Int.J.Curr.Microbiol.App.Sci (2019) *8*(7): 1306-1316

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 8 Number 07 (2019)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2019.807.155

Biomass Production and Vegetation Carbon Pool under Wheat – *Eucalyptus tereticornis* sm Based Agroforestry System

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Keywords

Wheat, Weed, Agroforestry, Biomass production, Vegetation carbon pool

Article Info

Accepted:
12 June 2019
Available Online:
10July 2019

ABSTRACT

An experiment was conducted at the farmer field village- Majitha, District- Jabalpur during the rabi season of 2016-17 and 2017-18. A field experiment was conducted during winter season to find out the biomass production and carbon storage by weeds, wheat crop and tree under eucalyptus based agroforestry system in randomized block design with three replications. The result revealed that the weed management practices increase the crop biomass production and reduce the weeds biomass. The biomass production was higher in agroforestry system than crop alone or tree alone. The highest total biomass production of agroforestry system was found under hand weeding 30 DAS (39.71 and 39.21 t ha^{-1} yr^{-1}) and total biomass production was found between 39.71 to 37.62 and 39.21 to 36.87 t ha^{-1} yr^{-1} during both the year as compare to crop alone and tree alone. The carbon storage depends on biomass of tree and crop. In wheat crop hand weeding found higher carbon storage 4.26 and 3.83 t ha^{-1} and lower in weedy check during both the year. When weeds are growing freely it stored 1.18 and 1.19 t C ha^{-1} during both the year. The eucalyptus stored 53.17 to 55.75 and 68.05 to 71.41 t carbon ha^{-1} during 2016-17 and 2017-18, respectively. The wheat – *Eucalyptus tereticornis* based agroforestry system showed higher carbon stock 17.18 to 18.24 and 17.13 to 18.16 t ha^{-1} yr^{-1} as compared to crop alone 4.26 and 3.83 t ha^{-1} yr^{-1}.

Introduction

Agricultural lands are believed to be a major potential sink and could absorb large quantities of carbon (C) if trees are introduced to these systems and judiciously managed together with crops and/or animals. Tree-based land use systems, forest plantation and agroforestry sequester CO_2 through the carbon stored in their biomass. By promoting agroforestry systems with higher carbon contents than the existing plant community, net gains in the carbon stock (hence sequestration) can be realized. The most significant increase in carbon storage can be achieved by moving from lower biomass land use systems to agroforestry systems. Thus, the importance of agroforestry as a land use system is receiving wider recognition not only in terms of agricultural sustainability but also in issues related to climate change. Agroforestry has importance as a carbon sequestration strategy because of carbon storage potential in its multiple plant species and soil as well as its applicability in agricultural lands and in reforestation. The potential seems to be substantial; but it has not been even adequately recognized, let alone exploited.

Proper design and management of agroforestry practices can make them effective carbon sinks. As in other land use systems, the extent of C sequestration will depend on the amount of C in standing biomass, recalcitrant C remaining in the soil, and C sequestered in wood products. Average carbon storage by agroforestry practices has been estimated as 9, 21, 50, and 63 Mg C ha^{-1} in semiarid, sub-humid, humid and temperate regions respectively. For smallholder agroforestry systems in the tropics, potential C sequestration rates range from 1.5 to 3.5 Mg C ha^{-1} yr^{-1}. Agroforestry also have an indirect effect on C sequestration when it helps in decreasing pressure on natural forests, which are the largest sink of terrestrial C. Another indirect avenue of C sequestration is through the use of agroforestry technologies for soil conservation, which could enhance C storage in trees and soils (Montagnini and Nair, 2004).

While carbon in the form of carbon dioxide is accumulating in the atmosphere at the rate of about 3.5 billion metric tonnes per annum as a result of fossil fuel combustion, tropical deforestation and forest fuel combustion, agroforestry system can be better climate change mitigation option than ocean and other terrestrial option because of the secondary environmental benefits such as food security and secured land tenure, increasing farm income, restoring and maintaining above and below ground biodiversity, maintaining watershed hydrology and soil conservation.

