A METHOD FOR MEASUREMENT OF ACTUE LEAF INJURY ON TOBACCO INDICATOR PLANTS

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A technique for instrumental scoring of damaged leaves on tobacco indicator plants is being developed. The leaves are photographed in situ with an integrated unit, which illuminates the leaf from behind and keeps the camera in a well-defined position. By using microfilm and a minus green filter, it is possible to obtain negatives where the necrotic flecks appear as dark spots on a white leaf.

The negatives are scanned in a TV-system and the size of the damaged fraction of the leaf is calculated

by a microprocessor and is shown as a percentage of the leaf.

INTRODUCTION.

In Europe, tobacco, *Nicotiana tabacum* L. cv. Bel W3, is increasingly used as an indicator plant for ozone in the lower atmosphere (FLOOR an POSTHUMUS, 1977; ASHMO-RE et al., 1978; SKÄRBY et al., 1979; KNABE et al., 1973; SCHOLL and VAN HAUT, 1977; RUDOLF, 1977; RO-POULSEN et al., 1981; EASTMOND and SKÄRBY, 1979). When Bel W3 is exposed to ozone in concentrations over a threshhold of 0.04–0.05 ppm (LARSEN and HECK, 1976), a typical damage pattern, consisting of necrotic flecks 1–5 mm in diameter and brown to tan in colour, appears on the leaves.

So far, the scoring of the percentage of

damaged leaf area has been performed with visual methods, typically by comparing the damaged leaves with standard charts (ASHMORE et al., 1978; SKÄRBY et al., 1979; RO-POULSEN et al., 1981; POSTHUMUS, 1979). However, since these methods are subjective, the results depend upon the persons performing the scoring. Therefore, a new objective instrumental technique is being developed. The scoring is performed in two steps:

- 1. Photographing of the damaged leaves in the field;
- 2. Measurements on the negatives with a TV-camera coupled to a microcomputer.

PHOTOGRAPHING.

A portable unit has been developed for photographing in the field (Fig. 1). The unit consists of a lightbox with a fluorescent lamp over which a light-funnel is fastened. On the top of the light-funnel, a camera is fastened and held in fixed position relative to the top of the lightbox. The camera is equipped with a 18 mm lens, a back for 250 pictures and a motor winder. A red-sensitive, black and white microfilm is used along with a minus green filter. In the light-funnel, a piece of

transparent plastic presses the leaf to be photographed against the light-box. The power to the lamp is delivered from a portable 35-Volt battery through a highfrequency AC-converter. When the leaf is in position, the light is turned on. After a few seconds when the light intensity peaks, the camera shutter is activated for a 1-second exposure. On the resulting negatives (Fig. 2), the leaf appears white with dark spots, against a dark background.

