

# A Survey on Rope-based Ascending Techniques and Materials of Professional Arborists in Italy<sup>†</sup>

Leonardo Bianchini<sup>1</sup>, Massimo Cecchini<sup>1</sup>, Pietro Gallo<sup>2</sup> and Marcello Biocca<sup>2</sup>

<sup>1</sup> Tuscia University – Department of Agriculture and Forestry Science (UNITUS-DAFNE);

<sup>2</sup> CREA Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria. Centro di Ricerca Ingegneria e Trasformazioni agroalimentari, via della Pascolare, 16, 00015 – Monterotondo (Roma).

\* Correspondence: marcello.biocca@crea.gov.it

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**Abstract:** The techniques funded on rope-based access to the tree canopy (the so-called tree-climbing) have been spreading in recent years. A variety of practices such as pruning, felling of trees, cabling, phytosanitary inspections and others, can be carried out using these techniques and the methods allow to operate on trees placed in any location, resulting extremely suitable to maintain trees grown in urban environment. In Italy the number of arborists operating with rope on trees is increasing strongly. They are usually highly specialized professionals and they use specific techniques and materials. Despite the diffusion of these techniques in modern arboriculture, it is not easy to find sound and updated information and data on them. In this work, based mainly on the answers obtained with a specific questionnaire addressed to 86 Italian professional climbers, some aspects of the applied techniques were reported. The paper shows data on professional training and formation, on the work organization, on the utilized materials and equipment. In general, a large variety of situations are reported, a result probably linked to the fast growth of the sector in the last years.

**Keywords:** Urban forestry; tree-climbing; safety; arboriculture; PPE

## 1. Introduction

Urban forestry and green areas are becoming increasingly important considering that in the European Union, in 2017, 75% of the population resided in urban areas [1], while in various parts of the world this percentage is even greater, with a strong growing trend. Therefore, in recent years the awareness that the presence of green areas and trees is certainly one of the elements that contributes to improving the quality of life, has expanded and strengthened.

On the other hand, urban forestry is high-requiring workforce activities so that a complex and professional approach is needed to manage and maintain trees in towns as well as to protect workers and residents during all phases of these work sites.

Among the techniques used by professional arborists for the maintenance of ornamental trees located in urban areas, rope-based access methods, commonly also named “tree-climbing”, have been spreading in recent years. A variety of practices such as pruning, felling of trees, cabling, phytosanitary inspections and others, can be carried out using these techniques. Tree-climbing shows several advantages compared to the traditional operations with aerial lifts: targeted and selective interventions on tree branches, reaching internal portions of the canopy without damaging branches of other trees or infrastructures, accessing to trees located in confined areas where machinery cannot enter [2]. In urban forestry, operating by means of tree-climbing are often the only possible solution to maintain trees.

Tree climbing involves the safe use of cutting tools (manual saws and chainsaws) by very specialized operators who use techniques initially borrowed from caving and mountaineering, to climb trees up to any height. Therefore, tree climbers use a variety of equipment such as ropes (mainly polyester), slings, connectors, descenders, etc.

The scientific literature about the technical and economic evaluation of maintenance operation performed by tree-climbing appears rather poor. Some authors have studied either safety aspects of the method [3–6] or technical and economical characteristics [7–10]. Mazzocchi (2018) carried out a study on ergonomic and safety aspects, including a wide survey on the work conditions of arborists [5].

## 2. Methods

To obtain updated information about techniques and material used by professional arborists, a specific questionnaire was developed. Firstly, a focus group was conducted in order to better define the contents of the questionnaire. Five experienced qualified professional tree-climbers (of which one of them is also an author of this paper) and the three researchers involved in this work, participated to the focus group. Once the questionnaire was completed, a first analysis of the contents and of its readability was carried out delivering the questionnaire to some identified tree-climbers and the obtained comments were considered to ameliorate the survey. The questionnaire was a close-ended structured instrument containing both objective contents and attitudinal/opinion questions (subjective content). To gather the arborists opinions a five-point Likert scale were applied. The questionnaire was divided in five sections (personal data, formation, safety, work organization, opinions) for a total of 48 questions. In this paper we analyze the information related to 26 answers.

