Determination of Carbon Sequestration in Tobacco Plants

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Introduction

Carbon sequestration is an expression used to define the process of removing carbon dioxide from the atmosphere. Naturally, this process is carried out by the growth of plants through photosynthesis and also by absorption from the ocean and soil.

Vegetation has a great contribution capturing and storing carbon. It is the main place for photosynthesis, being vital for the maintenance of life on the planet, as it is used as a source of food. In addition, it also releases oxygen for other living beings breathing.

Introduction

The determination of carbon content in dry biomass can be performed in several ways, such as the CHNS methodology, that is elemental analyzer by combustion of elements. This system uses high temperature ovens for complete combustion of the samples, selective retention of gases (separation by frontal chromatography) and detection of gases by TCD (thermal conductivity detector).

Objectives

GENERAL OBJECTIVE

Determine the amount of carbon in tobacco plants to estimate the CO_2 volume assimilated throughout the plant's growing phase.

SPECIFIC OBJECTIVES

- Determine the fresh mass of plant material from tobacco plants;
- Determine the dry mass of plant material from tobacco plants;
- Analyze the percentage of carbon on dry mass samples of plant material from tobacco plants;
- Calculate the amount of carbon contained on tobacco plants, as per plant part sampling.

Methodology

- The plant material was collected in stages as the leaves were harvested, being stored in properly labeled plastic bags for later weighing and processing. At the end of the season, the stem and roots of each plant were also collected, weighed and processed;
- In this way, each of the 6 tobacco plants in each grower had 6 different categories: 1st harvest + topping, 2nd harvest, 3rd harvest, 4th harvest, stem and root, resulting on 36 samples per grower and 144 samples in total;
- In the plant processing, they were weighed being called "fresh weight", and the leaves, stem and roots samples were dried to measure the "dry weight“, necessary for later determination of total carbon per plant. Ovens were used drying for 7 days and the fresh and dry weights were determined by utilizing a precision scale.

Methodology

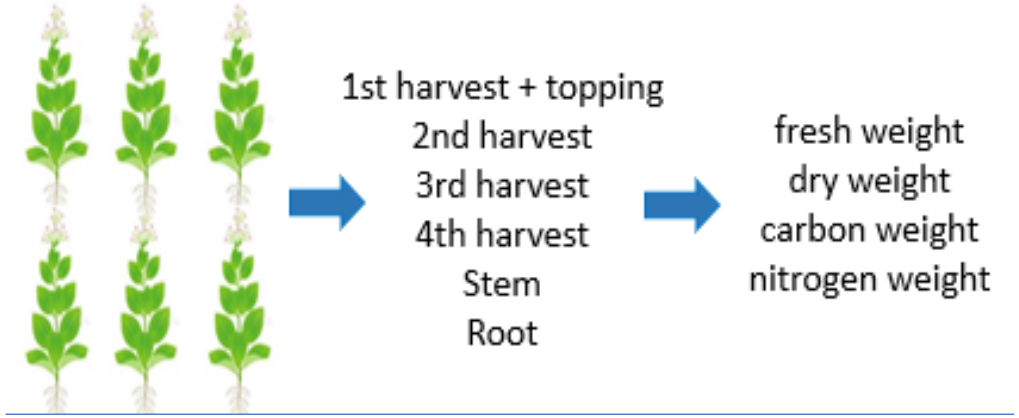
Tobacco plants were analyzed at 4 different growers, where 6 tobacco plants in each one were chosen at random. These selected plants were used to collect leaves, stems and roots.

Methodology

Plant material samples from leaves, stems and roots were grinded in a knife mill, homogenized and stored in dry form. For chemical analysis, the material was processed with a cryogenic mill in a N_2 environment and the analyzes were performed with CHNS for carbon determination. All samples were analyzed in triplicate.

Harvesting and processing activities followed the previously established schedule. All data were tabulated and analyzed.

Methodology flowchart



Results

The fresh and dry weights by grower and category are presented. Variations between plants and growers depends on the environmental conditions and agronomic production procedures. Since the chemical analyzes of the stored carbon are expressed in percentages of dry mass, the individual carbon of each grower and category can be calculated.

