



### Ten-years dataset of poplar inventory in northern Italy

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### Abstract

The data refer to several poplar plantations located in the plains of northern Italy. The information was collected during the vegetative rest of each year from 1987 to 1996. Dendrometric data were recorded, such as the diameter at breast height, the diameter at five meters height and the planting density, as well as damage caused by biotic and abiotic adversities using a three-level intensity scale. All data is raw, with only total volume and the volume of the first log (up to 5 meters height) calculated using dendrometric equations based on tree diameter and height. The availability of a continuous inventory with annual measurements for 10 years on the same trees in the permanent sample plots has allowed the creation of a particularly important database for the study of growth models and the influence of biotic and abiotic adversities on wood production. This dataset could be used to perform further investigations, such as CO<sub>2</sub> sequestration, to assess the environmental sustainability of the poplar plantations. Furthermore, thanks to this database, it is possible to identify which areas of the northern Italian plains are more suitable for poplar cultivation based on wood biomass production, or to evaluate the impact of pests and diseases with respect to clone and land characteristics.

**Keywords:** dendrometric data, *Populus* sp., clones, growth modelling, biotic and abiotic adversity data, georeferenced sampling.

## Introduction

The growing demand for wood assortments used in timber industry and biomass energy production, combined with efforts to conserve natural forests, has supported a significant expansion of forest plantations. The most commonly used trees belong to fast-growing species such as poplars (Corona et al. 2020).

The genus *Populus* is cultivated to produce sawn timber, veneer, and plywood due to its rapid juvenile growth, high photosynthetic capacity, high growth performance and high wood biomass production (Corona et al. 2020).

The main feature of poplar is its fast-growing nature, which results in short rotations, typically lasting around ten years. This leads to significant inter-annual fluctuations in the geographical distribution of planted areas, requiring frequent assessments that also take into account the growth stage of the trees.

In Italy, poplar cultivation is the most significant source of timber for industrial use, including furniture production, plywood, and other products. Of all the timber processed in Italy, poplar represents half of that which has been grown within the borders of the country.

Poplar cultivation provides several environmental benefits, such as erosion reduction, and is also used for climate change mitigation practices (D'Amico et al. 2021). One of these practices is carbon sequestration, in which trees absorb carbon from the atmosphere and store it in their biomass and the soil, reducing the greenhouse effect and enriching the soil simultaneously.

Additionally, using wood obtained from plantations instead of forests can help reduce pressure on natural forests and enhance associated environmental benefits.

Forest plantation inventories are valuable data sources for studying the environmental, social, and economic services provided (Nielsen et al. 2014), as they are an important tool for

tracking the distribution, characteristics, and time dynamics of plantations (Chiarabaglio et al. 2018).

The aim of this paper is to make available the inventory dataset concerning poplar plantations in northern Italy, so to allow the use in further investigations and analyses.

## **Methods**

### ***Study area***

The surveyed land consists of the plains of northern Italy, specifically the Po Valley. Data were collected in the administrative regions of Piemonte, Lombardia, Emilia-Romagna, Veneto and Friuli-Venezia-Giulia. All records are georeferenced with UTM metric coordinates in European Datum 1950, EPSG:4230.

### ***Sampling scheme and data collection***

The surveyed land consists of the plains of northern Italy. 2,322 clusters, georeferenced on the three-kilometre UTM grid, are systematically distributed over an area of 4,179,600 hectares. The nine subunits that make up each cluster are in coincidence with the points of a 500 meters square grid (Figure 1). The data refers to surveys during the vegetative rest of each year from 1987 to 1996.

[Here the Fig.1]

The diameter at breast height was measured with a dendrometric caliper, the diameter at 5 m height with a Finnish parabolic caliper. Total height was measured with a Blume Leiss hypsometer. The diameter of the permanent sample plot was measured with a metric tape. The center of permanent sample plot (PSP) was identified on the field through the interpretation of aerial photos (B/W infrared, scale 1:18,000, period 1978-84) on which their central points have been located using UTM

system coordinates ED50 (“European Datum 1950”, EPSG:4230).

When the centre of a cluster element falls within an intensive poplar plantation (at least 4 poplar rows covering an area of at least 1,000 m<sup>2</sup>) a 600 m<sup>2</sup> circular PSP is defined around such point. Site characteristics are recorded as well as cultivation characteristics, such as poplar clone, spacing, layout and year of planting. All the trees that belong to such sample plot are indelibly marked. Ground surveys begin in spring after budding and when all new plantations have been established. In autumn, at the end of the growing season, a second ground survey is carried out only in six years old and older plantations. Damages caused by biotic and abiotic adversities are surveyed using a scale of three levels of intensity. In the end, the following spring, before a new inventorial cycle takes place, a third ground survey is carried out on six years old and older poplar stands to assess how many, among those existing in the previous autumn, were subsequently felled. Table 1 reports the measures and observations obtained from each survey.

