed (+)	**0.259**			
C.D.(P=0.05)	**0.549**			

Percent organic carbon

Carbon stored in soils is derived from litter carbon stored in soils is derived from litter and root inputs, while losses result from microbial degradation of organic matter (OM) and erosion within limits. Soil C increases with increasing soil water and decreases with increasing temperature. A significant increase was found due to addition of leaves as they decompose and gets converted into litter which intern increases the soil organic carbon content. At first level of treatment the maximum carbon content 0.53% was observed at T7 and T13 due to 0.75 kg of mows and Salix leaves respectively. At second level of treatment the maximum yield 0.95%was observed at T8 with 1.5 kg of Morus leaves. The maximum amount of organic carbon in any plot (0.69%) was due to T15 at third level of treatment with 3 kg of Salix leaves and the lowest 0.51% and 0.48% was observed at T4 and T16 control respectively. The average yield at first second third level of treatment was 0.52% and 0.66% respectively.

Table 4.7: Effect of leaf litter on organic carbon after harvesting of crop.

Treatment	**Percent 0.C**			
	R1	**R2**	**R3**	**MEAN**
T1C5	0.51	0.52	0.54	0.52
T2C10	0.56	0.57	0.58	0.57
T3C20	0.61	0.66	0.65	0.64
T4J5				
T5J10				
T6J20				
T7M5				
T8M20				
T9M20				
T10P5				
T11P10				
T12P20				
T13S5				
T14S10				
T15S20				
T0				
F-Test	**S**			
S.Ed (+)	**0.011**			
C.D.(P=0.05)	**0.024**			

Water soluble organic carbon (ppm)

Water soluble organic carbon (WSOC) accounts only for a small portion of the total organic carbon in soil. Nevertheless WSOC is considered the most mobile and reactive organic carbon fraction thereby can control a number of physical' chemical and biological processes in both aquatic and terrestrial environments. There was a significant increase in WSOC at all the three levels of the treatment. The maximum amount of WSOC 49.20 ppm was observed at T10 with 0.75 kg of poplar leaves and 56.40ppm at second level of treatment. The highest amount of WSOC found in any plot 69.60ppm was observed at T3 with 3kg of Chinar leaves. The average amount of WSOC observed at first, second and third level of treatment was 45.60ppm, 53.36ppm and 67.04 respectively.

Table 4.8: Effect of leaf litter on WSOC after harvesting of crop.

Treatment	WSOC (ppm)			
	R1	R2	R3	MEAN
T1C5	40.80	52.80	39.60	44.40
T2C10	52.80	52.80	52.80	52.80
T3C20	69.60	67.20	72.00	69.50
T4J5				
T5J10				
T6J20				
T7M5				
T8M20				
T9M20				
T10P5				
T11P10				
T12P20				
T13S5				
T14S10				
T15S20				
T0				
F-Test	**S**			
S.Ed (±)	**5.076**			
C.D.(P=0.05)	**10.760**			

Labile carbon (mg/kg)

By contrast, the labile (bio-available) pool of carbon is primarily influenced by new organic matter (originating from plants and/or animals) contributed annually. A significant increase in the percent of labile carbon was seen at all the three levels of the treatment. At first level of treatment the maximum amount of labile carbon 348.90 mg/kg was found at T10 treated with 0.75 kg poplar leaves. At second level of treatment the maximum amount of labile carbon 357.63 mg/kg was observed at T11 treated with 1.5kg of poplar leaves. The maximum amount of labile carbon

(378.23 mg/kg) was seen at T15 treated with 3 kg of Salix leaves. The minimum amount of labile carbon (339.80 mg/kg and 303.13 mg/kg) among all plots was seen at T13 and T16 with 0.75kg Salix leaves and control respectively. The average amount of labile carbon at first, second and third level of treatment was 344.07 mg/kg, 351.88 mg/kg and 371.56 mg/kg.

Table 4.3- Effect of leaf litter on labile carbon after harvest of crop.

Treatment	Labile carbon (mg/kg)			
	R1	**R2**	**R3**	**MEAN**
T1C5	33750	35320	34870	34647
T2C10	34220	35770	35250	35090
T3C20	36010	38050	36020	36690
T4J5				
T5J10				
T6J20				
T7M5				
T8M20				
T9M20				
T10P5				
T11P10				
T12P20				
T13S5				
T14S10				
T15S20				
T0				
F-Test	**S**			
S.Ed (+)	**13.389**			
C.D.(P=0.05)	**28.385**			

