eco

ECOLOGICAL STEAM WEED CONTROL

eco PICK-UP

- ✓ **innovative**
- ✓ **no pesticides**
- ✓ **3 functions:**
  - Steam weed control
  - High pressure washing
  - Electricity generator
- ✓ **4 models**

ECO TREATMENT

WWW.MMSPRAY.IT

eco PICK-UP

DE-MOUNT AUTONOMOUS MACHINES
FOR HIGH PRESSURE WASHING,
DISINFECTION AND WEED CONTROL.

Many years of experience in the design and manufacture of spraying machines and high pressure washers, combined with the spirit of innovation featuring “M.M.”, led to the creation of the new **ecological line** of multi-purpose machines for weeding, disinfection and high pressure washing with respect of the environment.

> *The versatility of this machine appears to be an investment more than reasonable for a device that offers many possibilities and that can be used during the whole year with a minimum cost of maintenance.*

MAIN FEATURES

ECO PICK-UP 500
ECO PICK-UP 1000

Two models for a multi-purpose machine designed to perform different types of works that can be summarized in the following functions:

1. steam **weed control**
2. steam **disinfection**
3. **high pressure washing** with **hot water**
4. use of an **independent source of electric power** at 230V

EASE OF TRANSPORT

It can be easily transported on trucks, truck flatbeds and trailers where such means are compliant and can support the weight of the machine *(470 Kg empty, from 1100 to 1600 Kg at full load).* The machine is **easily lifted** and **placed** on the vehicle through a standard fork lift equipped with forks. It must be **firmly secured** on the **truck bed** with the points provided.

HOW IT WORKS

MM ECO PICK-UP draws the cold water contained in the tank (500 or 1000 liters depending on the version) sending it under pressure (20 or 80 BAR depending on the use) to a double coil boiler.

An oil burner heats the water until the desired temperature is reached by the operator (50-80°C in “washing mode”, 120-140°C in “weeding-disinfection mode”.

The action on the lance trigger starts the burner that heats the water as needed.

The transition between “weeding mode” to “washing mode” and vice versa is usually done in a few seconds, the technical time to adjust the temperature.

1 STEAM WEED CONTROL

Thanks to the production of steam at 140°C it can be used without risk of fire for the weeding of:

- gravel surfaces
- paved surfaces
- sidewalks
- driveways
- roads
- rest areas
- parks
- squares
- flowerbeds with mulch
- sport facilities
- cemeteries

eco PICK-UP

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2 ✓ DISINFECTION

Thanks to the production of steam at 140°C, **MM ECO-PICK UP** can also be used for the disinfection of **public toilets** and in **farms** such as kennels, sheepfolds, stalls, piggeries etc...

3 ✓ HIGH PRESSURE WASHING

MM ECO-PICK UP is a **self-pressure washer**. Thanks to a pressure of 80 BAR at 80°C and to the nozzles provided, it is suitable for the **cleaning of vehicles**, **buildings**, **monuments**, **urban furniture** (removing of chewing-gum, graffiti etc...) and **external surfaces**.
A rotating brush is included for an effective **cleaning of road signs**.

4 ✓ GENERATOR

MM ECO-PICK UP is equipped with a silenced, independent and retractable **generator** of 3000W that can be used separately for the use of various power tools.

STEAM WEED CONTROL

BEFORE TREATMENT

The STEAM WEED CONTROL is a modern and environmentally friendly means for the treatment of the areas subject to the growth of weeds without risk of fire.

The main advantage is the **absence of harmful and toxic residues on the ground.**

The absence of chemicals (pesticides and plant protection products) for which the use is increasingly limited except that prohibited, allows weeding **respecting the Environment.**

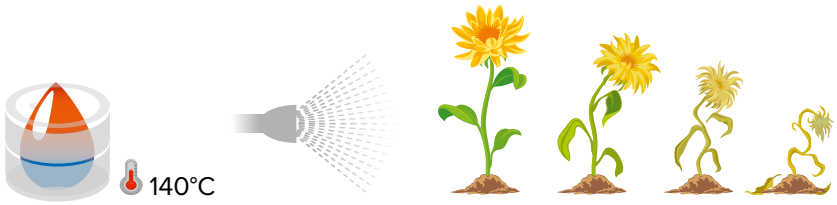
AFTER 1 HOUR

The heat emitted from the unit in the form of steam causes a thermal shock to the plant destroying cells.

The effect is immediately visible and the plant dies after a few days.

After some regular passages the plant will no longer have the strength to regrow and will finally disappear.

AFTER 3 DAYS



ECO TREATMENT

eco PICK-UP

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FOR HIGH PRESSURE WASHING,
DISINFECTION AND WEED CONTROL.

THE CONTROL PANEL

The control panel -simple, clear, ergonomic and completely safe- allows the operator to immediately become familiar with the operation of the machine.
The warning lights of the water level, fuel level, safety contactors provide the use of the machine without risk.
In case of lack of water or shutdown of the generator the machine will automatically shut down and the reserves will allow the operator to turn on the machine, lower the temperature and safeguard the life of the machine itself.

MM ECO PICK-UP

MM ECO PICK-UP has also been designed for the simultaneous work of **two** operators.
The operators can work safely thanks to the two lances fed by 20 m of insulated pipe mounted on two automatic stainless steel hose reels with spring recovery.

The complete casing of the machine and the super-silenced generator allow noise **levels less than 57 dB**, ideal for use of the machine in towns and public places.

ECO PICK-UP 1000 provides the operator with an autonomy of **3 hours in "weeding mode"**.

Once the water tank will be empty, it will be sufficient to fill the tank and the machine will be immediately ready for use.
The capacity of the fuel tanks is sufficient to carry out a full working day.

ACCESSORIES

THE MACHINE COMES STANDARD WITH:

- two aluminum shields complete with nozzles for weed control
- a 40 cm boom for weed control and disinfection
- two nozzles for high pressure washing
- a rotating brush for the cleaning of flat surfaces.

ALUMINUM SHIELD

40 CM BOOM

40 CM S.S. BOOM ON WHEELS

TECHNICAL DATA

ENGINE	
ENGINE	Petrol engine type Honda with electric and/or manual start with fuel tank for 7/8 working hours on silenced generator of 57 dB at 7 m
ALTERNATOR	120V 3000W max

BURNER	
CAPACITY	250.000 btu/h (75,6 kW)
CONSUMPTION	5.0 L/h
DIESEL TANK	45 L for about 8 hours of heating use at max. temperature
BURNER	230V
PRESSURE PROTECTION	Safety valve
MAX TEMPERATURE	140°C
TEMPERATURE FROM THE LANCE	110-125°C (depending on the external temperature)
COMBUSTION QUALITY	Less than 400 ppm of CO Opacity under 2

PUMP AND HOSE REELS	
TYPE	High pressure pump with 3 ceramic pistons and brass head.
MODEL	Annovi Reverberi SXM 15.20 15 LPM 80 BAR max
Rpm	1450
PRESSURE REGULATOR	20-80 BAR.
HOSE REEL	2 spring automatic S.S. hose reels
HOSE	2 reels of 20 m each of insulated pipe
LANCE AND GUN	2 lances of 120 cm with steam nozzle and shield

GENERAL INFORMATION	
DIMENSIONS OF THE CHASSIS	mm 1020x1700x1160 (LxWxH) - with 500 L tank mm 1020x2100x1600 (LxWxH) - with 1000 L tank
DRY WEIGHT	kg 470 (1000 L tank)
WEIGHT FULL LOAD	+/- kg 1600 (1000 L tank) +/- kg 1100 (500 L tank)
WATER CONSUMPTION	from 3 to 8 L/min with 1000 L tank 15 L/min for high pressure washing

ECO TREATMENT

Also available with battery power.

8 hours of AUTONOMY!

STANDARD ACCESSORIES

- **1** 4-nozzle **manual boom**
- **1 nozzle** for high pressure washing **for one lance**
- **2 nozzles** for high pressure washing for **two lances**
- **1 rotating brush**
- **1 descaling kit**

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The machine is certified according to the Machine Directive by an independent certification body.