The questionnaires were delivered to arborists either by sending targeted emails or by submitting it to specialized groups on social networks. The questionnaire was filled in total by 86 operators.

Categorical variables were analyzed also by means of correspondence analysis, which was computed with the software R [11].

## 3. Results and Discussion

The participants were all males, for the most part operating in Central (40%), and North Western Italy (31%); 21% were from North Eastern and 8% from South and Islands. Regarding their nationality they were almost all Italians (84 out of 86). Considering that the 62.8% of participants were less than 40 years, the tree-climbers seem to be quite young workers, especially if the data is compared with the average age of other employees in agriculture and forestry. Table 1 shows the age of arborists and their work geographical area.

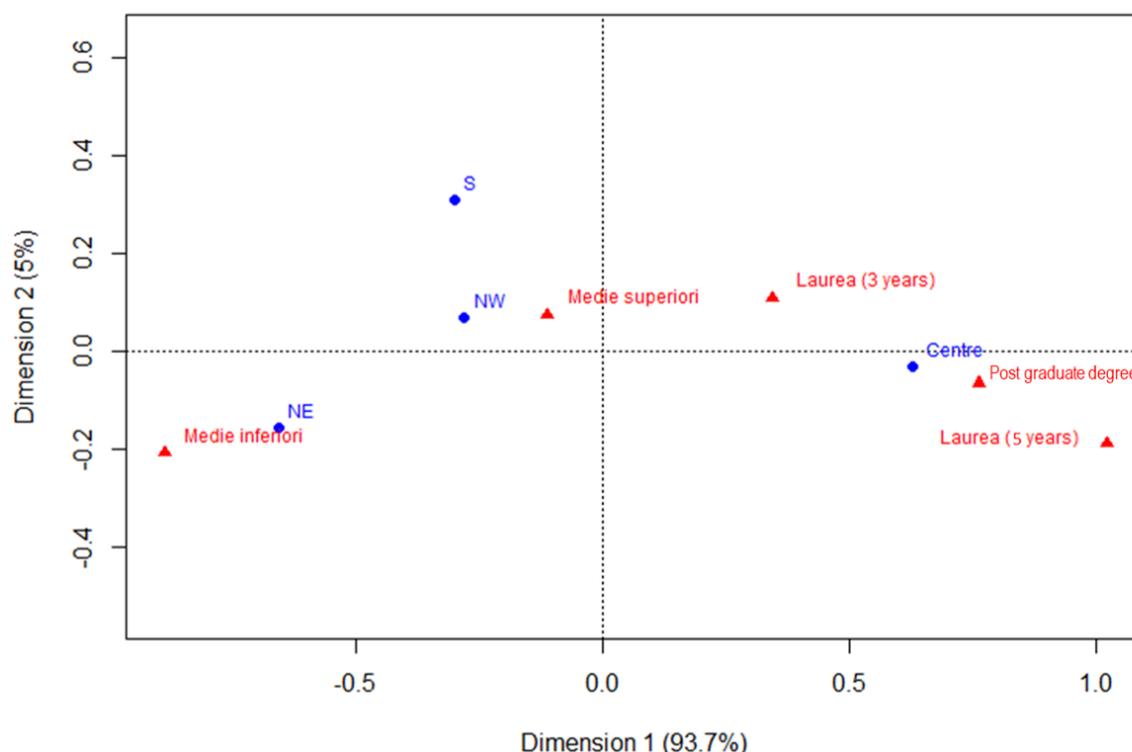
**Table 1.** Sample composition of arborists in terms of classes of age and work area.

Area	< 25	26-30	31-35	36-40	41-45	46-50	51-55	56-60
Northern West	2	5	6	6	3	3	2	0
Northern East	0	4	3	4	4	1	2	0
Center	0	3	6	10	8	4	1	2
South and Islands	1	1	1	2	2	0	0	0

Regarding the level of education, arborists have got a high general level. The most part of the workers (59%) have the high school diploma, that is the third degree of education in Italy, reached after 13 years of school. Furthermore, as much as 17% of the sample have got the highest education level (Master degree- 5 years – or post graduate degree, i.e. PhD).

