Supplementary Materials: Carbon Sequestration and Carbon Markets for Tree-Based Intercropping Systems in Southern Quebec, Canada. *Atmosphere* 2016, *7*, Article No. 17

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Statistical Analysis

We ran analysis of variance (ANOVA) to compare the soil C stock, the litterfall C and the above-ground biomass C (all expressed as kg C m^{-2}) amongst positions, *i.e.*, the distance from the tree, within TBI plots. There were a total of six positions (independent variables) within TBI plots as described in Section 2.4. The soil C stockk (dependent variable) was calculated for depth increments, *i.e.*, 0–5, 5–20, 20–30 cm, and total depth (0–30 cm). The ANOVA describing the effect of position on soil C stock, litterfall C and above-ground biomass C was done separately for the two field sites. Significant effects ($p < 0.05$) were followed by means comparison with a post-hoc Tukey test.

We then compared the weighted average of soil C stock, litterfall C and above-ground biomass C from the TBI systems to the non-TBI system. The weighted average considered that each sampling position represented a proportion of the plot area within the TBI system. As such, the "central" sampling position mid-way between alleys accounted for half of the area (*i.e.*, 0.25 for each), and the remaining "next-to-tree" positions ~1–2 m east and west of trees accounted for the other half (*i.e.*, 0.125 for each). Contrast analysis (TBI system *vs.* non TBI system) of the soil C stock, litterfall C and above-ground biomass C was done separately for the two field sites. As mentioned above, the soil C stock was calculated by soil depth, *i.e.*, 0–5, 5–20 and 20–30 cm, and total soil depth (0–30 cm), and each depth increment was considered in the contrast analysis. Statistical significance of contrast analyses was declared at $\alpha = 0.05$.

Summary Results

Average soil C stored at all observed soil depths (0–5, 5–20, 20–30, and 0–30 cm) was similar within TBI systems as presented in Tables S1a,b, for St. Edouard and St. Paulin, respectively. Average above-ground C stocks of crop within TBI systems has greater in mid-alley positions compared to east and west of poplar and hardwoods at St. Paulin ($p = 0.0014$; Table S3). Average litterfall C stocks were similar within positions at St. Edouard and St. Paulin (Table S4). The contrast analysis of total soil C in TBI and non-TBI systems was similar at all observed soil depths for St. Edouard and St. Paulin, Tables S5 and S6, respectively. Above-ground biomass stocks (kg C m^{-2}) were greater in the non-TBI system compared to the TBI system at St. Edouard ($p = 0.01$), and similar between TBI and non-TBI systems at St. Paulin (Table S7). Litterfall stocks (kg C m^{-2}) were similar in TBI and non-TBI systems at both St. Edouard and St. Paulin (Table S8).

Table S1. Measured soil carbon stocks (kg C m^{-2}) at tree-based intercropping site in St. Edouard, southern Quebec.

Depth (cm)	Position [a]						
	ep	Mid-Alley	wh	eh	Mid-Alley	wp	*p*-Value [c]
0–5	2.24 ± 0.29 [b]	2.28 ± 0.32	3.20 ± 0.23	2.28 ± 0.67	2.92 ± 0.30	2.95 ± 0.62	0.10
5–20	7.41 ± 1.68	7.64 ± 0.58	9.65 ± 1.55	9.17 ± 1.56	7.80 ± 1.00	8.36 ± 0.82	0.26
20–30	4.05 ± 1.96	5.32 ± 0.63	5.20 ± 0.46	5.04 ± 0.57	4.67 ± 1.66	5.55 ± 1.26	0.38
0–30	13.70 ± 3.39	15.24 ± 1.06	19.06 ± 2.30	17.20 ± 1.81	15.76 ± 1.87	15.98 ± 2.68	0.17

[a] Position: ep denotes east of poplar; mid-alley mid-way between alleys; wh west of hardwoods; eh east of hardwoods; wp west of poplar; all positions near trees were within ~1–2 m of tree; [b] Within rows (Position), means ± standard deviation; [c] *p*-Values are from a one-way ANOVA of the effect of sampling position within each soil depth. Poplar included hybrid poplar (DN3333 and DN3570; DN denotes *Populus deltoides* Bartr. Ex Marsh x *nigra* L.) and hardwoods included *Quercus rubra* L. and *Fraxinus americana* L.

Table S2. Measured soil carbon stocks (kg C m^{-2}) at tree-based intercropping site in St. Paulin, southern Quebec.

Depth (cm)	Position [a]						
	ep	Mid-Alley	wh	eh	Mid-Alley	wp	*p*-Value [c]
0–5	2.44 ± 0.43 [b]	2.61 ± 0.60	3.17 ± 0.67	2.86 ± 0.72	2.65 ± 0.98	2.42 ± 0.89	0.86
5–20	8.16 ± 1.22	7.76 ± 0.61	8.37 ± 1.03	8.41 ± 1.59	6.63 ± 1.57	4.57 ± 4.20	0.24
20–30	4.98 ± 0.37	5.27 ± 0.61	5.45 ± 1.02	5.04 ± 1.53	4.71 ± 0.80	3.75 ± 0.38	0.29
0–30	15.58 ± 1.79	15.75 ± 0.82	16.69 ± 2.45	16.30 ± 3.01	13.99 ± 3.22	10.74 ± 5.27	0.25

[a] Position: ep denotes east of poplar; mid-alley mid-way between alleys; wh west of hardwoods; eh east of hardwoods; wp west of poplar; all positions near trees were within ~1–2 m of tree; [b] Within rows (Position), means ± standard deviation; [c] *p*-Values are from a one-way ANOVA of the effect of sampling position within each soil depth. Poplar included hybrid poplar (DN3333 and DN3570; DN denotes *Populus deltoides* Bartr. Ex Marsh x *nigra* L.) and hardwoods included *Quercus rubra* L. and *Prunus serotina* Ehrh.