By including tree in agricultural production systems, agroforestry can increase the amount of carbon stored in lands devoted to agriculture, while still allowing for growing of food crops. Average sequestration potential in agroforestry has been estimated to be 25t C ha^{-1} over 96 million ha. of land in India (Sathaye and Ravindranath, 1998). Watson *et al.,* (2000) estimated carbon gain of 0.72 Mg C ha^{-1} yr^{-1} on 4000 million ha land under agroforestry, with potential for sequestering 26 Tg C yr^{-1} by 2010 and 45 Tg C yr^{-1} by 2040. The aim of the present study is to evaluate the potential of agroforestry system for sequestering carbon by different weed management practices.

Materials and Methods

The field experiment was conducted at the farmer field Village - Majitha Block-Shahpura District- Jabalpur (M.P.) during rabi season 2016-17 and 2017-18. Wheat crop was intercropped in 4 years old *Eucalyptus tereticornis* trees with distance of 3 m X 1.5 m. The experiment was laid out in Randomized Block Design with ten treatments under three replications.

The treatment combinations consisted of 2, 4-D @ 0.5 lit ha^{-1}, Metribuzin @ 0.250 Kg ha^{-1}, Butachlor @ 1 lit ha^{-1}, Clodinafop-propargyl @ 0.140 kg ha^{-1}, 2, 4-D @ 0.5 lit ha^{-1} *fb* metribuzin @ 0.250 Kg ha^{-1}, 2, 4-D @ 0.5 lit ha^{-1} *fb* butachlor @ 1 lit ha^{-1}, Metribuzin @ 0.250 Kg ha^{-1} *fb* butachlor @ 1 lit ha^{-1}, 2, 4-D @ 0.5 lit ha^{-1} + hand weeding at 30 DAS, Hand Weeding at 30 DAS and Weedy check. Wheat variety LOK-1 was sown with 25 cm row spacing at a depth of 4 cm from the top of the soil by opening furrows through a Kudal. The weed control treatments and herbicides were applied as post emergent at crop tillering stage i.e. about 30 DAS. The aboveground weed dry matter was also recorded from the above thrown quadrates after cutting weeds from the ground level and then oven dried at 60^0C and converted to m^2.

Destructive measurement of aboveground fresh biomass of sample trees

For the measurement of the fresh biomass of eucalyptus tree under different land use systems, mean dbh of 30 trees (one tree in each replication) were taken and felled at ground level. Each felled tree was partitioned into different parts *viz.,* leaf, bark, branches and woody bole without bark and fresh weight of the each part of tree is recorded immediately with the help of spring balance.

Sampling for analysis of dry oven mass

Sampling for dry mass analysis can be taken immediately after completion of measurement of fresh weight of each tree components. The following steps were carried out for sampling: To prepare a stem sample, three discs of 10 cm length at 3.5 m interval of wood bole were taken. Whereas, for leaf, branches and bark 0.5 kg of sample were taken in poly bags and tightly tied to prevent evaporation. All the samples were took in laboratory and kept in oven at 65^0C for 24 hours and oven dry weight is recorded. The oven dry weight is used for determination of oven dry mass on hectare basis. The above ground tree biomass was worked out by summing of leaf, bark, twinges, branches and bole biomass.

Sample of wheat and weed biomass (t ha^{-1})

Crop biomass was estimated by using 1m x 1m quadrates at harvesting time. The total crop and weed biomass occurring within the borders of the quadrate were cut at ground level and collected samples were weighted, sub sampled and oven dried at 60 ± 5^0 C to a constant weight.

Belowground biomass of trees (Kg ha^{-1})

The belowground biomass has been calculated by multiplying the above ground biomass (AGB) by 0.26 factors based on the root: shoot ratio (Hangarge *et al.,* 2012).

Belowground biomass = Above ground biomass x 0.26

Total Biomass (Kg ha^{-1})

Total biomass is the sum of the above and below ground biomass (Sheikh *et al.,* 2011)

Total Biomass (TB) = Aboveground Biomass + Belowground Biomass

Carbon pool studies

Ash percent (%)

The carbon in plant biomass was determined by ash method. The oven dried sample of 5 gm of tree and crops were taken in pre weighed crucible. The crucible was cooled slowly inside the desiccators.