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Agrion
Agricoltura ricerca innovazione

Functional techniques for weed control with environmentally friendly methods in non-agricultural areas

Foundation for research, innovation and technological development in Piedmontese agriculture
Via Faliceto, 24 12030 Manta (CN)
Tel 0175.1953030 VAT/CF 03577780046

Public awareness of nature and environmental sustainability has increased greatly in recent years. In urban areas, green areas are a flagship for administrations and, more and more often, events are organised in these corners of nature within cities.

The management of these areas has not always been so careful and respectful of the environment, but the EU regulations recently transposed at national and regional level have brought about a greater awareness and are leading to a change in the rota. EU Directive 2009/128/EC, transposed into national law with Legislative Decree No. 150 of 14 August 2012 and taken over by the Piedmont Region with D.G.R. 25-3509 of 2016, establishes a framework for the sustainable use of fitosanitary products, in order to reduce the risks to the environment and human health associated with their use. The priorities are human health, the environment and biodiversity in specific areas such as protected areas and those frequented by the population and vulnerable groups (children, the elderly, etc.).

This is an important challenge for municipalities and green operators in public places. In fact, the use of fitosanitary products is not only limited to the agricultural sector, as is often thought, as agropharmaceuticals are normally also used in urban green areas (parks, public gardens, sports fields, recreational areas and courtyards of schools and hospitals, etc.), and along roads and railways mainly to control spontaneous weeds that, besides being unattractive, can damage roads, reduce visibility or cause allergies in the population. Recently introduced regulations have established considerable restrictions on the use of fit in areas frequented by the population, with a heavy impact on the activities of the various bodies that manage parks and gardens, as well as the railway network, motorways and the road network, and sports centres.

In particular, Article 12 of EC Directive 2009/128 stipulates that in areas frequented by the population or vulnerable groups, and in agricultural areas adjacent to them, the use of fit-sanitary products must be minimised or prohibited. Among the measures that can be adopted are the use of low-risk fito-sanitary products, as defined in Regulation 1107/2009, and those for biological control. Current legislation, in particular, provides for the use of alternative means (mechanical, fixing, biological) or alternative approaches, the reduction of application doses, and the use of techniques and equipment that minimise dispersion in the environment.

The Piedmont Region, like other regions such as Veneto, Lombardy and Emilia Romagna, has issued specific guidelines regulating the use of fitopharmaceuticals on their territory to achieve three objectives:

- reduction of risks and damage to human health and the environment;
- reduction and rationalisation of chemicals;
- promotion and development of integrated and organic pest management.

The Regional Guidelines for the use of fitosanitary products in areas frequented by the population or vulnerable groups and in agricultural areas adjacent to them, constitute one of the regional implementing provisions for reducing the use of fitosanitary products in specific areas, in accordance with paragraph A.5 of the NAP (National Action Plan). In particular, with regard to the management of flora infestans, the

NAP requires local authorities for pest flora management to identify areas where chemical means are forbidden, with particular attention to areas frequented by vulnerable groups, and areas where chemical means may only be used within an integrated approach with non-chemical means and a multi-annual planning of interventions, referring to areas frequented by the population.
Therefore, differentiated management of the different areas must be envisaged, taking into account the protection of the population and public health, the environment and water, the degree of naturalness to be maintained, and technical-economic feasibility.

Weed control in areas frequented by vulnerable groups can be effected by: mulching, manual weeding, hand weeding, brush cutters, mechanical arm with shredder tool, rotary brush equipment or even fixed means such as pyro weeding, steam weeding, hot vegetable foam. Chemical weeding is normally prohibited in areas frequented by vulnerable groups. The use of herbicides is allowed, by way of derogation, only in areas where alternative solutions are not feasible. In all areas, aspects of urban decorum and special situations (e.g. the need to control allergenic plants) must also be considered. In all cases, the techniques, methods and times of intervention that allow the doses of chemical use to be limited must be used.
With a view to complying with newly introduced regulations, many administrations now need to experiment with techniques and products that are safer for citizens and the environment, while also taking into account their economic sustainability. Precise information is therefore needed on techniques and products that can enable functional weed management in terms of both environmental and economic sustainability.

In order to give operational support to the regional guidelines and provide local municipalities with the necessary tools for optimal implementation of the regulations, the Agrion Foundation conducted an experiment in urban areas in collaboration with the Municipality of Saluzzo and the Consorzio Servizi Ecologia e Ambiente (SEA Consortium). The activities were carried out with the advice of Prof. Aldo Ferrero (Department of Agricultural, Forestry and Food Sciences of the University of Turin), thanks to the financing granted by the Fondazione Cassa di Risparmio di Saluzzo and thanks to the collaboration of Massimo Zanini of Agrigarden sas (Villanova Canavese). During the experimental period, a number of alternative techniques were evaluated for the containment of weeds that were considered valid and sustainable in different environmental contexts and where there are different types of technical artefacts in which traditional fixing and mechanical methods are more difficult to use.
Thanks to the collaboration of the municipality's technicians, the most difficult to use fixed and mechanical methods were identified and where, with the operations carried out, the inconvenience to the community of residents was minimised.
In order to also raise awareness among farms and to be able to offrire effiacceptable tools for weed control, with a view to reducing the use of fitosanitary products in agriculture, the same products were used in the Foundation's orchard to verify the efficacy of containment.
The fitosanitary products used for the trial were chosen from the 'Green List'.

(Pesticide products that can be used in areas frequented by the population and vulnerable groups in to the provisions of the NAP) drawn up by the Regional Phytosanitary Sector and are assessed with a 'High Margin of Safety' by the Istituto Superiore di Sanità.
The following products were identified:

- products based on pelargonic acid, a natural substance of plant origin with herbicidal action that destroys the leaf cuticle and cell wall;
- products based on Flazasulfuron, an active substance with desiccant and residual action based on a sulphonylurea with low environmental impact, with no risk for the user and the public. Efficaceous for up to 7 months, with very low application doses of 200g/ha and authorised in areas not used for agricultural crops: railroads, industrial areas, civil areas and works (historical ruins, cemeteries, yards, roadside verges), urban and agricultural non-cultivated areas.

Mechanical and fixed methods were tested:

- the pyro H-AIR, a technique that uses the heat generated by a fire burner fed by a propane gas cylinder and hot air;
- steam weeding, a technique that employs steam at 140° and pressure of 20 to 80 bar obtained by heating water in a double coil boiler, which is then vaporised with lances of different types (bell or bar).

In addition, where possible, mowing was carried out with a brush cutter, a means already known but whose use to date is considered very expensive, in order to compare its functionality with the above methods, both in terms of efficacy and in terms of the duration of weed control.

Project activity and methodology

The trial focused on verifying the weed control capacity and the duration of control, since the number of interventions required during the year and therefore the costs are determined on the basis of the latter. Surveys were conducted on the experimental plots to verifiy soil cover and plant development.

Working time

The verification was effcarried out over the entire season (May-October) in order to be able to quantify, in addition to the efficacia, the total costs to be incurred for weed management over the entire season.

Application

The products and techniques adopted were applied, under the control of the technical manager of the project, with the mechanical means normally used by the companies that perform these services on behalf of the Municipal Administrations whenever each thesis was found not to be acceptable for urban decorum.

Experimental parcels

The experimental verification was conducted in the following city

1st Replica

A street in the historic centre, Via Santa Chiara (Castiglia area) with cobblestones along the entire road axis from the exit of the subway to the crossroads leading to the Church of San Giovanni). This type of road surface covering, characterised by fibroken cobblestones and therefore not flat but with screwing around each cobble, was chosen because of the operational difficulties encountered with the use of mechanical means. In fact, the brush cutter's file does not reach the base of the weeds and these, after mowing, grow rapidly with their root system intact.