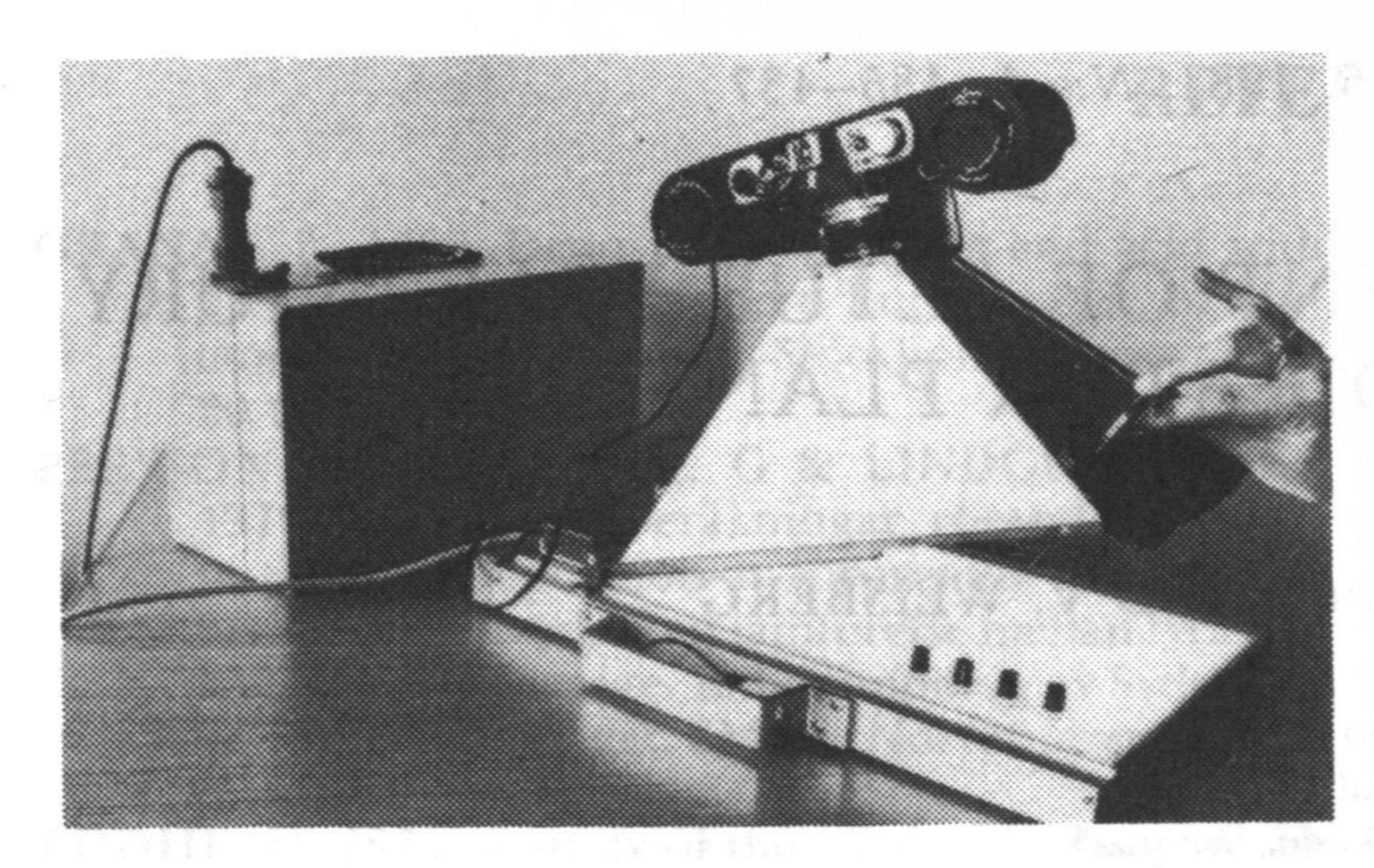


Figure 1. The unit used to photographe tobacco leaves in

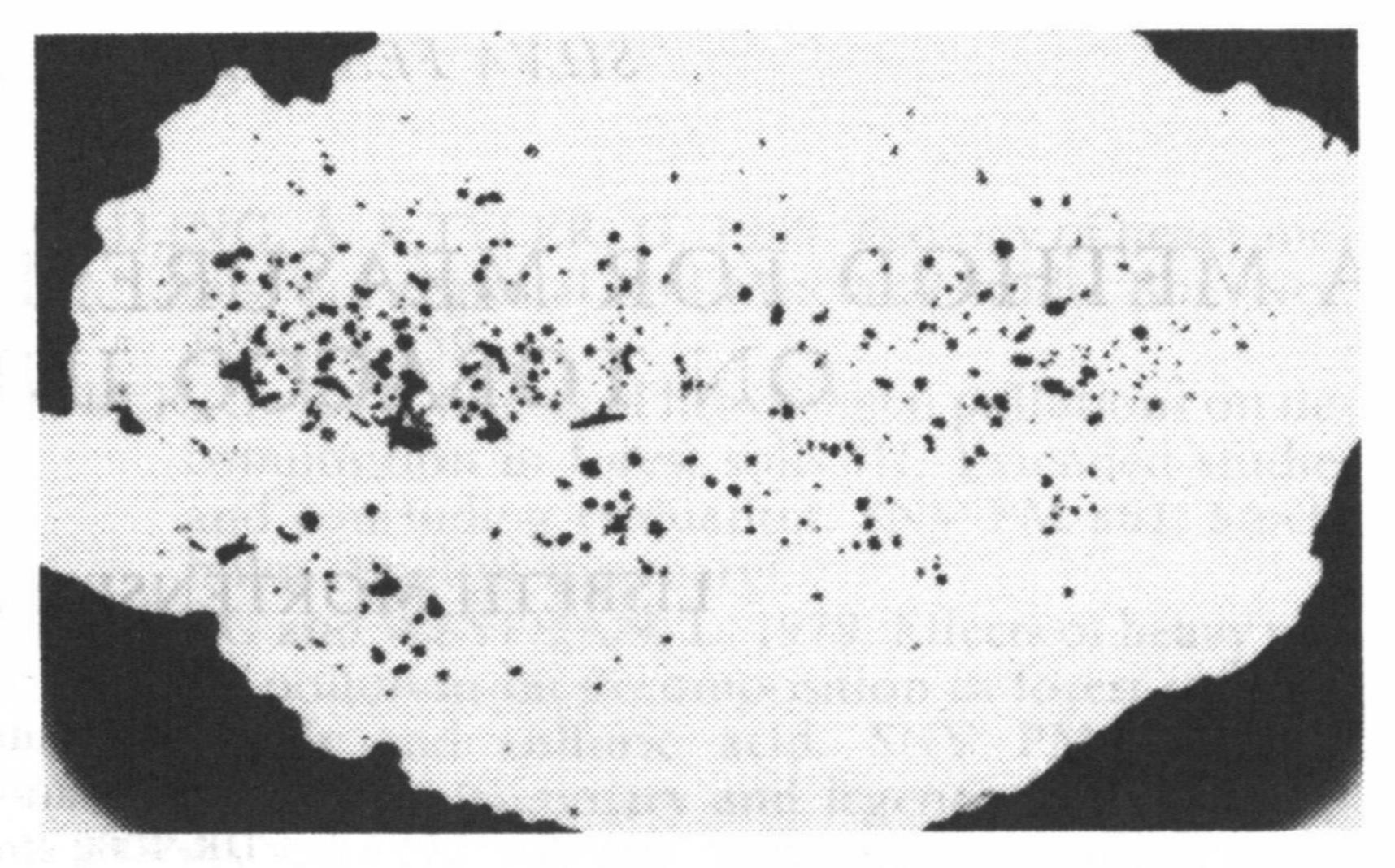


Figure 2. A negative, which is the result from photographing with the unit.

TV-SCANNING.

The coupling of the TV-scanning system is shown in the block diagram (Fig. 4), and the working principle appears from Fig. 3, which shows the video picture of a leaf and a series of signals corresponding to a line in the picture.

The video camera, recording the pictures of the negatives, delivers a video signal for a discriminator, which produces high and low outputs corresponding to light and dark parts of the picture. In addition, the camera gives synchronizing signals for the electronic frame generator controlling the measured part of the picture. The outputs from the discriminator, the frame generator and a 14 MHz clock oscillator are added in a gating ciricuit which produces pulse trains for three intergrators, T1, T2 and T3; they integrate the time they are turned on inside the electronically framed part of the picture. T1 measures the distance from the left edge of the leaf to the right side of the frame, while T2 and T3 measure the extent of the dark spots and the distance from the right edge of the leaf to the frame. T2, however, is reset every time the discriminator goes high inside the frame and thus ends up containing only the distance from the right edge of the leaf to the frame.

T1, T2 and T3 are summed up line-byline over a number complete pictures by a microprocessor which then performs the two subtractions and the divcsion necessary to find the percentage of damaged leaf area as indicated in Fig. 3.