After cooling the crucible with ash was weighed and percentage of organic carbon was calculated as formula given by Allen *et al.,* (1986).

Ash content (%)

$$\text{Ash (\%)} = \frac{W3 - W1}{W2 - W1} \times 100$$

Carbon percent (%)

C (%) = (100- Ash %) x 0.58

(Considering 58% carbon in ash-free litter material)

Where:

C = Organic carbon
W1 = Weight of crucibles

W2 = weight of oven dried grind samples with crucible

W3 = weight of ash with crucible

Carbon stock/Pool (t ha^{-1})

To determine biomass carbon stock, dry biomass was converted into carbon by ash method.

Dry biomass was multiplied by carbon content to give carbon stock as per the formula suggested by Rajput (2010)

Carbon stock = dry biomass x Carbon content

Results and Discussion

Aboveground biomass of tree (t ha^{-1})

During first year at the age of 4th year the total aboveground biomass production between 80.02 to 82.12 t ha^{-1} was found under wheat-*Eucalyptus tereticornis* based agroforestry system. The mean aboveground biomass of eucalyptus tree from 101.26 to 105.27 t ha^{-1} was found at the age of 5th year under wheat-*Eucalyptus tereticornis* based agroforestry system (Table 1).

Belowground biomass of tree (t ha^{-1})

During first year (2016-17) at the age of 4th year the total belowground biomass between 20.80 to 21.35 t ha^{-1} was found under wheat-*Eucalyptus tereticornis* based wheat-*Eucalyptus tereticornis* based agroforestry system. During second year (2017-18) at the age of 5th year the belowground biomass of tree was higher as compared to first year (2016-17). The mean belowground biomass of eucalyptus tree ranged from 26.33 to 27.37 t ha^{-1} was found under wheat-*Eucalyptus tereticornis* based agroforestry system (Table 1).

Total biomass production (Aboveground + belowground) (t ha^{-1})

During first year the total biomass of eucalyptus tree was found range between 100.82 to 103.48 t ha^{-1} under wheat-*Eucalyptus tereticornis* based agroforestry system. The total biomass production of eucalyptus tree ranged from 127.59 to 132.13 t ha^{-1} was found during second year under wheat-*Eucalyptus tereticornis* based agroforestry system (Table 1).

Wheat biomass (t ha^{-1})

The total (above + below ground) biomass of wheat was higher in hand weeding 8.35 and 7.30 t ha^{-1} during both the year. The biomass of wheat was lower in weedy check. The weed management practices were increase the total biomass production of wheat (Table 1).

Weed biomass (t ha^{-1})

The total (above + below ground) biomass of weed was higher in weedy check 2.29 and 2.25 t ha^{-1} during both the year. The biomass of weed was lower in hand weeding and weed management practices under wheat-*Eucalyptus tereticornis* based agroforestry system (Table 1).

Total Biomass production (tree and/or agriculture crops) (t ha^{-1})

The perusal of data showed that total biomass production was higher under hand weeding at 30 DAS (39.71 and 39.21 t ha^{-1} during 2016-17 and 2017-18, respectively) during both the years (Table 1).

The aboveground biomass and below ground biomass production under agroforestry system depends on number of factors *viz.*, choice of tree and crops, growth habit of tree and crops, genetic makeup of trees and crops, site quality, soil on which tree or crop are growing, age of tree, management practices applied, frequent intercultural operations, moisture conservation, allelopathy effect of tree, presence of hard pan in subsoil layers and the belowground interaction between tree and crops for sharing of nutrient, water, light and space and their interaction with belowground crops have also contributed towards the increasing aboveground and below ground biomass production. The findings of present study was also inconformity with several researchers *viz.*, Lott *et al.*, (2002), Sanneh (2007), Chauhan *et al.*, (2009), Rizvi *et al.*, (2011), Mangalassery *et al.*, (2014). Puri *et al.*, (2002) reported that the total biomass accumulation in *Populus deltoides* based agroforestry varied from 41 to 206 Mg ha^{-1} and highest was found under agroforestry as compared to sole.