The size and development of the road axis made it possible to apply the comparison theses provided by the project with three repetitions per thesis and its untreated witness. As there are no direct accesses to areas with residents in this **layer**, it is less problematic to plan the closure of the road axis when effecting the applications.

Theses envisaged:

A fixed media - steam weeding;

B fixed media - pyro weeding;

C use of Green List chemical (pelargonic acid);

D Use of chemical media in Green List mix (Flazasulfuron + Ac. Pelargonicum);

E - use of chemical means with residual action on the Green List (Flazasulfuron).

2nd Replica

Avenue inside the Municipal Cemetery with self-locking paving stones and gravel frontage towards the funerary artefacts. The choice of this site was made because these sites, frequented by vulnerable groups, are often managed by cemetery custodial staff and not by public greenkeepers. This often results in a lack of knowledge about bans on the use of certain chemicals and sustainable alternatives that can be used in weed management.

The dimensions, the development of the avenue and the characteristics of the identified artefact, allowed for the application of the comparative theses foreseen in the project with three blocks per thesis and its untreated witness. Planned theses:

A - fixed media - pyro weeding;

B - use of the chemical medium on the Green List (pelargonic acid or similar);

C - use of chemical mixtures from the Green List (Flazasulfuron + Ac. Pelargonicum); D - use of chemical residuals from the Green List (Flazasulfuron).

In this replica, the mechanical thesis could not be included due to the presence of gravel, which, given the high speed of the brush cutter head, can be thrown and cause damage to the funerary artefacts or their glazing.

The thesis using steam could not be included due to the size of the machine. The one used is so large that it has to be transported in a van, which does not allow access to the vents.

3rd Replica

Via G. Boeto pedestrian walkway at the junction with Via Propanoto (industrial area) with asphalt and kerbs separating it from the road axis to the extent necessary to create three thesis blocks and related untreated witness.

Theses envisaged:

A - mechanical means - brush cutter; B

- fixed means - weed whacker;

C - fixed media - steam weeding;

D - use of the chemical medium prescribed by the Green List (pelargonic acid or similar);

E - use of chemical mixtures from the Green List (Flazasulfuron + Ac. Pelargonicum); F - use of chemical residuals from the Green List (Flazasulfuron).

4th Replica

The experimental agricultural trial was carried out at the Agrion Foundation's premises in the experimental orchard, located in Manta (via Faliceto n.24), where the sub-field was treated, as is customary in integrated pest management, to make two blocks per thesis and the relative untreated witness. The applications were carried out as is customary in order to keep the sub-flare free of weeds and use low quantities of fitosanitary products.

Theses envisaged:

H - use of chemical medium Pelargonic acid KATOUN GOLD;

C - use of the chemical medium stipulated by the Green List Pelargonic acid FINALSAN PLUS;

D - use of chemical mixtures on the Green List (Flazasulfuron + Ac. Pelargonicum); E - use of chemical residuals on the Green List (Flazasulfuron);

F - use of the chemical desiccant medium (Carfentrazone); G

- use of the chemical medium acetic acid.

Organisation of controls

For each thesis, several randomised plots of a significant size were organised where the controls could be carried out. The controls were carried out by throwing a square frame (50x50cm or 100x100cm depending on the surface area available) within which the surface area covered by weeds was estimated and the species present were identified and counted. At each control, any resistance found was noted. The third site, consisting of an asphalt pavement bordered by stone kerbs, showed weed growth in the intersections between the asphalt and the kerbs, so the measurements were conducted over a linear length and not over the area of the square.

The applications were repeated according to the vegetation containment detected with the controls.

Results

Given the variability of the floristic composition and superficial coverage linked to the type of pavements

choices, it was appropriate to analyse each site separately, although the techniques used have had comparable outcomes.

1st Replication - Old Town Street Via Santa Chiara (Castiglia area) with cobblestones

Intervention was carried out on 14 June 2018 on all theses and was repeated where deemed necessary on 31 July, i.e. in the

fixed fields - steam weeding;

- Green List chemical (Pelargonic acid);
- use of chemical mixtures from the Green List (Flazasulfuron + Ac. Pelargonicum).

It is important to report some observations linked to the conditions of the plot, in which the edges of the road are bordered by brick walls that shelter the first part of the pavement from the sun, favouring weed growth in this part. Approximately 50 centimetres from the walls and across the entire width of the carriageway, on the other hand, weed growth was rather low for the entire period of the trial. It was therefore decided to effcarry out the surveys: one on each side of the road and one in the central part, since in these parts it is more difficult and therefore significant for the experimental purpose, the containment of weeds. The graph below shows the average amount of ground cover detected in the three surveys carried out in each of the three repetitions (plots).

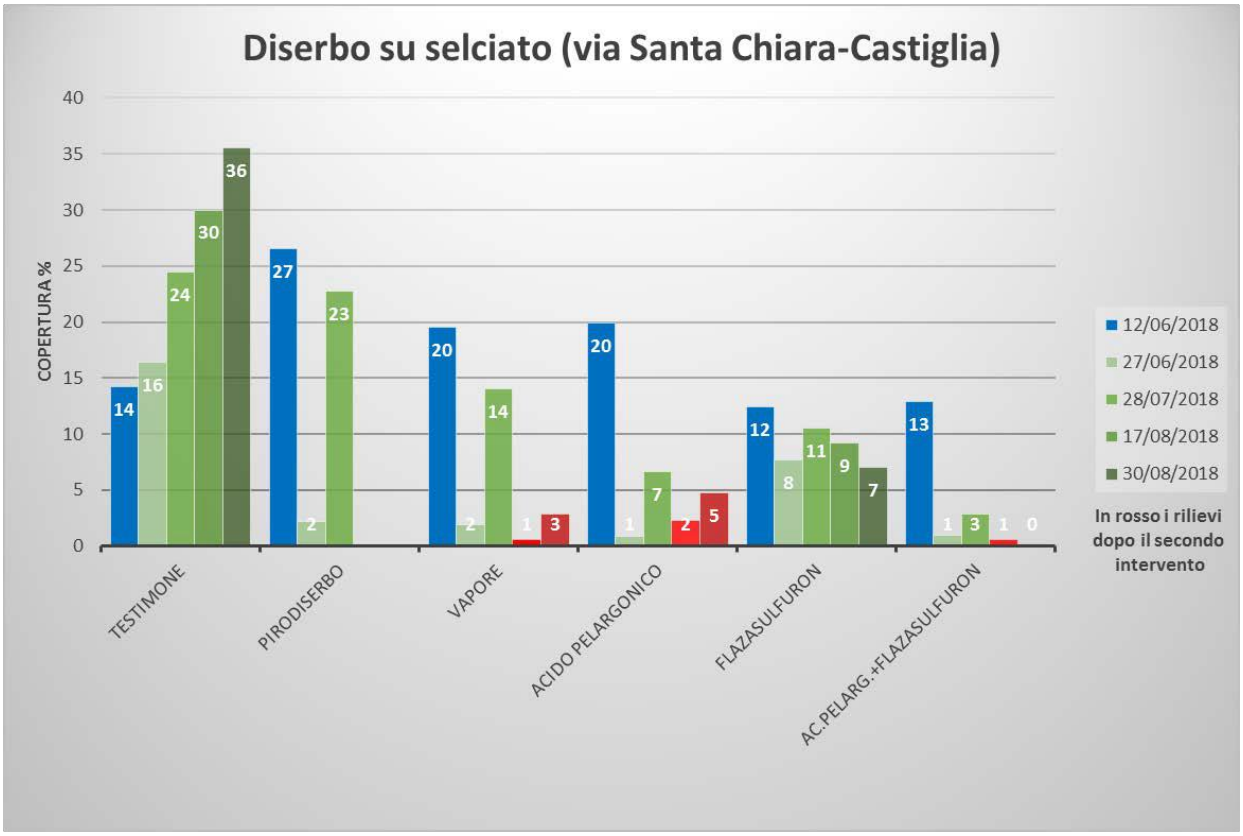
The percentage of cover, measured in the different theses, was used to assess the weed control capacity of each of the techniques used, i.e. how quickly, after treatment, the surface was again covered by weeds. It can be seen from the graph below that in the 'pyro weeding' thesis the average coverage after 2 weeks was about 2%. It can be assumed that in some plants only the aerial part was desiccated and not the root system, which allowed a faster restart. Approximately 45 days after the intervention, the cover returned to its pre-treatment value. It would have been necessary to repeat the intervention to contain the weeds until the end of the trial, but it was not possible to repeat the intervention for logistical reasons. In the "steam" thesis, as in the previous one, after 2 weeks the coverage is 2%, probably because, as the steam effect is localised to the point where the bell insists, the operator's accuracy must be high in order not to leave seedlings that will develop rapidly. It is important to note that even the most developed weeds (around 30 centimetres in height) present in the plots did not grow back after the steam treatment.

