Sustainable urban green management systems: battery powered machines and equipment.

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Abstract

In the last decades a particular sensitivity has developed towards the issues of urban green management and the use of efficient, safe and sustainable use equipment. The present research was aimed at evaluating the performance and technical reliability of battery-powered machines and equipment. We have experimented with machines such as hedge trimmer, lawn mower, chainsaw and brushcutters, ranges created for gardening.

The tests conducted in urban gardens of the city of Matera have highlighted efficient technologies and excellent handling, aspects that contribute to guaranteeing high quality and safety standards.

In particular, the possibility of using a single rechargeable lithium-ion battery, has been shown to produce levels of noise and less vibration compared to the levels generated by equipment driven by internal combustion engines, with operating costs and lower maintenance and environmental sustainability ensured.

1. INTRODUCTION

The "green" within a city or territory is a symbol of a close relationship between man and the natural environment that surrounds him. It represents an organized system of large and small spaces, intended for different uses, where the designer tries to assemble the natural components to the anthropic ones. To get a mixture of situations that can be beneficial to both man and nature.

This consideration in the city of Matera is closely linked to the evolution of a millennial agricultural landscape that has always stood out for an anthropological development that is deeply attentive to the preservation and sustainable management of resources.

In the last twenty years the planning of the green areas of the city of Matera has followed these indications:

- Create environments that fully meet the needs of their users and suitable for the activities they perform
- Satisfy users from a functional and aesthetic point of view
- Modify behaviors, increasing productivity and communication
- Design common spaces that facilitate cooperation, assistance and support among users
- Make buildings easily "legible", facilitating orientation.

It is important to consider that the "green" enters the realization of our cities not only as a furnishing element but above all as an eco-environmental system with a vast range of functions and benefits;

and therefore it is. The creation of green spaces within an urban situation contributes to making the vision of our cities better and to guarantee greater liveability.

Alongside these aspects, however, it is important to evaluate the ways in which plant operations and green management are managed; in fact the use of the machines can have a strong impact on the emission of noise and CO2.

The present study therefore had the purpose of evaluating the use of newly conceived machines as they are equipped with electric motors, replacing endothermic engines.

2. MATERIALS AND METHODS

The trial was conducted in the Villa Comunale of Matera, the European Capital of Culture 2019. The municipal villa occupies a triangular area of about 3850 square meters, was built around the 1930s. It is located in the heart of the city and in an area with a high density of tourism.

Its role is important as a green lung for the city, but also a place for recreation and socializing for adults.

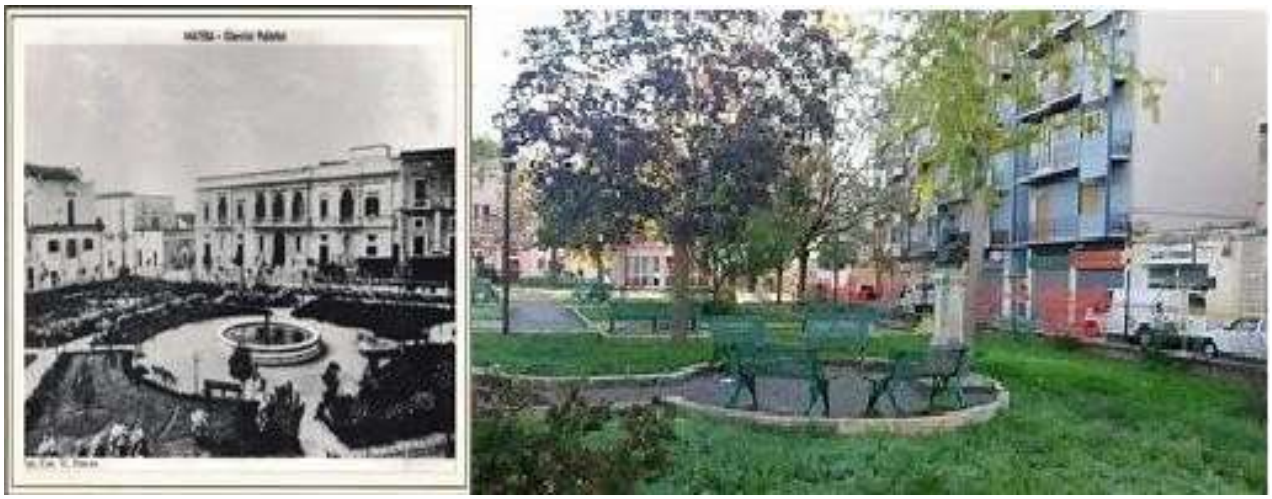

Figure 1 municipal villa of Matera

From the cultivation-landscape point of view, today the villa presents specimens of Mediterranean tree species such as holm oaks, privets, oaks and holly hedges, ivy, laurel cherry, pyracantha and rhododendron.