Carbon pool study (t C ha^{-1})

Carbon Pool from Wheat biomass

Aboveground Carbon pool (t C ha^{-1})

The perusal of data showed that significantly higher aboveground carbon stock was noticed under hand weeding at 30 DAS over weedy check during both the years. The different weed control treatments were also recorded higher biomass carbon and it varied from 2.54 to 3.42 t C ha^{-1} during first year (2016-17) and 2.23 to 3.08 t C ha^{-1} during second year (2017-18) over weedy check during both the years (Table 2).

Belowground carbon pool (t C ha^{-1})

The weed control treatments have marked influence on carbon pool from weed biomass. The belowground carbon pool was significantly higher under hand weeding at 30 DAS (0.83 and 0.75 t C ha^{-1} during 2016-17 and 2017-18, respectively) over weedy check (0.58 and 0.45 t C ha^{-1} during 2016-17 and 2017-18, respectively). The weed control treatments have had higher belowground carbon pool over weedy check (Table 2).

Total carbon pool by wheat (t C ha^{-1})

The weed control treatments have visible on carbon pool from wheat biomass. The total carbon pool was significantly higher under hand weeding at 30 DAS (4.26 and 3.83 t C ha^{-1} during 2016-17 and 2017-18, respectively) over weedy check. The rest of the weed control treatments were also gave higher total carbon pool over weedy check during both the year (Table 2).

Carbon Pool from Weed biomass (t C ha^{-1})

Aboveground carbon pool (t C ha^{-1})

Aboveground carbon pool was significantly higher under weedy check (0.95 and 0.97 t ha^{-1} during 2016-17 and 2017-18, respectively) over hand weeding at 30 DAS (0.13 and 0.04 t C ha^{-1} during 2016-17 and 2017-18, respectively). The different weed control treatments have had lower carbon pool during first and second year over weedy check (Table 2).

Belowground carbon pool (t C ha^{-1})

The weed control treatments have significant influence on carbon pool in weed biomass. The belowground carbon pool was significantly higher under weedy check (0.23 and 0.22 t C ha^{-1} during 2016-17 and 2017-18, respectively) over hand weeding at 30 DAS during both the year. The weed control treatment was given lower belowground carbon pool over weedy check. The weed management practices were found lower below ground carbon pool over weedy check under wheat - *Eucalyptus tereticornis* based agroforestry system (Table 2).

Table.1 Total biomass production (tree, wheat and weeds) under wheat- *Eucalyptus tereticornis* based agroforestry system

Treatment		Tree biomass production (t ha^{-1})						Wheat biomass (t ha^{-1})		Weed biomass (t ha^{-1})		Biomass Production (t ha^{-1} yr^{-1})	
		Aboveground		Belowground		Total		2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
		2016-17	2017-18	2016-17	2017-18	2016-17	2017-18						
T_1	2, 4-D @ 0.5 lit ha^{-1}	80.47	104.19	20.92	27.09	101.40	131.28	7.13	5.84	0.55	0.49	38.21	37.96
T_2	Metribuzin @ 0.250 Kg ha^{-1}	81.13	105.27	21.09	27.37	102.22	132.63	7.19	5.94	0.76	0.57	38.73	38.46
T_3	Butachlor @ 1 lit ha^{-1}	80.02	101.66	20.80	26.43	100.82	128.09	6.19	5.23	1.07	0.79	37.62	36.87
T_4	Clodinafop-propargyl @ 0.140 kg ha^{-1}	80.07	101.83	20.82	26.48	100.89	128.31	7.43	6.39	1.08	0.81	38.88	38.10
T_5	2, 4-D @ 0.5 lit ha^{-1} *fb* metribuzin @ 0.250 Kg ha^{-1}	81.42	101.46	21.17	26.38	102.59	127.84	6.89	6.03	0.53	0.44	38.29	37.26
T_6	2, 4-D @ 0.5 lit ha^{-1} *fb* butachlor @ 1 lit ha^{-1}	82.03	102.74	21.33	26.72	103.36	129.46	6.67	5.81	0.90	0.67	38.68	37.66
T_7	Metribuzin @ 0.250 Kg ha^{-1} *fb* butachlor @ 1 lit ha^{-1}	81.00	105.10	21.06	27.33	102.06	132.43	6.49	5.25	1.08	0.84	38.29	38.00
T_8	2, 4-D @ 0.5 lit ha^{-1} + hand weeding at 30 DAS	81.59	104.47	21.21	27.16	102.80	131.63	7.12	5.87	0.56	0.50	38.62	38.08
T_9	Hand Weeding at 30 DAS	81.90	104.86	21.30	27.27	103.20	132.13	8.35	7.30	0.30	0.09	39.71	39.21
T_{10}	Weedy check	82.12	101.26	21.35	26.33	103.48	127.59	5.84	4.42	2.29	2.25	39.27	37.40
SEm±		1.24	1.07	0.32	0.28	1.56	1.35	0.13	0.30	0.10	0.07	0.48	0.38
CD (P=0.05)		3.62	3.14	0.94	0.82	4.56	3.95	0.37	0.86	0.29	0.22	1.39	1.12