The plot treated with pelargonic acid had 1% coverage after two weeks and after 45 days 7%. It was decided to repeat the treatment in order to arrive at the end of the trial period, i.e. at the end of August, with a coverage of 5% of the surface.

The following histograms show the results of the thesis treated with Flazasulfuron for which only one treatment was made in mid-June due to the long persistence. The initial coverage was 12 % and was

maintained between 11 and 7% until 30 August, the date of the last survey. It should be noted that the treatment was similar to that of the witness (14%), which reached 36% at the end of August, suggesting a good containment of dicotyledons by the residual action of Flazasulfuron, while the coverage observed throughout the period was given by monocotyledons that were not sensitive to this molecule and which naturally declined at the end of the season due to the heat and drought.

In the last thesis, pelargonic acid and Flazasulfuron were used as the first treatment in June in combination, bringing coverage from the initial 13% to 1% after 2 weeks and 3% after 45 days. In this case, too, a second treatment was opted for in order to obtain a better containment evaluation, which made it possible to arrive at the end of August with a completely weed-free surface.



Graficure 1. Average vegetation cover per square metre measured at the experimental site in Via Santa Chiara - Saluzzo

2nd Replication - Avenue inside the Municipal Cemetery with self-locking paving stones and gravel frontage

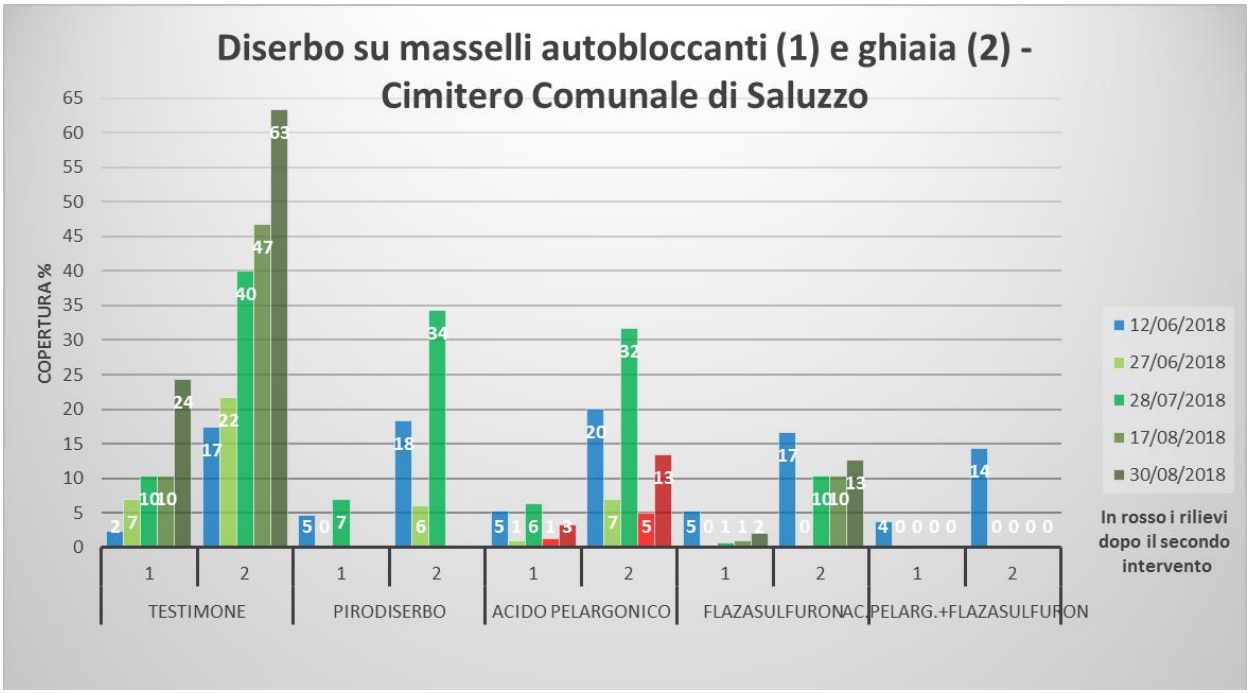
Interventions were carried out on 14 June 2018 on all theses and the intervention was repeated where deemed necessary on 31 July, i.e. in the thesis:

- Green List chemical (pelargonic acid).

The second site has two different substrates: the first, consists of self-locking boulders where weeds grow in the spaces between the boulders and indicated in the diagram by the histograms above the numbers 1 and 2, is the part in front of the funerary artefacts covered with fine gravel.

It is interesting to note that in the first 2 theses (pyro weeding and pelargonic acid) the coverage was already 6% after 2 weeks and after 45 days had practically the same value as in the witness. After the survey at 45 days it was deemed necessary to repeat the intervention to contain the weeds. In the 'pyro weeding' thesis it was not repeated, although necessary, for logistical reasons.

In the other two theses, on the other hand, the use of Flazasulfuron enabled good containment throughout the period from June to August. It can be seen that in the thesis where only Flazasulfuron was used, this did not completely eliminate the plants present, but did prevent their development and the establishment of new ones. In the second thesis in which Flazasulfuron was used in combination with pelargonic acid, the plants present were completely eliminated and no new ones grew.



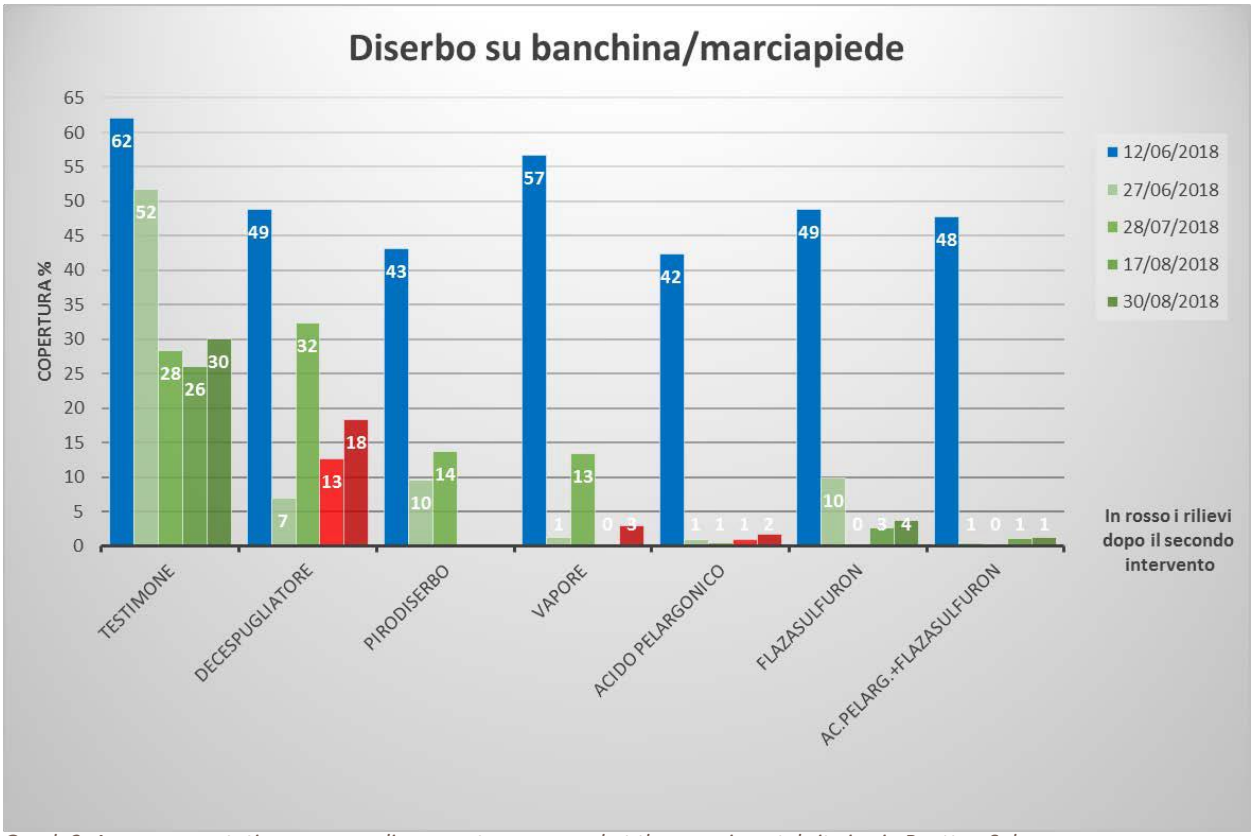
Graph 2. Average vegetation cover per square metre measured at the experimental site within the Municipal Cemetery - Saluzzo