Interestingly, the degree of education significantly differs according to geographical work area (p-value = 0.01242 after the Pearson’s Chi-squared test). In fact, the most part of high level educated people works in the Central Italy, while in the Northern East, the most part of respondents have got the secondary school certificate (Figure 1). This fact is likely due to the different job market of the two

areas, being the North-East a zone with a low number of unemployed having a high level of education.



**Figure 1.** Biplot chart of the correspondence analysis between geographic area of work and level of education (Medie inferiori = primary school diploma; Medie superiori = high school diploma; Laurea = Master degree; Post graduate degree = PhD).

The declared working positions were freelance (44%), company owners (34%), employee (17%), contractor (2%) and member of cooperative (2%).

In average, the participants have 8.3 years of working activity. However, the activity of operating with rope to access the tree crown is often only a part of the yearly total work. In fact, 60.5% of the arborists devote to the tree-climbing activity less than 50% of their working time. Nevertheless, a considerable part of arborists (22.0%) operates with a very high degree of specialization, with more than 81% of their working time.

Concerning technical and professional training, the tree-climbers show a generally good degree of curricular training. They must compulsorily follow the courses required by the T.U. 81/2008 (specific module on rope work on trees– Art.116 - annex XXI D.Lgs. 81/08). Surprisingly 8 out of 86 (9.3%) participants declare that they have not taken this course, thus admitting working outside the law.

The other courses considered in the questionnaire included the following: basic courses for Health & safety Manager (Directive 89/391/EEC) (attended by the 68.6%), supervisor courses (36.0%), gardener courses (14.0%), chainsaw courses (59.3%), mobile aerial platforms courses (64%), first rescue courses (51.2%) and anti-fire courses (39.5%). Considering all these 8 courses together, the 62.9% of the participants have followed from 4 to 8 courses.

Moreover, a large part of the respondents to the questionnaire have followed other qualification courses (40.7%) and/or other courses related to the profession (32.6%) and/or voluntary certification courses (for example the European Tree Worker - ETW - qualification).

The survey also revealed in which way the operators keep themselves updated about their working sector. The most frequent modality of updating is talking with colleagues (81.4%), followed by the participation to meeting or conferences (60.5%), reading specialized magazines and journals in Italian (50.0%) or English (32.6%). The updating from sellers of specialized equipment attains a

44.2%. Surprisingly, the web is only 14.0%. A residual 2.3% indicated the tree-climbing championships/competition as a place for their updating.

At the beginning of their careers, the most part of arborists (62.8%) has received coaching from experienced colleagues. However, this time is quite variable, ranging from a 2-7 days period (19%) to 400-1100 days (13%). The most frequent coaching time was 10-30 days (28%).

The initial motivation of the professional choice was also indagated, by asking the participants which why they begun the profession of arborist. The most influencing motivation on the choice of profession was having studied at school subjects related to trees (average 3.3 on a score from 1 to 5) even if the percentage of operators having an educational qualification related to arboriculture was only 31%. The choice was followed by the job opportunity (3.1/5), by the fact that the arborist was practicing sport activity close to the tree-climbing such as mountaineering or caving (2.5/5), or because they followed friends who already were working as tree-climbers (2.3/5).

A point of the questionnaire regarded specifically the access of arborists to the tree crown. As for the ascending techniques, the most part of tree-climbers (70%) uses the single rope technique (SRT), followed by the doubled rope technique (DdRT - 17%). Some operators use the DdRT with handled rope clamp and prusik (8%) (especially in the Northern-West Italy) and 5% states to use the climbing spike and adjustable lanyard. Among the techniques of ascent, SRT is clearly preferred (70%) and this may be given by the fact that SRT allows easy ascent and easy descending movements, allowing a free vertical route [7].

The arborists use a variety of descenders or friction hitches. Table 2 shows the most employed equipment (Figure 2). The results obtained demonstrate a high use of the Zig zag mechanical descender (71.8%) and, although the legislation fosters mechanical systems, friction nodes are still widely used (Valdotain tresse 58.3%).