Table.2 Carbon pool in wheat and weeds biomass under wheat- *Eucalyptus tereticornis* based agroforestry system

Treatment		Carbon pool from wheat biomass (t C ha^{-1})						Carbon pool in weed biomass (t C ha^{-1})					
		Aboveground		Belowground		Total		Aboveground		Belowground		Total	
		2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
T_1	2, 4-D @ 0.5 lit ha^{-1}	2.94	2.48	0.71	0.60	3.65	3.08	0.23	0.21	0.06	0.05	0.29	0.26
T_2	Metribuzin @ 0.250 Kg ha^{-1}	2.95	2.53	0.72	0.61	3.67	3.15	0.32	0.24	0.08	0.05	0.40	0.30
T_3	Butachlor @ 1 lit ha^{-1}	2.54	2.23	0.62	0.54	3.15	2.77	0.45	0.34	0.11	0.08	0.55	0.41
T_4	Clodinafop-propargyl @ 0.140 kg ha^{-1}	3.05	2.72	0.74	0.66	3.80	3.38	0.45	0.34	0.11	0.08	0.56	0.42
T_5	2, 4-D @ 0.5 lit ha^{-1} *fb* metribuzin @ 0.250 Kg ha^{-1}	2.81	2.55	0.68	0.62	3.49	3.17	0.22	0.19	0.05	0.05	0.27	0.24
T_6	2, 4-D @ 0.5 lit ha^{-1} *fb* butachlor @ 1 lit ha^{-1}	2.72	2.46	0.67	0.60	3.39	3.05	0.37	0.28	0.09	0.07	0.46	0.35
T_7	Metribuzin @ 0.250 Kg ha^{-1} *fb* butachlor @ 1 lit ha^{-1}	2.65	2.23	0.65	0.54	3.30	2.77	0.45	0.36	0.11	0.08	0.55	0.44
T_8	2, 4-D @ 0.5 lit ha^{-1} + hand weeding at 30 DAS	2.90	2.51	0.71	0.61	3.61	3.12	0.23	0.22	0.05	0.05	0.29	0.27
T_9	Hand Weeding at 30 DAS	3.42	3.08	0.83	0.75	4.26	3.83	0.13	0.04	0.03	0.01	0.16	0.05
T_{10}	Weedy check	2.36	1.88	0.58	0.45	2.94	2.33	0.95	0.97	0.23	0.22	1.18	1.19
SEm±		0.06	0.12	0.01	0.03	0.07	0.15	0.04	0.03	0.01	0.01	0.05	0.04
CD (P=0.05)		0.17	0.35	0.04	0.09	0.22	0.44	0.12	0.10	0.03	0.02	0.15	0.12

Table.3 Carbon pool in tree biomass under wheat - *Eucalyptus tereticornis* based Agroforestry system