3rd Replication - Via G. Boeto pedestrian quay at the junction with Via Propanoto (industrial area) with asphalt and stone kerbs

Interventions were carried out on 14 June 2018 on all theses and were repeated where deemed necessary on 31 July:

- mechanical means - brush cutter;
- fixed means - steam weeding;
- Green List chemical (pelargonic acid).

The third site, consisting of an asphalt pavement bordered by stone kerbs, showed weed growth in the intersections between the asphalt and the kerbs. Given the poor shading and the summer heat insisting on the plots, it is possible to observe from the graph below how, in the untreated plot from June to August, the cover tended to reduce naturally, thus favouring weed control in all theses. Observing the surveys of each thesis, it is possible to note how the mechanical thesis and the two physical theses recover slowly after treatment, in particular the pyro weed control and the steam weed control have approximately one third of the witness coverage in the survey of 28 July and the thesis where the brush cutter was used has approximately double the coverage of the others.
In the last survey, at the end of August, it can be observed that in the mechanical thesis, after 2 interventions, the average coverage was 18% while the steam-treated thesis 3%. In the thesis using pyro H-AIR it was not possible to repeat the intervention for logistical reasons.
Looking at the last three series of measurements, it is immediately observable that, following the first intervention, the coverage remained very low, with the exception of the Flazasulfuron thesis, where the reduction was more gradual due to the different mechanism of herbicidal action of the active ingredient and the selectivity towards weed species.



Graph 3. Average vegetation cover per linear metre measured at the experimental site in via Boetto - Saluzzo

4th replication - Experimental agricultural trial carried out at the Agrion Foundation's premises in the experimental orchard, located in Manta (via Faliceto n.24)

Interventions were carried out on 14 June 2018 on all theses and were repeated where deemed necessary on 16 July:

- H - use of chemical medium Pelargonic acid KATOUN GOLD;
- C - use of the chemical medium stipulated by the Green List Pelargonic acid FINALSAN PLUS;
- D - use of chemical mixtures from the Green List (repeat only with Ac. Pelargonic);
- F - use of the chemical desiccant medium (Carfentrazone);
- G - use of the chemical medium acetic acid.

Graph 4 shows, broken down by thesis, the average coverages of the theses tested in the orchard with environmentally friendly products with a high margin of safety.
As a first look at the results, it is interesting to observe the comparison of the efficacy of the two pelargonic acid-containing formulations:

- Finalsan, a prodrug containing pelargonic acid at a concentration of 18.5% and maleic hydrazide. The latter molecule facilitates the translocation of the acid into the leaf cuticle, causing deeper damage to plant tissue.
- Katoun Gold product containing 51.9 per cent pelargonic acid.

The two products were used, as stated on the label, at doses of 20% and 10% respectively.

Coverage was, after 32 days from the first treatment, 54% and 63% respectively, and at the end of August after the second treatment, eff carried out on 16 July (about 45 days from the first treatment) 35 and 65% respectively. In both theses, resistance of some monocotyledons to pelargonic acid was observed.
In particular, the different coverage found between the two theses can be justified by the consistent presence of *Cynodon dactylon* in the thesis treated with Katoun Gold. This species, commonly known as couch grass, proved resistant to almost all the techniques used, producing shoots from the rhizomes very quickly compared to other weeds.
Graphs 5 and 6 below show the floristic composition of the two theses in which a preponderance of monocotyledons, particularly the species *Cynodon dactylon, is* visible in the thesis treated with Katoun Gold.
From graphs 5 and 6 it can be seen that the monocotyledon group, in the H thesis, consists of *Cynodon dactylon, Poa spp., Festuca spp., Digitaria Sanguinalis, Setaria spp. and Echinocloa Crus Galli*, which together form 76% of the flora. In thesis C, the monocotyledons present are: *Echinocloa Crus Galli, Digitaria Sanguinalis, Cynodon Dactylon, Poa spp* that altogether make up 41% of the flora.
It has been observed that Pelargonic Acid in some species such as *Festuca, Cynodon and Echinocloa is* not able to completely desiccate the plants except in the early stages of development, a practice, however, that would require a frequency of intervention too close together to be sustainable.

The other theses tested employed different active ingredients, such as Flazasulfuron, the combined thesis (Pelargonic acid and Flazasulfuron), Carfentrazone and acetic acid.
In the Flazasulfuron thesis, as can be seen in the graph below, the coverage increases from 13% (14 days after the intervention) to 43% at 32 days and remains so until the last survey at 76 days. The increase in coverage is due to the selectivity of the molecule, which allows certain species to proliferate without being affected by the residuality of the product. However, it is possible to appreciate from the graph how, with a single intervention, the average coverage remained fixed at less than 50% compared to the witness until the end of August.
The combined thesis, Pelargonic acid and Flazasulfuron, at this site shows good weed control capacity, although not as efficient as observed in urban theses. In the survey 32 days after the first intervention, coverage was in fact 35% and in the subsequent survey 46 days after the second intervention, 43%. Not significantly different from the previous thesis in which only Flazasulfuron was used.

The last theses in which Carfentrazone and acetic acid were used, respectively, did not yield significant results, generating a slowdown in weed growth that was not able to reduce the plot cover as can be observed in the graph below.