CONCLUSION

The experiment entitled Change in organic carbon content and yield attribute of potato (Solanum tuberosum) was carried out in the Kharief season of 2015 at the field of district Kulgam Kashmir. The experiment was laid out in a randomized Block Design. As regards to the treatments three levels each of Chinar, Juglens, Morus, poplar and Salix leaves were employed in C5, C10 and C20; J5, J10 and J20; M5, M10 and M20; and P5, P10 and P20 and S5,S10 and S20 respectively. The total number of combinations worked out to 16 increasing control. The crop was harvested on 28-10-2015. The crop stands very good. The stems were thick and the plants grew to a height of over 86.80cm. A brief report of the pre and post-harvest observations are now placed before the reader. (i) There was a good response of the main treatment (3kg leaves/plot) as well as first (0.75kg leaves/plot) and second (1.5kg leaves/plot) levels of treatments. (ii) A good response to number of secondary branches was also seen but not on primary branches. Thus primary and secondary branches were counted significantly and maximum difference or increase was seen at third level of treatment of about 1.30 branches. (iii) A maximum number of fruits (45.99) per plant were observed at T15 with 3 kg teak leaves. (iv) A significant increase in yield of potato was seen at all the three levels of treatment. A maximum yield of 34.47 kg was observed at T15 with 3kg Salix leaves. (v) All the three levels of treatment show a significant response towards carbon pools in soil organic carbon reaches maximum to 0.69% at 115, water soluble carbon maximizes up to 69.60ppm at T3 and labile carbon reaches its maximum 378.23 mg/kg at T15.Chinar, Juglens, Morus, poplar and Salix leaves at all the three levels were found to effect all the growth, yield and post-harvest soil parameters. Among the third level treatments Salix leaves alone show good response on most of the parameters except plant height, number of branches and organic carbon that were affected by Morus, Juglens and Salix leaves respectively. So it can be concluded that all these five types of tree leaves (Litter) effect the plant growth, yield as well as carbon pools in soil.

REFERENCES

1. Batjes, N.H. (1996). Total carbon and nitrogen in the soils of world. *European Journal of Soil Science,* 47: 151-163.
2. Batra, L. (2004). Dehydrogenase activity of normal saline and alkaline soils under different agriculture management systems. *Journal of Indian Society of Soil Science,* 52(2): 160-163.
3. Berg, B. (2000). Litter decomposition and organic matter turnover in northern forests soils. *Forest Ecology and Management,* 133(1-2): (165 p.).
4. Bhattacharyya, T., Pal, D.K., Mandal, C. and Velayutham, M. (2000). Organic carbon stock in Indian. Soils and their geographical distribution. *Cu!. Sci.,* 79: 655-660.
5. Chander, K., Goya!, S., Mundra, M.C. and Kapoor, K.K. (1997). Organic matter, microbial biomass sand enzyme activity of soils under different crop rotations in the tropics. *Biology and Fertility of Soils,* 24: 306-310.
6. Cotrufo, M.F. De. Santo, A.V. Alfani, A. Bartoli, G. and De, Cristofaro, A. (1995). Effect of urban heavy metal pollution on organic matter decomposition in Quercus ilex L. woods. *Environmental pollution,* 89(1): 81-87.
7. Dinar, M. and Rudics, J. (1985). Effect of heat stress on assimilates partition in tomato. *Ann. Bot.,* 56: 239-249.
8. Ding Lei, W., Yin, M.Y. Cai, Z. and Zheng, X. (2007). CO_2 emission in an intensively cultivated loam as affected by long term application of organic manure and nitrogen fertilizer. *Soil Biology and Biochemistry;* 39(20): 669679.

9. Dixon, R.K. (1995). Agro forestry systems: Sources or sinks of greenhouse gases? *Agroforestry systems*, 31: 99-116.
10. DOE (1999). Carbon sequestration: State of the Science, US Department of Energy (DOE), Washington, DC.
11. Fang-chang Ming; P. Moncrieff and J.B. Smith (2005). Similar response of labile and resistant soil organic matter pools to change in temperature. *Nature*, 433(7021): 57-59.
12. Gupta, Naveen, Kukal, S.S. Bawa, S.S. and Dhaliwal, G.S. (2009). Soil organic carbon and aggregation under poplar based agro forestry system in relation to tree age and soil type. *Agroforestry system*, 76: 27-37.
13. Hatil, K.M., Swarup, A., Mishra, B., Manna, M. Wanjari, R.H. Mandal, K.G. and Mishra, A.K. (2008). RH Impact of long-term application of fertilizer, manure and lime under intensive cropping on physical properties and organic carbon content of an Alfisol. Geoderma, 148: 173-179.
14. Janzen, H.H., Larney, F.J. and Olson, R.M. (1992). Quality factors of problem soils in Alberta proceeding of the Alberta Soil Science Workshop, 17-28.
15. Kang, B.T., Caveners, F.E., Tian, G. and Kolawole G.O. (1999). Long-term alley cropping with four species on an Alfisol in Southwest Nigeria — affect on crop performance. Soil chemical properties and nematode population. *Nutrient Cycling in Agroeco-system*, 54: 145-155.
16. Lal, R. (1989). Conservation tillage for sustainable agriculture. *Adv. Agro*, 42: 85-197.
17. Lal, R. (1995). Global soil erosion by water and carbon dynamics. In: R. Lal, T. Kimble, E. Levine and B.A. Stewart (Eds.). Soil Management and green house effect. Lewis Publ. Boca Raton, FL.
18. Lal, R., Henderlong, P. and Flwoers, M. (1998). Forages and row cropping effects on soil organic carbon and nitrogen content. *In management* of *carbon sequestration in soils* (Ed. R. Lal et al.), pp. 365-379.
19. Majumder, B. (2006). Soil organic carbon pools and biomass productivity under agro-ecosystems of subtropical, Jadavpur University, Kolkata, India.
20. Mandal, B., Mujumder, B., Adhya, T.K., Bandyopadhyay, P.K., Gangopadhyay, G., Sarkar D., Kundu, M.C., Chadnhary, S. and Hazra, A.K. (2008). Potential of double cropped rice ecology to conserve organic carbon under subtropical climatic. Global *change Biology*, 14: 1-13.