Average of **fresh** weight (g) by category and grower

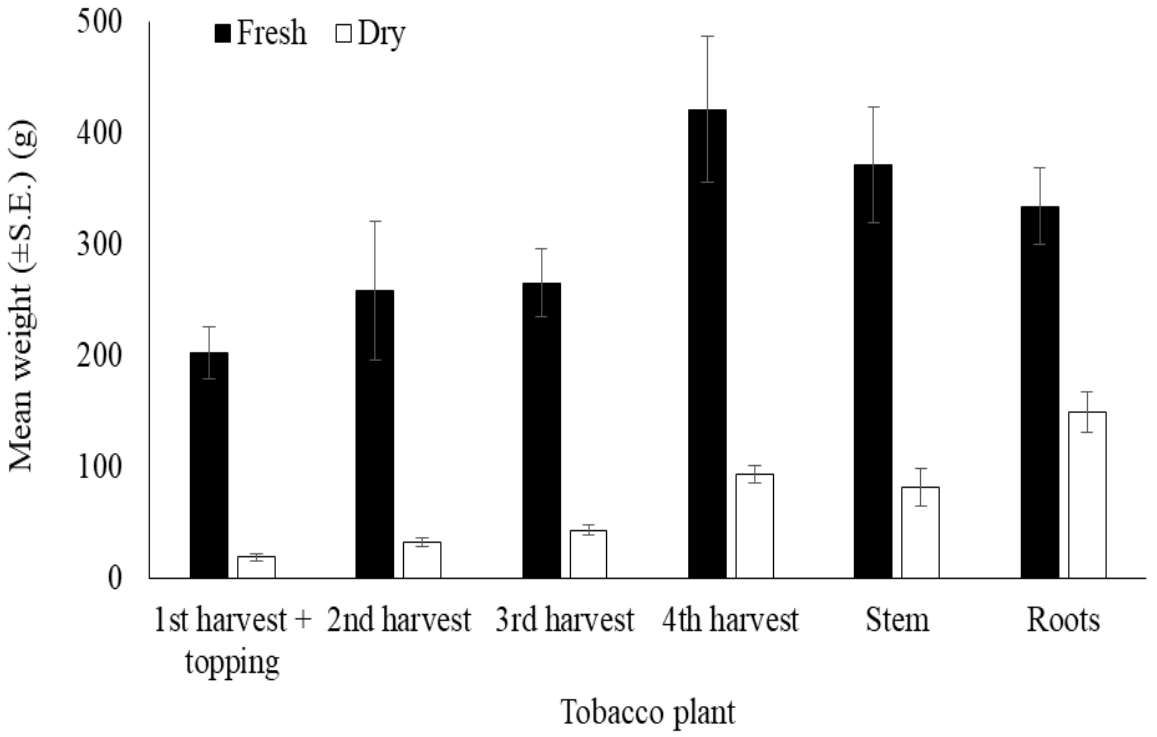
CATEGORIES	Fresh weight (g)				
	Grow. A	Grow. B	Grow. C	Grow. D	Average
1ª harvest + Topping	155,00	251,67	171,67	231,67	202,50
2ª harvest	158,33	416,67	296,67	161,67	258,33
3ª harvest	263,33	290,00	325,00	181,67	265,00
4ª harvest	283,33	526,67	538,33	334,58	420,73
Stem	353,33	503,33	378,33	249,82	371,20
Roots	373,33	405,00	303,33	253,83	333,87
Total	1.586,67	2.393,33	2.013,33	1.413,22	**1.851,64**

Results

Average **dry** weight (g) by category and grower

CATEGORIES	Dry weight (g)				
	Grow. A	Grow. B	Grow. C	Grow. D	Average
1ª harvest + Topping	15,11	21,16	13,39	27,22	19,22
2ª harvest	28,85	36,02	40,00	23,35	32,05
3ª harvest	54,57	40,42	45,78	31,75	43,13
4ª harvest	85,00	103,33	108,92	74,70	92,99
Stem	70,00	130,00	76,67	51,30	81,99
Roots	158,33	193,33	135,00	109,21	148,97
Total	411,86	524,25	419,75	317,54	**418,35**