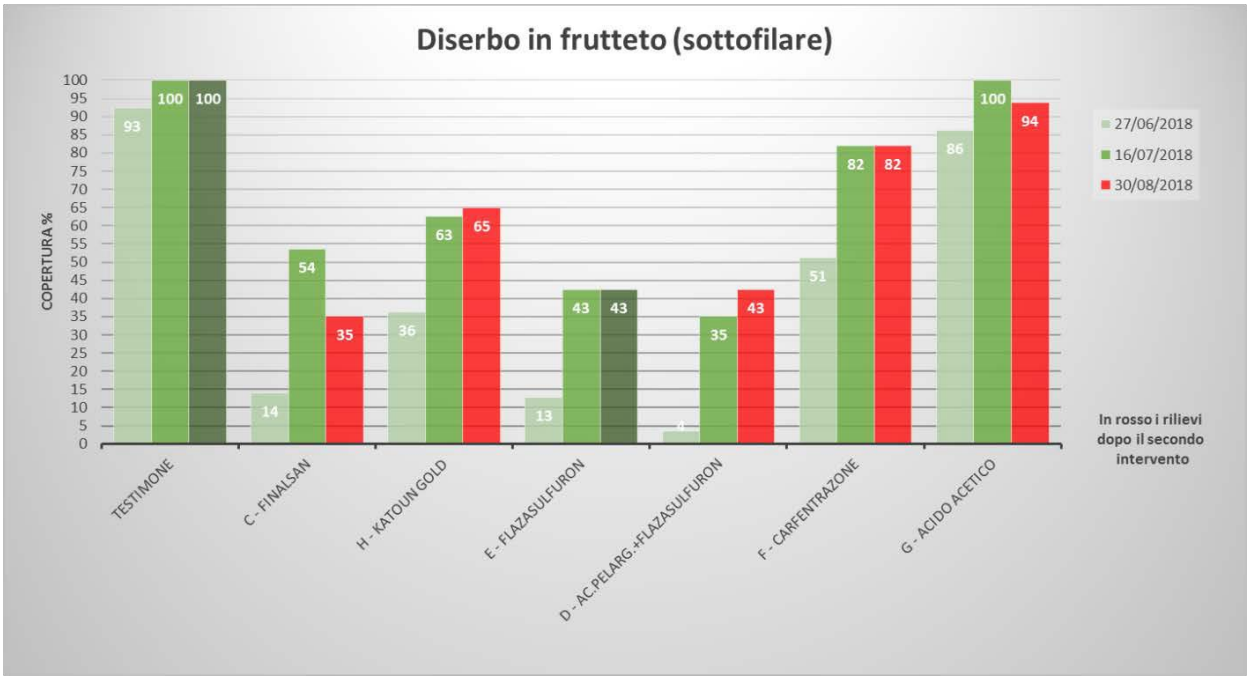
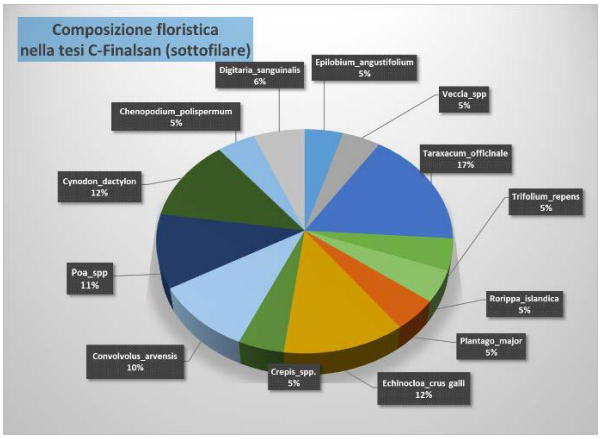
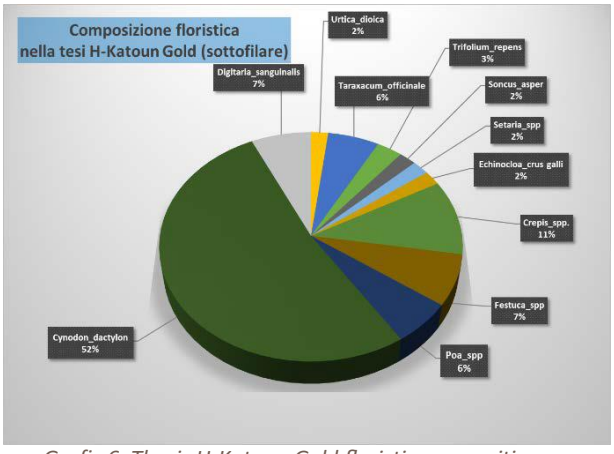


Figure 4. Average plant cover per square metre measured in the experimental orchard of the Agrion Foundation - Manta



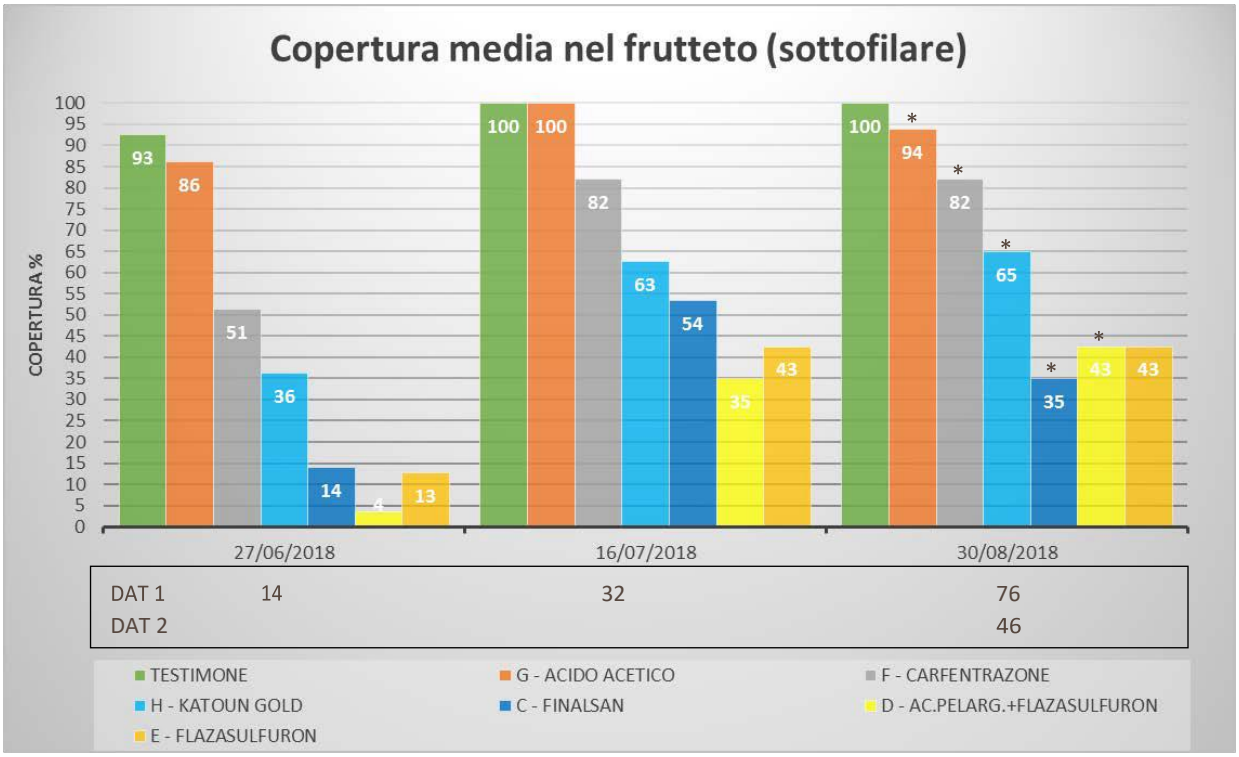
Grafic 5. Composition floristic thesis C - Finalsan



Grafic 6. Thesis H-Katoun Gold floristic composition

Graph 7 shows the average coverages of the theses tested in the orchard by date. From this graphical representation, it is possible to appreciate how the theses in which the best

results are the same as those experienced in urban trials. In particular, the two products based on Pelargonic acid and Flazasulfuron.