21. Mandal, K.G., Misra, A.K., Hati, KM., Bandyopadhyay, K., Ghosh, P.K. and M. (2004). Rice residue management options and effects on Mohanty, soil properties and crop productivity. Food, *Agriculture and Environment*, 2: 224-231.
22. McGill, W.B., Cannon, K.R., Robertson, J. A.andCook and F.D. (1986). Dynamics of soil microbial biomass and water soluble organic carbon in Bretonal after 50 years of cropping to two rotations. *Canadian Journal of Soil Science*, 66: 1-19.
23. Nyamangara, J., Piha, M.I. and Kirchmann, H. (1999). Interactions of aerobically decomposed cattle manure and nitrogen fertilizers applied to soil nutrient cycling in Agro-ecosystems, 1314-1385.
24. Paustian, K.; Six, T. Elliott, E.T. and Hunt, H.W. (2000). Management options for reducing CO^2 emissions from agricultural soils. *Biogeochem*, 48: 147-163.
25. Powlson, D.S., P. Smith, K., Coleman, J.V. Smith, M.J., Glendining, M. Korschens and U. Franko (1998). An European network of long term sites for studies on soil organic matter. *Soil and tillage Res.*, 47: 263-274.
26. Prasad, R. (1983). Increased crop production through intensive cropping system, P. 331-322. In VC Holmes and W.M. Tahir (eds) more food from better technology, FAO, Rome.
27. Pulleman, MM., Bouma, J. Van, Essen, E.A. and Meijtes, E.W. (2000). Soil organic matter as a function of different land usehistory. *Soil Science Society of America Journal*, 64: 689-693.
28. Rashid, I. and Reshi, Z. (2010). Does carbon addition to soil counteract disturbance promoted alien plant invasions? International Society for ˙tropical, Ecology, 51: 339-345.
29. Saha, R., Tomar, J.M.S. and Gosh, P.K. (2007). Evaluation and selection of multipurpose tree for improving soil hydro physical behavior under hilly eco-system of northeast India, *Agro forestry System*, 69: 239-247.
30. Scheel, T., Jansen, B., Van Wijk, A.J., Verstraten, J.M. and Kalbiz, K. (2008). Stabilization of dissolved organic matter by aluminium: a toxic effect or stabilization through precipitation. *European Journal of Soil Science*, 59(6): 1122-1132.
31. Shaddari, A.L., Ladha, J.K., Pathak, H., Padre, A.T., Dawe, D. and Gupta, R.K. (2002). Yield and soil nutrient changes in long-term rice-wheat solution in India. *Soil Science Society of American Journal*, 58: 185-193.
32. Shen, W., Reynolds, J.F. and Hui, D. (2009). Response of dry land soil respiration and soil carbon pool. Global change biology, 15: 2274-2294.

33. Sommerfoldt, T.G., Change, C. and Entz, T. (1988). Long-term annual manure application increase soil organic master and nitrogen and decrease carbon to nitrogen ratio. *Soil Science Society of American Journal*, 52: 1668-1672.
34. Sukhel, W., Geel, W. Van and Haan, J.J. de (2008). Carbon equestrian in organic and conventional managed soils in the Netehrlands. 16th (FOAM Organic World Congress, Modena Itlay, June 16-20, 2008. Archived at http:/rog prints.org/view/projects/conference.htanl.
35. Wkinoto, A., Nair, V.D. and P.K.R. (2008). Contribution of tree to soil carbon sequestration under agro forestry system in the west African Sahel. *Agro forestry* systems. 76: 11-25.