[Here the Tab. 1]

#### ***Data access and metadata description***

The dataset can be download using the following reference:

“Rizza D., Chiarabaglio P.M., Coaloa D., Rocci, A. 2023 - *Dataset of ten years of poplar inventory in northern Italy* [Data set].” DOI: 10.5281/zenodo.7612569. The file is provided as a ‘comma-separated values’ file (csv).

#### ***Technical validation***

The dataset is a collection of dendrometric information, including pest and disease attacks, from intensively cultivated poplar plantations in the plains of northern Italy. It includes data on 33,632 trees measured during a continuous poplar inventory

conducted from 1987 to 1996, with annual ground surveys. The data of each tree have been carefully verified before the publication, avoiding misspelling or error among data collected by different operators in different years.

### ***Reuse potential and limits***

The ten-year data collection period of this dataset provides a valuable resource for research activities. Sharing this information with the scientific community will allow for the development of growth models, using the georeferenced and temporally placed data to understand the relationships between dendrometric data collected for individual trees and soil and climatic conditions in the sampled areas.

The dataset is particularly useful for modelling the growth of poplar plantations using annual data recorded for each tree, by clone and/or by land characteristics. Additionally, the data could help in assessing the environmental sustainability of the plantations by determining the amount of CO<sub>2</sub> sequestered by the trees.

### ***Acknowledgements***

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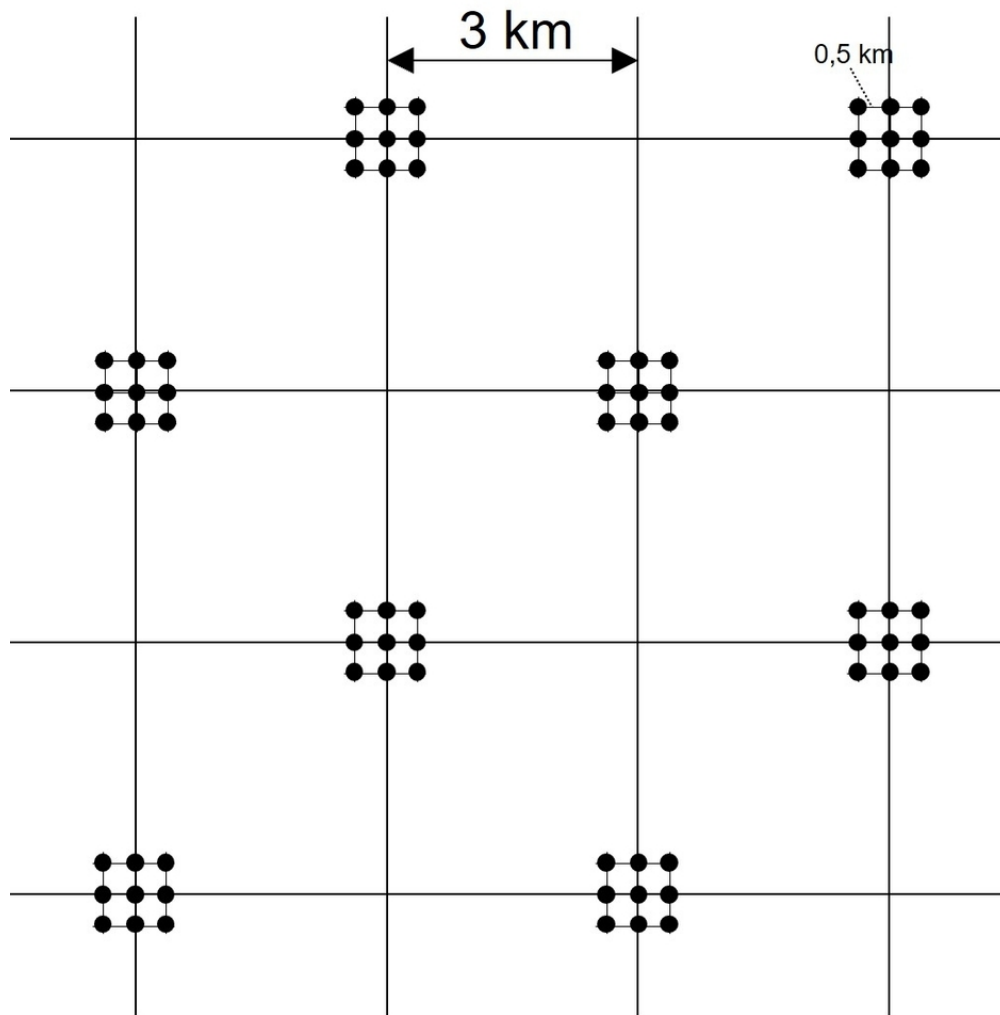