Treatment		Carbon pool in tree biomass (t C ha^{-1})					
		Aboveground		Belowground		Total	
		2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
T_1	2, 4-D @ 0.5 lit ha^{-1}	42.15	56.21	11.02	14.72	53.17	70.93
T_2	Metribuzin @ 0.250 Kg ha^{-1}	42.94	57.89	11.23	15.21	54.17	73.10
T_3	Butachlor @ 1 lit ha^{-1}	42.69	55.17	11.22	14.58	53.91	69.75
T_4	Clodinafop-propargyl @ 0.140 kg ha^{-1}	42.58	54.56	11.15	14.31	53.73	68.86
T_5	2, 4-D @ 0.5 lit ha^{-1} *fb* metribuzin @ 0.250 Kg ha^{-1}	43.18	55.25	11.32	14.51	54.51	69.77
T_6	2, 4-D @ 0.5 lit ha^{-1} *fb* butachlor @ 1 lit ha^{-1}	44.01	54.90	11.56	14.42	55.57	69.33
T_7	Metribuzin @ 0.250 Kg ha^{-1} *fb* butachlor @ 1 lit ha^{-1}	42.81	57.14	11.17	15.03	53.98	72.17
T_8	2, 4-D @ 0.5 lit ha^{-1} + hand weeding at 30 DAS	42.87	55.24	11.22	14.49	54.08	69.72
T_9	Hand Weeding at 30 DAS	43.79	56.59	11.50	14.82	55.30	71.41
T_{10}	Weedy check	44.13	53.91	11.62	14.14	55.75	68.05
SEm±		1.06	1.13	0.30	0.32	1.36	1.45
CD (P=0.05)		3.10	3.30	0.87	0.94	3.96	4.24

Table.4 Carbon pool in (tree and/or agriculture crops) biomass under wheat- *Eucalyptus tereticornis* based agroforestry system

Treatment		Carbon pool from vegetation biomass (t C ha^{-1} yr^{-1})					
		Aboveground		Belowground		Total	
		2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
T_1	2, 4-D @ 0.5 lit ha^{-1}	13.71	13.94	3.52	3.59	17.23	17.53
T_2	Metribuzin @ 0.250 Kg ha^{-1}	14.01	14.35	3.60	3.71	17.61	18.06
T_3	Butachlor @ 1 lit ha^{-1}	13.66	13.60	3.53	3.53	17.18	17.14
T_4	Clodinafop-propargyl @ 0.140 kg ha^{-1}	14.15	13.97	3.64	3.60	17.79	17.57
T_5	2, 4-D @ 0.5 lit ha^{-1} *fb* metribuzin @ 0.250 Kg ha^{-1}	13.82	13.79	3.57	3.57	17.39	17.36
T_6	2, 4-D @ 0.5 lit ha^{-1} *fb* butachlor @ 1 lit ha^{-1}	14.10	13.72	3.65	3.55	17.75	17.27
T_7	Metribuzin @ 0.250 Kg ha^{-1} *fb* butachlor @ 1 lit ha^{-1}	13.80	14.02	3.55	3.63	17.35	17.65
T_8	2, 4-D @ 0.5 lit ha^{-1} + hand weeding at 30 DAS	13.85	13.78	3.56	3.56	17.41	17.33
T_9	Hand Weeding at 30 DAS	14.50	14.44	3.74	3.72	18.24	18.16
T_{10}	Weedy check	14.34	13.63	3.71	3.50	18.06	17.13
SEm±		0.27	0.22	0.07	0.06	0.34	0.28
CD (P=0.05)		0.77	0.64	0.21	0.18	0.99	0.81

Total carbon pool in weed (t C ha^{-1})

The weed control treatments have marked influence on carbon pool from weed biomass.

The total carbon pool was significantly higher under weedy check (1.18 to 1.19 t C ha^{-1} during 2016-17 and 2017-18, respectively) over hand weeding at 30 DAS during both the year.

The other weed control treatment was also had lower total carbon pool in weed biomass over weedy check during both the years.

The carbon pool in weed biomass was significantly higher under weedy check (1.18 t C ha^{-1}) over hand weeding at 30 DAS (0.10 t C ha^{-1}). The lower carbon pool was observed in weed management practices over weedy check under wheat-*Eucalyptus tereticornis* based agroforestry system (Table 2).

