

A Survey on Rope-Based Ascending Techniques and Materials of Professional Arborists in Italy [†]

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Abstract: The techniques funded for 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 one to operate on trees placed in any location, proving extremely suitable for maintaining trees grown in an urban environment. In Italy, the number of arborists operating with a rope on trees is increasing significantly. 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 from 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, and 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 past years.

Keywords: urban forestry; tree climbing; safety; arboriculture; PPE

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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.

However, urban forestry has a high requirement of workforce activities, so 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 has several advantages compared to 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, and access to trees located in confined areas where machinery cannot

enter [2]. In urban forestry, operating by means of tree climbing is 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 on the technical and economic evaluation of maintenance operation performed by tree climbers appears rather poor. Some authors have studied either the 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 the techniques and material used by professional arborists, a specific questionnaire was developed. First, a focus group was conducted in order to better define the contents of the questionnaire. Five experienced, qualified professional tree climbers (of which one is also an author of this paper) and the three researchers involved in this work participated in 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 content and attitudinal/opinion questions (subjective content). To gather the arborists' opinions, a five-point Likert scale was applied. The questionnaire was divided into 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 Northwest Italy (31%); 21% were from Northeast and 8% from the South Italy. Regarding their nationality, they were almost all Italians (84 of 86). Considering that 62.8% of the participants were less than 40 years old, the tree climbers seem to be quite young workers, especially if the data are 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
Northwest	2	5	6	6	3	3	2	0
Northeast	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 a high general level. Most of the workers (59%) have a high school diploma, which is the third degree of education in Italy, reached after 13 years of school. Furthermore, as many as 17% of the sample have the highest education level (master's degree (5 years) or postgraduate degree, i.e., PhD).

Interestingly, the degree of education significantly differs according to the geographical work area (p -value = 0.01242 after Pearson's chi-square test). In fact, most of

the highly educated people work in Central Italy, while in the Northeast, most of the respondents have a secondary school certificate (Figure 1). This fact is likely due to different job markets in the two areas, the Northeast being a zone with a low number of unemployed having a high level of education.

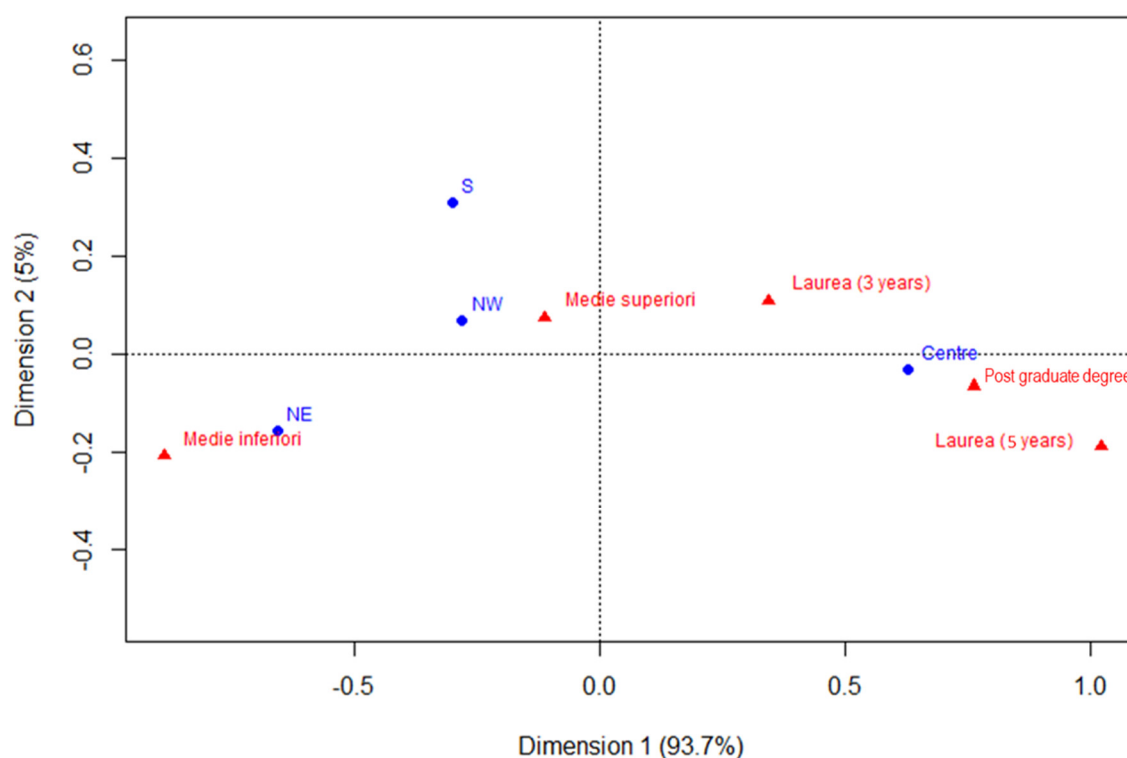


Figure 1. Biplot chart of the correspondence analysis between geographical area of work and level of education (medie inferiori = primary school diploma; medie superiori = high school diploma; laurea = master's degree; postgraduate degree = PhD).