Figure 1 - Clusters and sample units' systematic distribution on the three-kilometer UTM grid

79x82mm (300 x 300 DPI)



**Table 1** - Description of the fields of the dataset.

Field	Description	Field type	Unit of measurement
<b>Fuse</b>	UTM metric coordinates in the ED50 projection of the center of permanent sample plots (PSP)	Numeric	
<b>Lat</b>			
<b>Lon</b>			
<b>Cod_ele</b>	The letter refers to the Italian Region code (E= Emilia Romagna, F=Friuli Venezia Giulia, L=Lombardia, P=Piemonte, V=Veneto); the first number specifies the cluster; the second number refers to the element of the cluster	String	
<b>Cod_num</b>	Cod_ele with single tree identification number	String	
<b>h_dendro</b>	Tree height	Numeric	m
<b>h_5m</b>	Tree height at 5 m; less than 5 meters in case of stem breakage or unpruned branches	Numeric	m
<b>Diam</b>	Tree diameter at breast height	Numeric	cm
<b>Diam_5</b>	Tree diameter at 5 meters height	Numeric	cm
<b>Vol</b> (Tree volume)	$Vol = c_1 \cdot D^{c_2} \cdot H^{c_3} \cdot S^{c_4} \cdot a^{c_5}$ $c_1=0.2535; c_2= 2.093, c_3= 1.02777; c_4=0.0275$ $c_5=0.082; D=Diam; H=h\_dendro; S=Planting\_density; a=Age$	Numeric	m <sup>3</sup>
<b>Vol_5</b> (Tree volume at 5 meters height)	$Vol_5 = \frac{1}{3} \cdot \frac{\pi}{4} \cdot (D^2 + d^2 + D \cdot d) \cdot (h - 1.3) + \frac{\pi}{4} \cdot D^2 \cdot 1.3$ d=Diam_5; h=h_5m	Numeric	m <sup>3</sup>
<b>Age</b>	Tree age	Numeric	
<b>Clone</b>	100 <i>P.alba</i> ; 200 <i>P.nigra</i> ; 300 <i>P.delt. x maxim.</i> ; 301 Eridano; 400 <i>P.deltoides</i> ; 401 Onda; 402 Lux; 403 Lena; 500 <i>P. x euramericana</i> ; 501 I-214; 502 Cima; 503 Pan; 504 Bellini; 505 Cappa Bigliona; 506 Luisa Avanzo; 507 BL Costanzo; 508 Guardi; 510 Type CANADESE; 511 Bocculari; 512 Stella; 513 BRA.NA.GESI; 514 Gattoni; 515 Adige; 520 Type CAROLINIANO; 521 San Martino; 522 Triplo	Numeric	
<b>Growth_stage</b>	1 Tree still in place 2 felled trees (last measurement)	Numeric	
<b>Tree_psp</b>	Number of trees in the permanent sample plot	Numeric	
<b>Planting_density</b>	Plant density	Numeric	m <sup>2</sup>
<b>Year_measure</b>		Numeric	
<b>Missing</b>		Logic	
<b>Dead</b>			

<b>Broken</b>			
<b>Replaced</b>			
<b>Planting year</b>			Numeric
<b>h_1_branch</b>	Height of the first branch		Numeric m
<b>Mech_damage</b> (mechanical damage)			
<b>Fire_damage</b>			
<b>Hail_damage</b>			
<b>Frost_damage</b>			
<b>Wind_snow_damage</b>			
<b>Brown_spot_damage</b> ( <i>Marssonina brunnea</i> )		Damage intensity scale:	
<b>Virus_damage</b> ( <i>Poplar Mosaic Virus</i> )		0 no damage	
<b>Rot_damage</b> ( <i>Rosellinia necatrix and others</i> )		1 low	Numeric
		2 moderate	
		3 high	
<b>Woolly_aphid</b> ( <i>Phloeomyzus passerinii</i> )			
<b>Saperda</b> ( <i>Saperda carcharias</i> )			
<b>Rodents</b>			
<b>Necrosis</b> ( <i>Discosporium populeum</i> )			