**Table 2.** Relative use of descenders and reference EN standards (78 answers) and friction hitches (48 answers).

Descender	EN	%	Friction hitches	%
ZigZag (EU) 2016/425	EN 12841:2006	71.8	Valdotain tresse	58.3
	EN 341:2011 Class 2, Type A			
Rig (EU) 2016/425	EN 12841:2006 Type C	30.8	Blake’s hitch	45.8
	EN 15151-1:2012			
	EN 341:2011 Class 2, Type A			
I’D (EU) 2016/425	EN 12841:2006 Type C	25.6	Distel	31.3
	EN 15151-1:2012			
	EN 12841/C			
Druid (EU) 2016/425	EN 341/2A	9.0	Knut	12.5
	EN 15151-1			
Spiderjack	CE EN 358	7.7	Prusik	10.4
	EN 12841/C			
Axel (EU) 2016/425	EN 341	3.8	Machard	8.3
	EN358:1999			
Taz Lov 2(EU) 2016/425	EN12841 Type A/C	1.3	Munter hitch	4.2
Stop petzl en342 (EU) 2016/425	EN 15151-1:2012	1.3	Michoacan - Knut	2.1
	EN 12841 Type A/B/C			
Giant (EU) 2016/425	EN 341/2A	1.3	Swabish	2.1
Hitch Hicker X		1.3		



**Figure 2.** Zigzag descender (on the left) and Valdotaïn tresse (on the right).

The survey has indagated the use of a relative innovative equipment, such as the electric battery powered chainsaws for pruning. The half of the respondents (42 out of 84 respondents) and 5 out of 6 arborists who have just started their career (less than one year of experience) declare to use electric chainsaw either often or always. Electric tools are widespread in all Italian areas, with a prevalence in the Northern West part of the country. Furthermore, it was studied what was the perceived risk in the use of these equipment, asking if the operator considered electric tools having higher, lower or the same degree of danger in comparison with the traditional chainsaws. The most part of the respondents thinks that the two types of chainsaw are equally dangerous, while the 19% consider electric tool less dangerous; 8% of the sample did not have a clear opinion.

#### 4. Conclusions

Arboriculture is a growing subject, especially when referred to the management of trees located in large cities where urban green areas and trees need to be improved, maintained and cared for their strategic role in contrasting climate change and ameliorating the quality of life. However, it seems difficult to find scientific findings on this type of work. Study results also call for more research on urban forest governance and relation between urban green benefits and existing policies (e.g. climate change adaptation, energy policy or health) [12].

In the present study, technical and work conditions of professional arborists operating in tree care and maintenance were indagated by means of a survey carried out at national level.

The sector is characterized by a high level of operator education, training and a high degree of technological innovation both in terms of techniques and tools and equipment. However, some innovations, as for example the battery-powered electric tools, still struggle to fully enter the daily life of climbers, despite the advantages in terms of safety and ergonomics [13].

We have compared the results with a previous survey carried out by Mazzocchi in 2017 [5]. It is possible to observe that operators under the age of forty are 68% in 2017 and 62% in 2020. As regards the job position, a reduction of self-employed workers was observed (44% versus 63%) with an increase in employers and employees (respectively 34% and 17% against 20% and 5%) probably due to the general growth of the business in the sector.

Regarding the employed equipment, the obtained results show a high use of the ZigZag mechanical descender (71.8%) and, in any case, an increase in the use of mechanical descenders which in the past was around 31%. Although the Italian legislation promotes the use of mechanical descenders, clutch systems with knots are still widely used (Valdotaïn tresse 58.3%).

An additional change was observed is the increase in the number of operators having got voluntary ETW certification, which increase from 27% to 32.6%, that denotes an increasing attention to the quality and to the level of professionalism that characterizes the operators of this sector.

Among the techniques of ascent, SRT is clearly preferred (70%) and this may be due to the fact that SRT allows easy ascent and easy descending movements, allowing for a free vertical sight [7].

The figure marks an increase compared to the data collected in 2017 when users were 50% of the sample.

In conclusion, the role of the professional arborist has gone beyond being only a pruner, as training and continuing specialization allow operators to provide tree management services from many domains [14], including that of transforming the pervasive erroneous perception that trees in cities are just an hazard, safeguarding the role of trees in the sustainability of the urban environment [15]. However, further in-depth studies are desirable to improve productivity and safety of this type of emerging work dedicated to the correct management of urban green areas.

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