Carbon Pool from Tree biomass

Aboveground carbon pool (t C ha^{-1})

During first year the aboveground carbon pool of eucalyptus tree was found non-significant effect by the weed control treatments. The aboveground carbon pool of eucalyptus tree range between 42.15 to 44.13 t C ha^{-1} was found wheat-*Eucalyptus tereticornis* based agroforestry system.

During second year aboveground carbon pool of eucalyptus tree was higher as compared to first year. The total aboveground carbon pool of eucalyptus tree ranged from 53.91 to 57.89 t C ha^{-1} was found wheat-*Eucalyptus tereticornis* based agroforestry system (Table 3).

Belowground carbon pool (t C ha^{-1})

During first year the belowground carbon pool of eucalyptus tree was found non-significant effect by the weed control treatments. The belowground carbon pool of eucalyptus tree range between 11.02 to 11.62 t C ha^{-1} was found under wheat-*Eucalyptus tereticornis* based agroforestry system. During second year belowground carbon pool of eucalyptus tree was higher as compared to first year.

The total belowground carbon pool of eucalyptus tree ranged from 14.14 to 15.21 t C ha^{-1} was found under wheat-*Eucalyptus tereticornis* based agroforestry system (Table 3).

Total carbon pool (t C ha^{-1})

During first year the total carbon pool of eucalyptus tree was found non-significant effect by the weed control treatments. The total carbon pool of eucalyptus tree range between 53.17 to 55.75 t C ha^{-1} was found under wheat-*Eucalyptus tereticornis* based agroforestry system. During second year total carbon pool of eucalyptus tree was higher as compared to first year. The total carbon pool of eucalyptus tree ranged from 68.05 to 73.10 t C ha^{-1} was found under wheat-*Eucalyptus tereticornis* based agroforestry system (Table 3).

Vegetation carbon pool (tree and/or agriculture crops) (t C ha^{-1} Yr^{-1})

The weed control treatment does not show significant difference on total carbon pool under agroforestry system (Table 4). The aboveground carbon pool from aboveground and belowground vegetation range between 13.66 to 14.50 and 3.52 to 3.74 t C ha^{-1} yr^{-1} was found during first year. During second year aboveground and belowground carbon pool was found ranged from 13.60 to 14.44 and 3.50 to 3.72 t C ha^{-1} yr^{-1} was found under wheat - *Eucalyptus tereticornis* based agroforestry system during both the year. The total carbon pool of agroforestry system range between 17.18 to 18.24 and 17.13 to 18.16 t C ha^{-1} was found during both the year under wheat-*Eucalyptus tereticornis* based agroforestry system (Table 4). It can be inferred from the above results that, the variability in the aboveground carbon pool under different land use systems depends primarily upon the ash content and the ash content depends upon the amount of structural components. More the structural tissue higher will be the retained ash content and lower will be the carbon content and it may also depends on nature of components (tree and crops), crop density, growth habit, genetic makeup, age, structure, functional components and their number, intensity of management. The findings of present experiment are also inconformity with many researchers. Albrecht and Kandaji (2003) have also reported that, carbon variability in plant biomass can be high within complex systems and productivity of the land use depends on several factors including age, nature of component, the structure, soil properties and the management of system. Mangalassery *et al.*, (2014), Prasad *et al.*, (2012) and Chauhan *et al.*, (2015).

The agroforestry system can increase the amount of carbon stored in agriculture crop, weeds and tree component due to higher biomass production than single component. The weed management practices were increase the wheat biomass, whereas, weedy check was found higher weed biomass. The higher total biomass production was found under hand weeding 30 DAS (39.71 and 39.21 t ha^{-1}) during both the year. The total vegetation carbon pool of agroforestry system range between 17.18 to 18.24 and 17.13 to 18.16 t C ha^{-1} yr^{-1} was found during both the year under wheat-*Eucalyptus tereticornis* based agroforestry system.

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How to cite this article:

Atul Singh, K.K. Jain and Upadhyay, S.D. 2019. Biomass Production and Vegetation Carbon Pool under Wheat - *Eucalyptus tereticornis* sm Based Agroforestry System. *Int.J.Curr.Microbiol.App.Sci.* 8(07): 1306-1316. doi: https://doi.org/10.20546/ijcmas.2019.807.155