Average **fresh** and **dry** weight (g) by category and grower



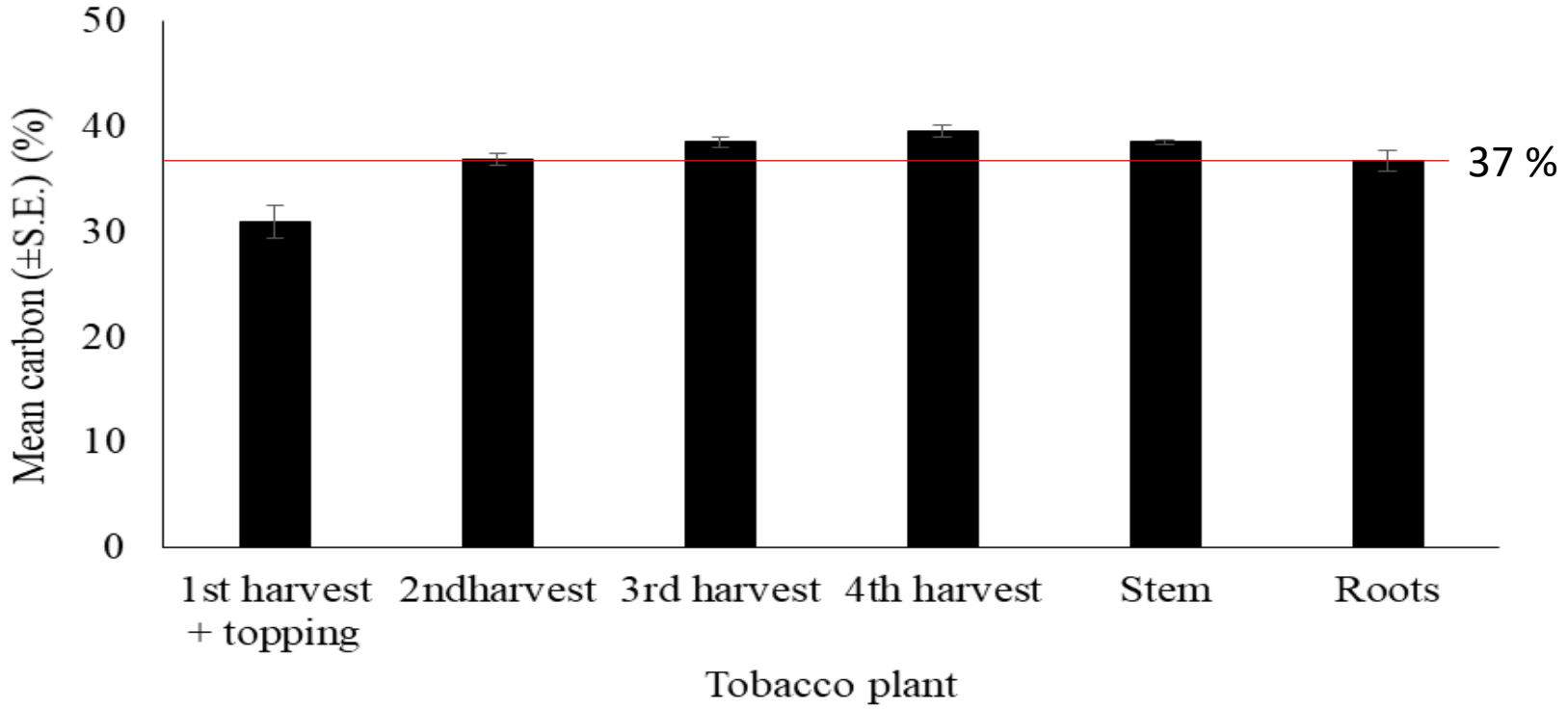
Results

Analyzing the data from the growers and their plants, the alongside table presents a summary of all the data collected. It shows that a tobacco plant has an average **fresh weight of 1.85 kg and carbon fixed of 157,53 g** in chemical bonds per plant. On average, a tobacco plant holds 36.88 % of its dry weight in carbon. As a conclusion, 8.5 % of its fresh weight is represented by carbon.

CATEGORIES	Fresh weight	Dry weight	Carbon weight	Carbon weight
	Average (g)	Average (g)	Average (%)	Average (g)
1ª harvest + Topping	202,50	19,22	30,97	5,95
2ª harvest	258,33	32,05	36,91	11,83
3ª harvest	265,00	43,13	38,56	16,63
4ª harvest	420,73	92,99	39,62	36,84
Stem	371,20	81,99	38,53	31,59
Roots	333,87	148,97	36,71	54,68
Total	**1.851,64**	418,35		**157,53**

Results

Average of fresh mean carbon [%]



