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THE USE OF AN INFRARED CAMERA

IN THE EVALUATION OF TREE HAZARD

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The systems used at present to detect damage in trees can be essentially divided into four categories which include:

- ❖ Tapping the trunk with a hammer and interpreting the sound produced;
- ❖ Extracting a core (Pressler auger) to directly examine internal tissue;
- ❖ Inserting a probe directly into the trunk;
- ❖ Non-invasive exam by using radiographic or radar systems.

Characteristics of the systems currently used

- They are time-consuming;
- They require a number of operators and the use of ladders or scaffolding to reach the upper parts of the tree;
- Those systems that require the carrying out of holes can further damage an already ailing plant by causing the breakdown of its defense barriers and encouraging the spread of pathologies or fungi possibly present;
- The numerous holes that are necessary to detect a cavity might become spread routes for parasites and pathogens;
- The use of radioisotopes or radiographic systems can be dangerous because of the radiation they emit.

- The proposed method is based on the assumption that the presence of discontinuity in the internal structure of plants causes a decrease in thermal conductivity in the affected area compared to the surrounding, undamaged parts;

- There is an uneven distribution of surface temperature between the two areas; the damaged area, where the alteration is present, is colder.

Advantages of the proposed technique:

- Detection of possible internal damage without having to touch the tree;
- 1-2 operators are needed for the measurements and the use of scaffolding is not necessary;
- The distance from the plant does not influence the results at least up to about 25 metres: greater distances could prevent the detection of small-sized damage;
- The study is carried out by pointing the lens to the chosen tree from the ground and assessing the images of the various areas filmed: damage is present where a discontinuity which is not justified by surface damage of the trunk or bark is present.

Apparatuses that can be used have to:

- Work in the 2.5-5.6 μm or 8-14 μm wavelenght intervals, have high resolving power and thermal sensitivity;
- Provide the images of the area filmed on a monitor in real time and be able to store them for a later elaboration.

The apparatus used to take the images presented here is a hand-held AVIO TVS 610 camera sensitive in the 8-14 μm interval. Its characteristics are as follows:

- A sensor made up by a 320 x 240 microbolometres matrix which does not need to cool down;
- The camera provides b&w and color images of the area under investigation;

  The sensor, the commands and the 5’ display on which the thermal image appears are gathered in a single apparatus which is slightly bigger than a common TV camera equipped with a battery which allows up to 4 hours of continuous functioning;
- Thermal images can be recorded on a mobile videocassette recorder or stored on to a PCMCIA compact flash card so that they can be transformed in bitmap images through a purpose-built software;
- A reference scale shown only on original images (*.iri) allows to immediately assess the differences in temperature present.

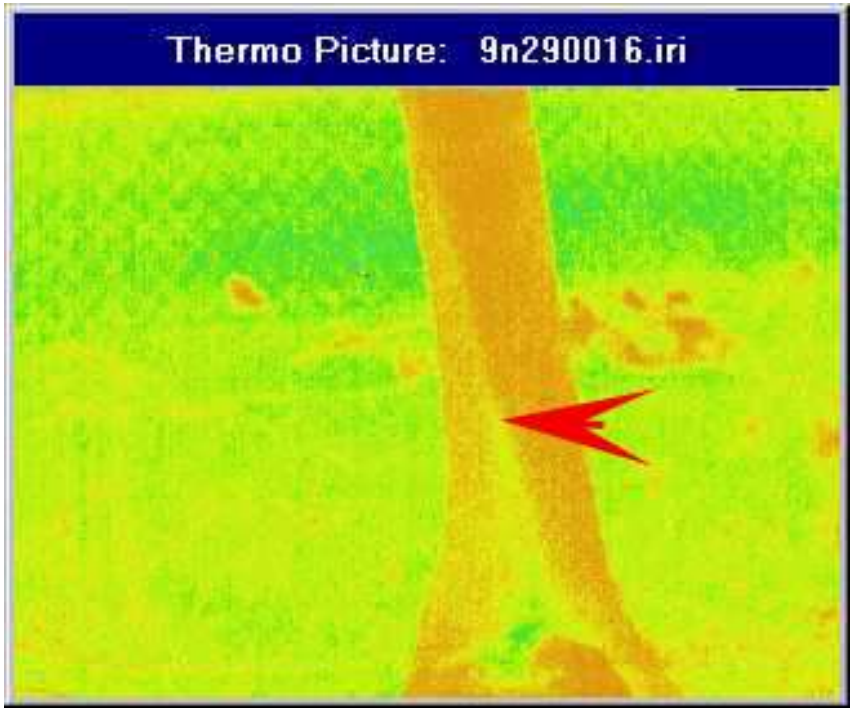
Be careful:

- Not all of the differences in colour are due to the presence of damaged tissue: since the apparatus “sees” only the surface of the tree, it is necessary to look for any superficial damage on the bark that might distort the image;
- When assessing a species never previously studied, it is necessary to verify how its bark is rendered on the thermogram: the deeply fissured bark of a lime tree or of a pine is rendered in a very different way from a plane or a Mediterranean hackberry.

Conclusions

- The investigation with the thermographic apparatus, fast and reliable, is harmless to plant and man;
- The absolute non invasiveness of the apparatus does not aggravate or spread damage already present in the plant, since it does not cause or favour the penetration of pathogens into the tree;
- This method allows us to spot the presence of damage that cannot be seen from the outside and is at its initial stage, thus allowing us to provide an early diagnosis and monitor the tissue conditions over the years without damaging the tree;
- Thermography cannot detect the type of damage (rotten tissue or cavity);
- The system is greatly useful because it allows us to use an invasive method of investigation only in the points where the damage has been detected;
- The tecnique can be applied only if there exists a thermal difference between the undamaged and the damaged tissue: the system only work on living trees;
- The possibility to store thermal images allows us to follow the possible development of the pathology over the years by simply comparing them with the ones taken at a later time.