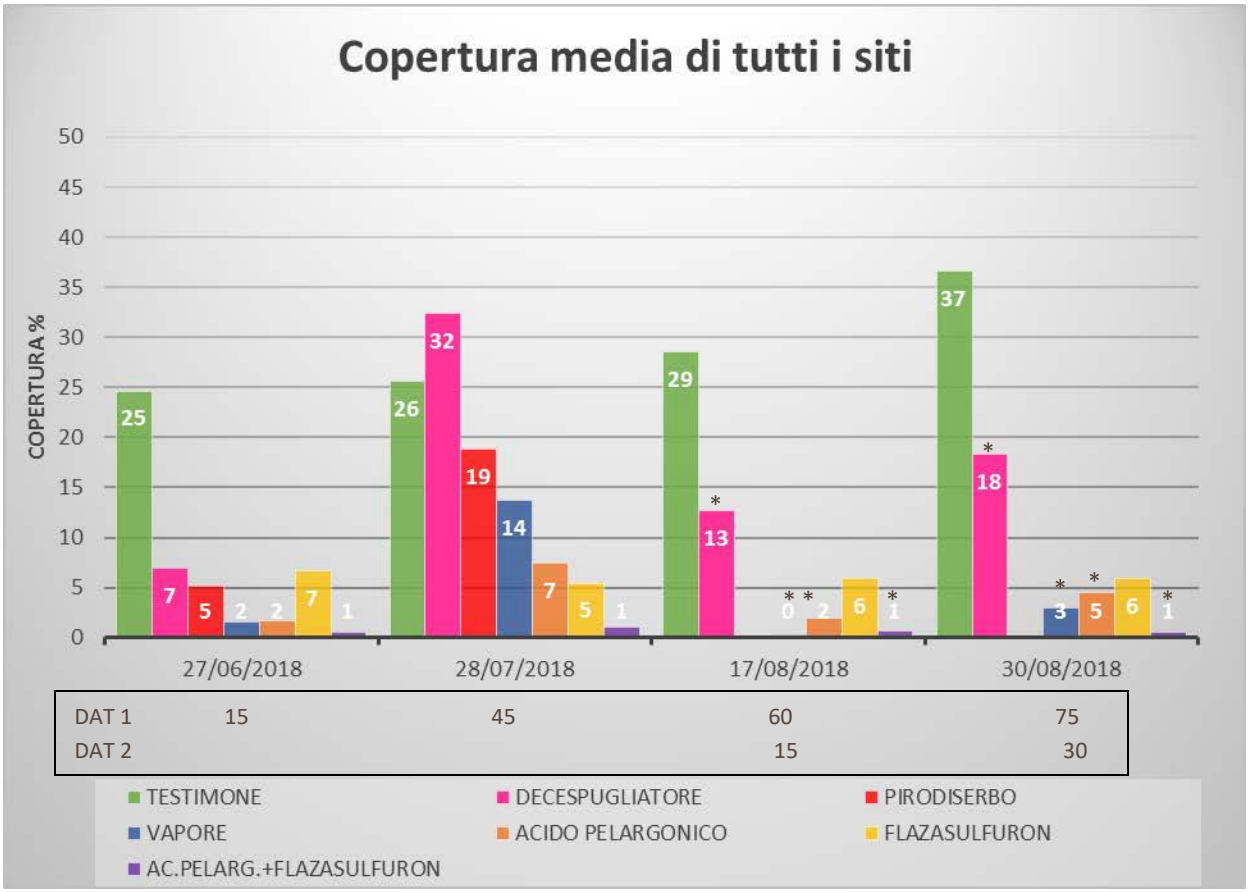
Grafic 7. Average coverage calculated on all theses tested in the orchard.
DAT 1 (Day After Treatment) indicates the days since the first intervention.
DAT 2 indicates the days spent in the theses (indicated with '') where a second treatment was carried out.*

Repeats 1-2-3

Lastly, the data obtained from the average coverage measurements of each thesis (regardless of the site) of the non-agricultural areas only are reported. The first date shows the measurements 15 days after the first treatment, the second the measurements 45 days after the first treatment, the third and fourth the measurements 60 and 75 days after the first treatment for Flazasulfuron and, for the other theses, the measurements 15 and 30 days after the second treatment (marked with an asterisk above the histogram). From the graph below, it can be observed that among the mechanical and physical theses, the "bushwhacker" and "pyro weeding" theses, 45 days after the first intervention, have higher percentages of coverage than the "steam" theses, and the same difference is confirmed in the measurements following the second intervention, so it can be stated that among the mechanical/physical theses, the "steam" theses were the most efficient. With regard to the theses where chemical products were used: in the "Flazasulfuron" and "pelargonic acid" theses throughout the period of experimentation, an average coverage of around 6% was recorded, thus resulting in

less satisfactory than the data from the individual sites described above, but still satisfactory. On the other hand, the thesis in which the two active ingredients are applied in combination is the one with the lowest 1% coverage over the entire period investigated.

The best results in terms of containment duration and weed reduction were obtained with steam weeding in the mechanical/physical theses and in the theses treated with Pelargonic Acid and Flazasulfuron. In particular, the thesis in which the two products are combined.



Graficure 8. Average coverage calculated on all non-agricultural theses.
DAT 1 (Day After Treatment) indicates the days elapsed since the first treatment. DAT 2 indicates the days elapsed in the theses (indicated with '') where a second treatment was carried out. The thesis pyrodisaster in the surveys of 17 and 30 August is not represented.*

The floristic composition of extra-urban replicas

Table 1 shows the floris c composition of the non-agricultural experimental sites. 16
The information provided by this table is useful in understanding the reasons for choosing to carry out experiments at sites with different paving or ground cover. In fact, depending on the pavement and exposure, the most suitable weed species are selected to develop under the conditions present there, and it is important to know what they are in order to choose the most efficient techniques for containment.

Floristic composition					
via Santa Giulia - Castiglia		Saluzzo municipal cemetery		via Propanotto	
paveme		screeds and gravel		quay	
	%		%		%
Purslane_oleracea	24,6	Euphorbia_maculata	37,6	Cynodon_dactylon	5,6
Polygonum_lapathifolium	22,7	Conyza_canadensis	7,8	Crepis_spp.	4,8
Poa_spp	22,6	Poa_spp	7,6	Trifolium_repens	3,0
Digitaria_sanguinalis	14,4	Purslane_oleracea	4,0	Euphorbia_maculata	2,8
Cymbalaria_muralia	11,5	Soncus_asper	1,0	Epilobium_angustifolium	2,0
Parietaria _officinalis	9,8	Plantago_major	1,0	Oxalis_acetosella	1,9
Stellaria_media	8,0			Digitaria_sanguinalis	1,9
Oxalis_acetosella	6,5			Soncus_asper	1,7
Conyza_canadensis	6,4			Setaria_spp	1,7
Euphorbia_maculata	6,0			Artemisia_vulgaris	1,7
Veronica_persica	5,5			Convolvolvulus_arvensis	1,4
Setaria_spp	4,9			Purslane_oleracea	1,1
Crepis_spp.	4,0			Veronica_persica	1,0
Convolvolvulus_arvensis	4,0			Taraxacum_officinal	1,0
Soncus_asper	3,3			Senecio_vulgaris	1,0
Trifolium_repens	3,0			Eleusine_indica	1,0
Taraxacum_officinal	2,7			Echinocloa_crus galli	1,0
Senecio_vulgaris	2,4			Conyza_canadensis	1,0
Urtica_dioica	2,3				
Solanum_nigrum	2,3				
Plantago_major	1,7				
Amaranthus_spp.	1,7				
Epilobium_angustifolium	1,0				
Eleusine_indica	1,0				
Chenopododium_album	1,0				
Cynodon_dactylon	1,0				

Table 1 . floris c composition in experimental sies

Preliminary cost analyses

In order to enable a complete evaluation of the techniques to be employed, the following tables show a evaluation of the costs of each thesis tested.
For the theses where chemical means were used to estimate the cost, the cost of the product distributed per square metre was calculated, as well as the cost of the product that can be distributed in one hour by the operator and the cost of the operator. For this calculation, it was estimated that an operator with a weed pump could distribute the product over an area of 1,000 square metres in one hour.
The hourly cost estimates for mechanical/physical methods were provided by the company, which in turn derived the cost, where possible, from the regional price list.