The tests conducted included the use of two innovative machines powered by lithium batteries

The batteries are supplied with an ergonomic harness, perfectly adaptable to any morphology and have been designed to facilitate daily work, guaranteeing greater autonomy and freedom in the workplace.

Figure 2 Lithium ion battery

The "Ultra Lithium Battery 700" battery develops almost 700 Wh in 3.3 kg of lithium ion elements using the ternary lithium ion (Nickel-Manganese-Cobalt) technology. To develop the same energy, a nickel cadmium battery (Ni Cd) would weigh 13.5 kg, a nickel metal hydride (NiMH) battery would weigh 9.7 kg, a lithium iron phosphate battery (technology for electric cars) would weigh 8.8 kg and a lithium-manganese ion battery (portable power tool technology for the general public) would weigh 6.6 kg. Figure

In particular, the machines used were:

- a Selion range of chainsaws, excellent for pruning tree branches;
- a Helion range hedge trimmer, used for the management of the hedges that are present on the perimeter of the villa.

Selion range of chain saws.

The model used was the Pellenc C20, among the lightest, weighing in fact only 2 kg for the C20. In different models; Pole, Universal or Telescopic, these hedge trimmers improve working conditions, particularly light (from 3 kg to 4 kg), they are equipped with a revolutionary 1200 watt motor. Thanks to the four-speed selector, it is possible to adapt the tool to the type of cut desired; to easily trim, the Pole and Telescopic models are equipped with a 90 ° / -45 ° swivel head, while for vertical cutting, the Universal model has a +/- 90 ° rotating handle. The test involved the use of the Universal Model. The tests conducted inside the villa were carried out during the pruning operations in February for 2 consecutive years. The hedge trimmer has mounted 1/4 "chains during the tests.

Figure 3 Sellion model C20 chainsaw and Helion range hedge trimmer

SELION	C20	HELION	Universal
Peso	2 kg	Peso (con lama da 63cm)	3 kg
Potenza motore	2000 W	Potenza	1200W(1,63ch)
Equivalenza motore termico	45 cm³	Lunghezza in cm (con lama da 63 cm)	110x22X17
Velocità della catena	14,4 m/s	Lunghezza di taglio	51/63/75 cm
Guida della catena PELLENC	12’’– 30 cm	Distanza fra i denti	33 mm
Catena	OREGON ¼’’	Selettore a 4 velocità	SI
Capacità de l serbatoio dell’olio	0,25 L	Cadenza di taglio	da 3200 a 3800 tagli/min
Batteria Consigliate: 700 (in arrampicat POLY 5)	a	Paracolpi antirimbalzo	SI
		Quick Switch	SI
		Paralama di protezione	NO
		Paralama multifunzione	SI
		Impugnatura ruotabile	5 tacche: +/-90°
		Testa di taglio orientabile	5 tacche: +/-90°
		Cinghie di trasporto	5 tacche: +/-90°
		Aggancio per cintura	5 tacche: +/-90°

3. RESULTS AND DISCUSSION

Use of the Sellion chainsaw model C20. The tests conducted allowed the following assessments in terms of performance and safety:

- no ignition problems due to the spark plug, fuel and air filters and carburetor;
- Energy saving; the engine, in direct contact with the cutting tool, had an efficiency close to 90%, with a saving of 32% of oil;
- engine speed: the engine had a speed between 5900 and 6200 rpm without sparks.

- security; safe use has been made possible by:
  - double impulse ignition trigger use of chains with weak rebound.
  - electronically activated rebound sensor: this device instantly activates an electric chain brake in the event of a fall or a rebound (kick-back phenomenon);
  - presence of a tool self-diagnostic system: the ignition can be performed only if the rebound sensor is operational.

Use of Helion range hedge trimmer.

The hedge trimmer has mounted 1/4 "chains during the tests. The tests conducted allowed the following assessments in terms of performance and safety:

- the tool was very easy to handle for the operators, who performed operations with a reduction of the effective time of 20%;
- The cut is accurate without causing defects, this certainly due to the guide of the chain in steel and composite material, which allows torsion flexibility;
- the transport belts and the hooks for the belts with different possible options, have allowed to modulate the use of the tool according to the shape of the operator and the crown to be treated, with consequent greater practicality in the operation and therefore profitability and safety of the intervention.

4. CONCLUSIONS

The experimentation allowed to represent the following conclusive evaluations.