The detection of internal tree damage is a serious problem for municipalities and plant pathologists alike in that it is usually discovered only when there is a sudden collapse, often creating a serious public safety hazard. The danger of the phenomenon is increased by the fact that often on the exterior only minor signs of the damage are visible – a small hole, a decortication, the stump of a branch – that only an expert is able to equate with the damage they can conceal.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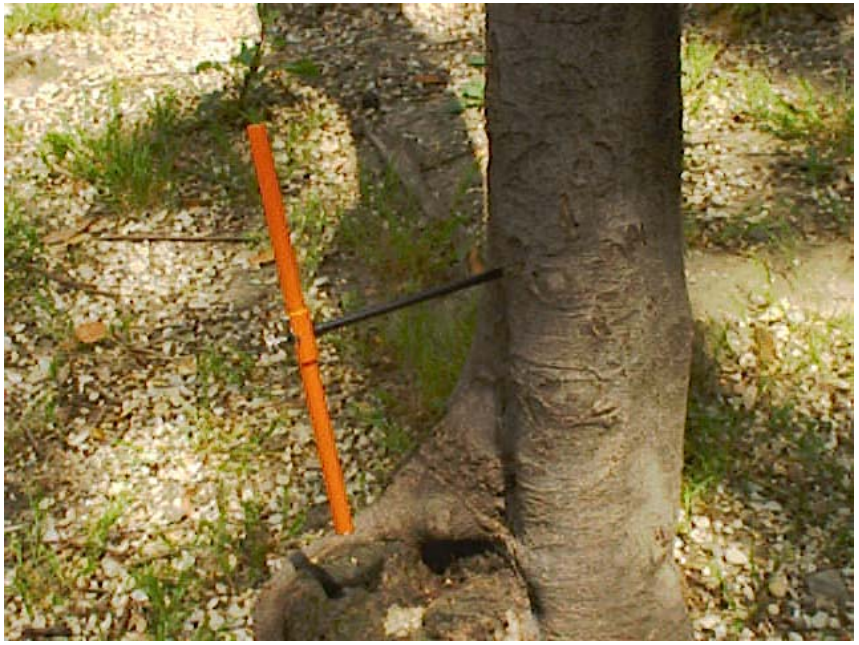

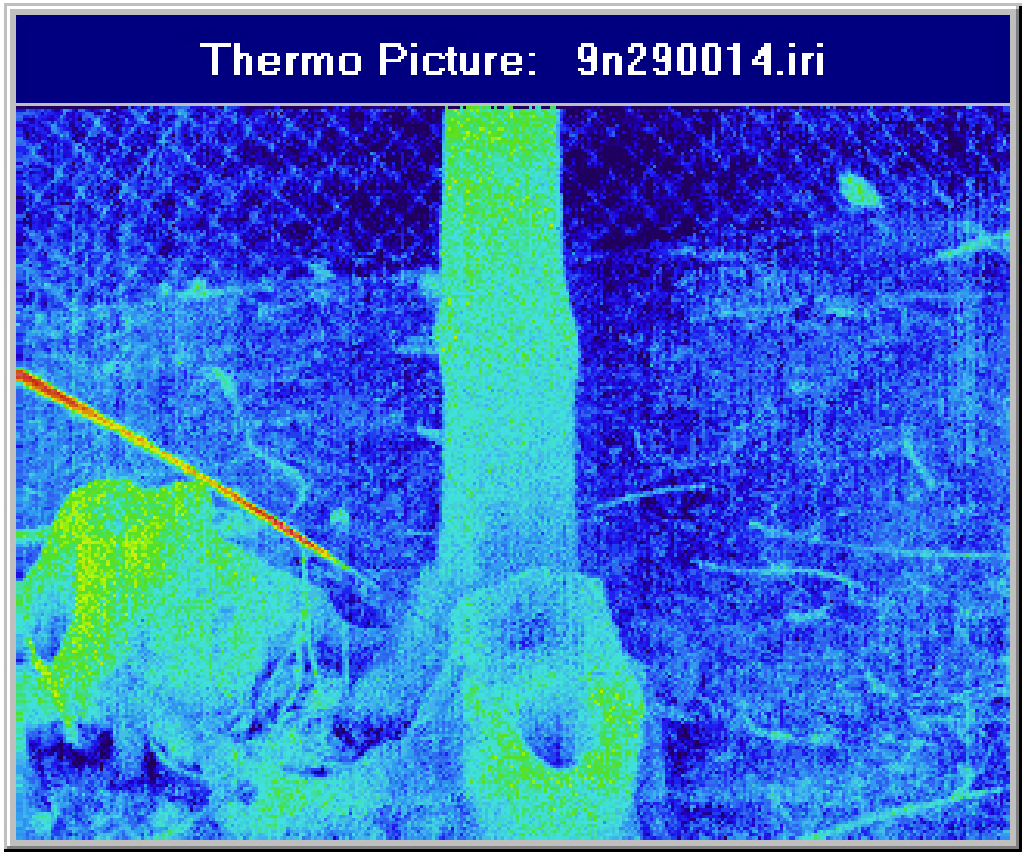
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