ENVIRONMENTALLY							
	Cost of herbicide products					*Labour*	*Total*
Product Name	***Cost***	***dose label***	***dose prod.***	***€/sq.m***	***€/hour***	***€/hour***	***€/hour***
FINALSAN PLUS (Ac.pelargonicum)	€/1LT 8,00	100 ml/sq.m.	20 ml/sq.m. product	0,16	160,00	30,00	**190,00**
KATOUN GOLD (Ac.pelargonicum)	38,00	22.5 l/ha	2.25 ml/sq.m.	0,086	85,50	30,00	**115,50**
CHIKARA (Flazasulfuron)	€/200gr 200,00	200gr/ha	0.02g/sqm	0,02	20,00	30,00	**50,00**
FINALSAN PLUS + CHIKARA (Mixture)							**210,00**
ROUNDUP 360 POWER* (glyphosate)	6,80	6 l/ha	0.6ml/sqm	0,0041	4,08	30,00	**34,08**
MECHANICAL/PHYSICAL							
Technique	***Consumption/re***						***Total €/hour***
STEAM	5 L / HOUR GAS; labour 2 persons; means of transport.						**80,00**
PIRODISERBO	2.5 KG/ HOUR / 800MQ; labour 1 person.						**38,00**
BRUSHCUTTER	Equipment depreciation; labour 1 person.						**33,00**

Table 2. Estimated cost per hour for each technique used and comparison with cost assumptions with glyphosate

In order to make the costs of the different methods more comparable, the hourly cost was related to the same unit of area (1,000 square metres) and multiplied by the number of interventions required to contain the weeds. In this way it is possible to have a rough estimate, given the assumption of a homogeneous and contained area coverage.

ENVIRONMENTALLY SUSTAINABLE CHEMICAL METHODS				
Product Name (name principle active)	***Cost Total*** *€/hour*	***minimum interventi necessary***	***Full cost season (1000 sqm)***	***notes***
FINALSAN PLUS (Ac.pelargonicum)	190,00	2	**380,00**	Average area treated in 1 hour 1000sq.m/hour
KATOUN GOLD (Ac.pelargonicum)	115,50	2	**231,00**	Average area treated in 1 hour 1000sq.m/hour
CHIKARA (Flazasulfuron)	50,00	1	**50,00**	Average area treated in 1 hour 1000sq.m/hour
FINALSAN PLUS + CHIKARA (Mixture)	210,00	2	**400,00**	Average area treated in 1 hour 1000sq.m/hour Second intervention with only Ac.Pelargonic acid
ROUNDUP 360 POWER* (glyphosate)	34,08	2	**68,16**	Average area treated in 1 hour 1000sq.m/hour
MECHANICAL/PHYSICAL				
Technique	***Cost Total €/hour***	***minimum interventi necessary***	***Full cost season (1000 sqm)***	***notes***
STEAM	80,00	2 3	**320,00** **480,00**	It takes 2 hours to treat 1,000 square metres
PIRODISERBO	38,00	3	**228,00**	It takes 2 hours to treat 1,000 square metres
BRUSHCUTTER	33,00	3	**99,00**	

Table 3. Cost of weed control for the entire growing season on an area of 1,000 square metres

The table below shows the estimated costs in relation to the results obtained as weed control in each replication and for each technique used. The table allows a quick comparison between costs and achievable results from the first year of experimentation.

ENVIRONMENTALLY SUSTAINABLE CHEMICAL METHODS

Product Name	*minimum interventi necessary*	*Full cost season (1000 sqm)*	*DAT - days 1a 45*	*past 2a 30*	*from the application application No. of days*
FINALSAN PLUS (Ac.pelargonicum)	2,00	**380,00**	7% 6% 32% 1%	5% 3% 13% 2%	cobblestones self-locking cemetery gravel cemetery pavement
KATOUN GOLD (Ac.pelargonicum)	2,00	**231,00**	- - - -	- - - -	cobblestones self-locking cemetery gravel cemetery pavement
CHIKARA (Flazasulfuron)	1,00	**50,00**	11% 1% 10% 0%	7% 3% 13% 4%	cobblestones self-locking cemetery gravel cemetery pavement
FINALSAN PLUS + CHIKARA (Mixture)	2	**400,00**	3% 0% 0% 0%	0% 0% 0% 1%	cobblestones self-locking cemetery gravel cemetery pavement
MECHANICAL/PHYSICAL					
Technique	*minimum interventi necessary*	*Full cost season (1000 sqm)*			
STEAM	2 3	**320,00** **480,00**	14% - - 13%	3% - - 3%	cobblestones self-locking cemetery gravel cemetery pavement
PIRODISERBO	3	**228,00**	23% 7% 34% 14%	- - - -	cobblestones self-locking cemetery gravel cemetery pavement
BRUSHCUTTER	3	**99,00**	- - - 32%	- - - 18%	cobblestones self-locking cemetery gravel cemetery pavement

Table 4. Weed containment cost for the entire vegetation period on a 1,000 m2 surface area with reference to the average coverage observed in the replications.
The '-' sign in the % coverage indicates the absence of da where the test was not performed

Comments

In order to facilitate the choice of the most suitable technique for the contexts under consideration, it is considered appropriate to make a few observations of a practical nature that may be useful in

highlighting some of the critical operational issues encountered or important

elements that emerged during the

Mechanical/physical means

The rotation of the mowing head makes it risky to use it in contexts where the throwing of small stones can cause damage to parked vehicles or, as in the case of cemeteries, to funerary artefacts. Moreover, in the case of uneven surfaces, it does not reach the base of plants, making the effect even less durable.

The pyro H-AIR, compared to pyro weeding eff carried out with the classic method, reduces the fire risk because the system does not use free fire to dry out plants but a geto of hot air at a pressure of 1.5 bar, which, in any case, in the case of dry plant materials and infilammable materials generated small fires. It is not recommended to use it near the tyres of parked cars or where there are wooden artefacts or infiammable materials. The application times of this technique are fairly quick, but the consumption of propane gas used (2.5 kg/hour for a surface area of approx. 800 ^{m2}) is significant. With the 10 kg cylinder supplied, an average of 3,000 ^{m2} can be treated.

Steam is a technique that requires a certain amount of experience and accuracy on the part of the operator and considerable application time, particularly if the plants are highly developed. Furthermore, the hourly cost of this technique is affected by: the cost of the boiler, the consumption of diesel (5 l/hour) to feed the boiler, the water tank, the necessary means of transport and the difficulty of reaching the point of application with this equipment. In favour of this technique, in addition to the evident release of only water on the soil and thus the complete safety for the environment and the operator, it has been observed that the treated plants are devitalised finally to the root system and thus guarantees a prolonged containment of weeds, which is greater, as observed in the results, than mechanical means and pyro weeding or pyro H-AIR.

Chemical means (herbicides)

Treatment with the products used requires less time for application, but the high dosages at which pelargonic acid must be used and the high cost are factors that must be taken into consideration. The selectivity of the products used may be a weak point for this method in some situations.

In favour of this technique, which employs environmentally friendly products considered to have a high margin of safety, is the applicability in all the contexts observed and the absence of risks for the operator and for vehicles or artefacts. By comparing the theses reported in the results, the combination of pelargonic acid with Flazasulfuron allows, with a single intervention, good containment for the entire growing season and overcomes the limit of selectivity of individual products.

Conclusions

The products used in the experimental trials have a much higher sustainability profile
than those used first. In particular, Pelargonic Acid is a natural substance of plant origin and Flazasulfuron, is an active ingredient that resides in the first 5 centimetres of soil, does not cause leaching risks to the deep layers, avoiding groundwater contamination and is

completely degraded after 60 days by microbial and chemical action, preventing the accumulation of in the ground.

It can be concluded that the techniques tried out in urban areas have proved to be differently efficient in containing weed development and, depending on requirements, it is possible to opt for fixed techniques, where a greater number of interventions during the year will be necessary, or for the use of environmentally friendly chemicals.

It is important to make the appropriate considerations when choosing the techniques to be used so as to optimise the costs of intervention by selecting those most suitable for each site. Evaluating where it is deemed advisable to act with fixed means, which are more costly, or with sustainable chemical means, which are less costly in terms of personnel, since they are quicker to apply, but still costly as products, or alternating the different techniques.

When assessing sustainability, it is also important to consider the fuel consumption required for fixing techniques. Indeed, it is true that these do not release any substances into the soil, but fuel consumption releases CO_2 and other pollutants into the air.