The declared working positions were freelance (44%), company owners (34%), employees (17%), contractors (2%), and members of cooperatives (2%).

On average, the participants have 8.3 years of working activity. However, the activity of operating with a rope to access the tree crown is often only part of the yearly total work. In fact, 60.5% of arborists devote less than 50% of their working time to the tree-climbing activity. Nevertheless, a considerable percentage of arborists (22.0%) operate with a very high degree of specialization for 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 Consolidated Act N. 81/2008 (specific module on rope work on trees: Art.116—annex XXI D.Lgs. 81/08). Surprisingly, 8 of 86 (9.3%) participants declared 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 and safety manager (Directive 89/391/EEC) (attended by 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, 62.9% of the participants attended 4 to 8 courses.

Moreover, a large percentage of the respondents to the questionnaire attended 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 participating in meetings or conferences (60.5%) and reading specialized magazines and journals in Italian (50.0%) or English (32.6%). Updating from sellers of specialized equipment is at 44.2%. Surprisingly, the web is used by only 14.0%. A residual 2.3% indicated tree-climbing championships/competitions as a place for their updating.

At the beginning of their careers, most of the arborists (62.8%) received coaching from experienced colleagues. However, this time was quite variable, ranging from 2–7 days (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 researched by asking the participants why they joined the profession of an arborist. The most influencing motivator for the choice of profession was having studied school subjects related to trees (average score 3.3 on a scale from 1 to 5) even if the percentage of operators having an educational qualification related to arboriculture was only 31%. This choice was followed by job opportunity (3.1/5); by the fact that the arborist was practicing a 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 ascending techniques, most of the tree climbers (70%) use the single-rope technique (SRT), followed by the doubled-rope technique (DdRT, 17%). Some operators use the DdRT with a handled rope clamp and prusik (8%) (especially in Northwest Italy), and 5% state using a climbing spike and adjustable lanyard. Among the techniques of ascent, the SRT is clearly preferred (70%), and this may be due to the fact that the SRT allows easy ascending 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 frequently employed equipment (Figure 2). The results obtained demonstrate a high use of the zigzag mechanical descender (71.8%), and although legislation recommends mechanical systems, friction nodes are still widely used (Valdotain tresse, 58.3%).

Table 2. Relative use of descenders and reference European 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 Valdostain tresse (on the right).

The survey researched the use of relative innovative equipment, such as battery-powered electric chainsaws for pruning. Half of the respondents (42 of 84) and 5 of 6 arborists who have just started their career (less than one year of experience) declared using an electric chainsaw either often or always. Electric tools are widespread in all Italian areas, with a prevalence in the northwestern part of the country. Furthermore, what the perceived risk was in the use of this equipment was studied, asking whether the operator considered electric tools having higher, lower, or the same degree of danger in comparison with traditional chainsaws. Most of the respondents think that the two types of chainsaw are equally dangerous, while 19% consider electric tools less dangerous; 8% of the sample did not have a clear opinion.

4. Conclusions

Arboriculture is a growing subject, especially when referring to the management of trees located in large cities where urban green areas and trees need to be improved, maintained, and cared for due to their strategic role in fighting 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 the relationship 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 researched by means of a survey carried out at the national level.

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

We compared our results with a previous survey carried out by Mazzocchi in 2017 [5]. It is possible to observe that operators under the age of 40 were 68% in 2017 and 62% in 2020. As regard the job position, a reduction in self-employed workers was observed (44% versus 63%), with an increase in employers and employees (34% and 17% against 20% and 5%, respectively) probably due to the general growth of the business in the sector.

Regarding the equipment employed, 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 (Valdostain tresse 58.3%).

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

Among the techniques of ascent, the SRT is clearly preferred (70%), and this may be due to the fact that the SRT allows easy ascending and easy descending movements, allowing for 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 a hazard, safeguarding the role of trees in the sustainability of the urban environment [15]. However, further in-depth studies are desirable to improve the productivity and safety of this type of emerging work dedicated to the correct management of urban green areas.

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