Results

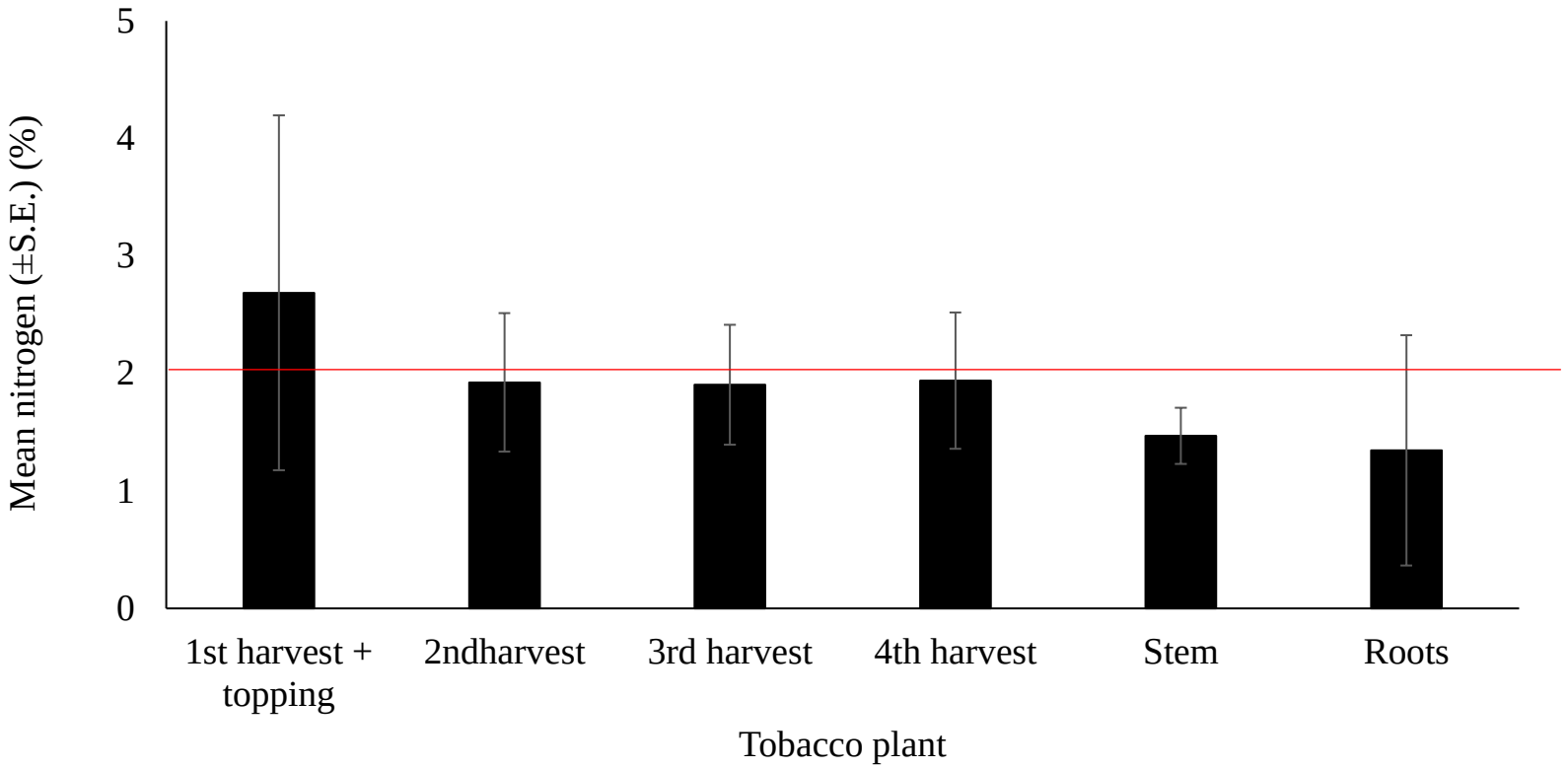
The values of nitrogen stored in chemical bonds in tobacco plants were analyzed, showing that a tobacco plant has an **average fresh weight of 1.85 kg, and 6,96 g of nitrogen fixed** in chemical bonds per plant. On average, a tobacco plant holds 1,88 % of its dry weight in nitrogen, that is, 0,38 % of its fresh weight is nitrogen.

Average of fresh, dry and nitrogen weight (g), as well as the nitrogen % on dry samples.

CATEGORIES	Fresh weight	Dry weight	Nitrogen percentage	Nitrogen weight
	Average (g)	Average (g)	Average (%)	Average (g)
1ª harvest + Topping	202,50	19,22	2,69	0,52
2ª harvest	258,33	32,05	1,92	0,62
3ª harvest	265,00	43,13	1,90	0,82
4ª harvest	420,73	92,99	1,94	1,80
Stem	371,20	81,99	1,47	1,20
Roots	333,87	148,97	1,34	2,00
Total	**1.851,64**	418,35		**6,96**

Results

Average nitrogen % on dry samples.



Considerations

- Considering that one single plant of tobacco is able to capture **157,53 g of Carbon** during its entire cycle and assuming that the average plant population per hectare in the Old Belt/RS growing area is 16.666 plants, we deduct that **2.625,39 kg** of Carbon are removed from the environment by tobacco cycle, per hectare;
- 54,76 % or 1.437,66 kg of Carbon collected per hectare are fixed in the soil by roots and stem. In addition, the organic matter is incremented as well;
- As mentioned, the tobacco plant fixes 0,38 % of his fresh weight in Nitrogen. Considering fresh weight per plant as 1.851,64g and converting to hectares (16.666 plants), it is possible to fix **117,26 kg** of Nitrogen in this considered area;
- Taking in to consideration that both, Root and Stem, will be fixed in the soil, one can say that 44,65kg of Nitrogen will remain in the soil after the tobacco season;

Considerations

- Premium Tabacos do Brasil is aware that the impact caused by fertilizers, machinery and further sources of emissions during the tobacco production cycle must be carefully studied in order to obtain the proper CO_2 emission impact;

- This Project reflects an initial effort. The Company is engaged to advance the studies in order to stablish metrics and parameters to mitigate and understand the real impact generated by the tobacco culture in face of global warming.

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TABACOS DO BRASIL

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