Table S3. Measured above-ground biomass stocks (kg·C·m^{-2}) at tree-based intercropping sites in St. Edouard and St. Paulin, southern Quebec.

Site	Position [a]						
	ep	Mid-Alley	wh	eh	Mid-Alley	wp	*p*-Value [c]
St. Edouard	0.036 ± 0.015 [a,b]	0.048 ± 0.009 [a]	0.054 ± 0.008 [a]	NA	NA	NA	0.21
St. Paulin	0.042 ± 0.034 [b]	0.178 ± 0.040 [a]	0.037 ± 0.026 [b]	0.048 ± 0.023 [b]	0.165 ± 0.077 [a]	0.033 ± 0.017 [b]	0.0014

[a] Position: ep denotes east of poplar; mid-alley mid-way between alleys; wh west of hardwoods; eh east of hardwoods; wp west of poplar; all positions near trees were within ~1–2 m of tree; [b] Within rows (Position), means ± standard deviation followed by the same letter are not significantly different according to Tukey test ($p < 0.05$); [c] *p*-Values are from a one-way ANOVA of the effect of sampling position for above-ground biomass stocks (kg C m^{-2}) at each site, St. Edouard and St. Paulin. Poplar included hybrid poplar (DN3333 and DN3570; DN denotes *Populus deltoides* Bartr. Ex Marsh x *nigra* L.) for both sites. At St. Edouard, hardwoods included *Quercus rubra* L. and *Fraxinus americana* L. At St. Paulin, hardwoods included *Quercus rubra* L. and *Prunus serotina* Ehrh.

Table S4. Measured litterfall stocks (kg C m^{-2}) at tree-based intercropping sites in St. Edouard and St. Paulin, southern Quebec.

Site	Position [a]						
	ep	Mid-Alley	wh	eh	Mid-Alley	wp	*p*-Value [c]
St. Edouard	0.105 ± 0.051 [b]	0.062 ± 0.034	0.048 ± 0.019	0.059 ± 0.038	0.034 ± 0.021	0.090 ± 0.033	0.21
St. Paulin	0.035 ± 0.015	0.044 ± 0.016	0.065 ± 0.039	0.034 ± 0.002	0.037 ± 0.039	0.036 ± 0.004	0.44

[a] Position: ep denotes east of poplar; mid-alley mid-way between alleys; wh west of hardwoods; eh east of hardwoods; wp west of poplar; all positions near trees were within ~1–2 m of tree; [b] Within rows (Position), means ± standard deviation; [c] *p*-Values are from a one-way ANOVA of the effect of sampling position for litterfall stocks (kg·C·m^{-2}) at each site, St. Edouard and St. Paulin. Poplar included hybrid poplar (DN3333 and DN3570; DN denotes *Populus deltoides* Bartr. Ex Marsh x *nigra* L.) for both sites. At St. Edouard, hardwoods included *Quercus rubra* L. and *Fraxinus americana* L. At St. Paulin, hardwoods included *Quercus rubra* L. and *Prunus serotina* Ehrh.

Table S5. Contrast analysis for soil C stocks (kg C m^{-2}) at tree-based intercropping site in St. Edouard, southern Quebec.

Depth (cm)	Contrast [a]		
	TBI [b]	Non-TBI	*p*-Value
0–5	2.70	2.55	0.86
5–20	8.18	8.68	0.69
20–30	5.11	5.55	0.65
0–30	15.99	16.79	0.65

[a] Contrast analysis was done separately for the two sites. For soil C stocks, contrasts were also done by soil depth, *i.e.*, 0–5, 5–20 and 20–30 cm, and total soil depth (0–30 cm). Statistical significance of all analyses was declared at α = 0.05; [b] TBI is tree-based intercropping system; Non-TBI refers to the adjacent agricultural system without trees.

Table S6. Contrast analysis for soil C stocks (kg C m^{-2}) at tree-based intercropping site in St. Paulin, southern Quebec.

Depth (cm)	Contrast [a]		
	TBI [b]	non-TBI	*p*-Value
0–5	2.68	2.13	0.69
5–20	7.29	6.91	0.98
20–30	4.90	4.16	0.65
0–30	14.85	13.19	0.60

[a] Contrast analysis was done separately for the two sites. For soil C stocks, contrasts were also done by soil depth, *i.e.*, 0–5, 5–20 and 20–30 cm, and total soil depth (0–30 cm). Statistical significance of all analyses was declared at α = 0.05; [b] TBI is tree-based intercropping system; Non-TBI refers to the adjacent agricultural system without trees.

Table S7. Contrast analysis for above-ground biomass stocks (kg C m^{-2}) at tree-based intercropping sites in St. Edouard and St. Paulin, southern Quebec.

Site	Contrast [a]		
	TBI [b]	non-TBI	*p*-Value
St. Edouard	0.05	0.07	0.01
St. Paulin	0.11	0.13	0.17

[a] Contrast analysis was done separately for the two sites. Statistical significance of all analyses was declared at α = 0.05; [b] TBI is tree-based intercropping system; Non-TBI refers to the adjacent agricultural system without trees.

Table S8. Contrast analysis for litterfall stocks (kg C m^{-2}) at tree-based intercropping sites in St. Edouard and St. Paulin, southern Quebec.

Site	Contrast [a]		
	TBI [b]	Non-TBI	*p*-Value
St. Edouard	0.062	0.067	0.62
St. Paulin	0.041	0.020	0.08

[a] Contrast analysis was done separately for the two sites. Statistical significance of all analyses was declared at α = 0.05; [b] TBI is tree-based intercropping system; Non-TBI refers to the adjacent agricultural system without trees.