The particularly high efficiency (90%) is associated with the energy consumption due to the battery charging current which has a much lower cost than the supply of two- or four-stroke petrol engines with fuels such as gasoline or petrol. These light, odorless technologies silent, without problems of starting or filling the tank, they are certainly a big drawback compared to chainsaws, hedge trimmers or thermal trimmers that despite being sometimes obsolescent from the technological point of view continue to characterize forest management and urban green areas. Compared to petrol engines, they have a high adaptability to all weather conditions and ensure immediate ignition both when hot and cold. Even the absence of exhaust gases makes it preferable to models with petrol engines, reduced noise levels - in many cases lower than 70 decibels (dB) - make them ideal for use in residential areas, parks, public places, in addition to allowing the use of the equipment without using ear protectors (headphones, ear filters). With battery-powered tools, periodic maintenance of the engine is not needed, with relative checks, cleaning and replacement of the spark plug, air filter, engine oil. In addition, they operate indifferently at different levels of altitude, while petrol engines require carburetion adjustment to the various working elevations. It is certainly worth investigating the phase after use, that is when they are no longer suitable for recharging and it is therefore necessary to think about disposal. During use, the batteries are not dangerous for health and the environment, at the time of their depletion, they must be disposed of according to special precautionary measures; this is a long process, delicate and of fundamental importance, so that these materials are not a threat to our ecosystem and economic benefits can be obtained by recycling.

Surely the study of environmentally sustainable disposal systems represents the real challenge for a completely innovative and alternative use of these machines to those with endothermic engines.

References

Albert, M., (2015). Seven Things to Know about the Internet of Things and Industry 4.0.

Alcaide, A., Palomar, E., Montero-Castillo, J. And Ribagorda, A., (2013). Anonymous authentication for privacy-preserving IoT target-driven applications. Computers & Security, 37, pp. 111-123.

Axmann, B., (2016). Digital factory industry 4.0 (motivation, challenges and solutions). ZWF Zeitschrift fuer Wirtschaftlichen Fabrikbetrieb, 111(3), pp. 143-147.

Azuma, R., Furmanski, C., (2003). Evaluating label placement for augmented reality view management. The Second IEEE and ACM International Symposium on Mixed and Augmented Reality, 7-10, IEEE, pp. 66-75.

Baban, A., (2016). Industry 4.0: The entrepreneurial perspective. Industria, 37(3), pp. 387

Biocca, M. (2007). Macchine ed attrezzature per il verde urbano. CRA-ISMA.

Biondi, P. (1999). Meccanica agraria. UTET, Torino.

Bodria, L., Pellizzi G., Piccarolo P., (2013). Meccanica e Meccanizzazione Agricola. Edagricole, Bologna.

Camilli, G., (2013). Veicoli Elettrici opportunità e prospettive,ANIE Innovation Cloud, Milano.

Cardinale D., D'Antonio P., Moretti N., Scalcione V N , (2020). Risk perception in forest utilizations: experimental analysis in the Basilicata forest sites, Journal of Forestry, wild life and Environment, Vol. 1, Issue 1.

Chalk, S. G,. Miller J. F., Power Sources J., (2006). Key challenges and recent progress in batteries, fuel cells, and hydrogen storage for clean energy systems, vol. 159, no. 1, pp. 73 80.

Cook, E.A., Van Lier H.N., (1994). Landscape planning and ecological networks, Elsevier, Amsterdam.

D'Antonio P., Scalcione V. N., (2020). Digital Humanities: ICT for a Teaching of Inclusion, Agricultural Research & Technology, , Volume 23 Issue 4.

D'Antonio P., Scalcione V. N., Romano F., (2020). The use of satellite technology for digital citizenship: experimental tests and investigation methods, International Journal of Food Science and Agriculture, Vol. 4, Issue 1.

Delfanti, M., Chiesa, V., Bertlè, U., (2013). Smart Grid Report, sistemi di storage ed auto elettrica,

Eigner, M., Muggeo, C., Apostolov, H., Schäfer, P., (2016). Kern des system lifecycle management: Im kontext von industrial internet mit industrie 4.0 und internet der dinge und dienste. ZWF Zeitschrift fuer Wirtschaftlichen Fabrikbetrieb, 111(1-2), pp. 63-68.

Hernández, J., García, L., Ayuga F., (2004). Assessment of the visual impact made on the landscape by new buildings: a methodology for site selection. Landscape and Urban Planning 68 (2004) 15 28

Hernández, J., García, L., Ayuga, F., (2004). Integration Methodologies for Visual Impact Assessment of Rural Buildings by Geographic Information Systems. Biosystems Engineering (2004) 88 (2), 255 263.

Hubert, N. van Lier., (1998). The role of land use planning in sustainable rural systems. Landscape and Urban Planning 41 1998 83 91.

Peruzzi, A., Sartori L. (1997). Guida alla scelta ed all'impiego delle attrezzature per la
Sereni E., (1961). Storia del paesaggio agrario italiano, Laterza, Bari.
Sumner, P. E., Jay Williams E., (2013).What Size Farm Tractor Do I Need?", University of Georgia.
Tassinari P., (2008). Le trasformazioni dei paesaggi nel territorio rurale: le ragioni del cambiamento e possibili scenari futuri. Approfondimenti interdisciplinari per la salvaguardia, la gestione e la pianificazione, Roma, Gangemi Editore.