The T1 and T3 trains are fed directly into the registers of the microprocessor through 4 bit prescalers reducing the 14 MHz clock frequency to a value acceptable by the processor. T2 has to be treated in a slightly more complicated way as it is

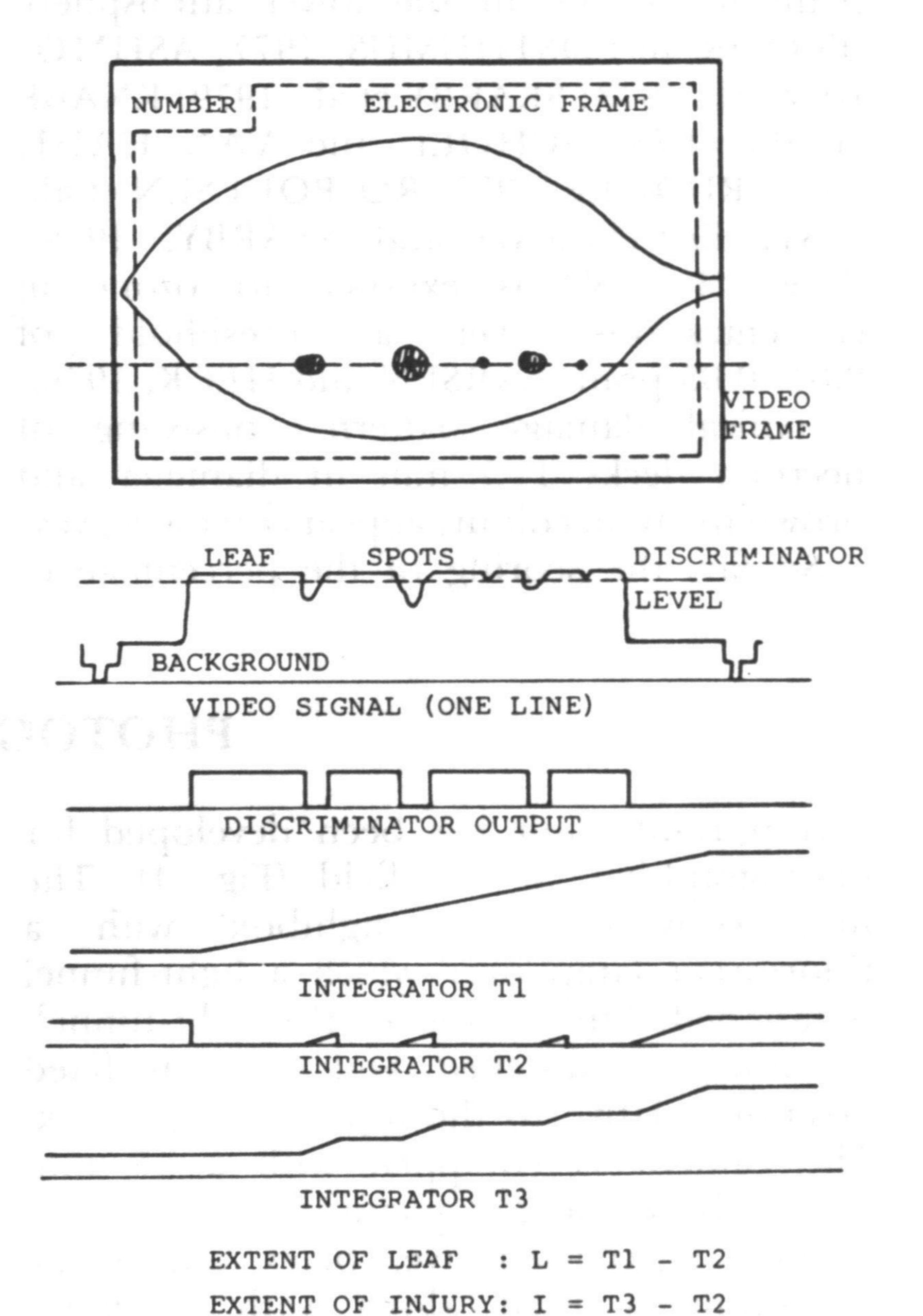


Figure 3. Working principle of the TV-scanning system.

necessary to store the value reached at the end of each line temporarily to avoid losing it when the discriminator goes high. T2 is therefore first registered in a 12 bit "up"-counter, the contents of which are transferred to a "down"-counter in the interval between the lines. T2 is then transferred to the microprocessor during the next line by counting clock pulses until the counter and the processor reaches zero.

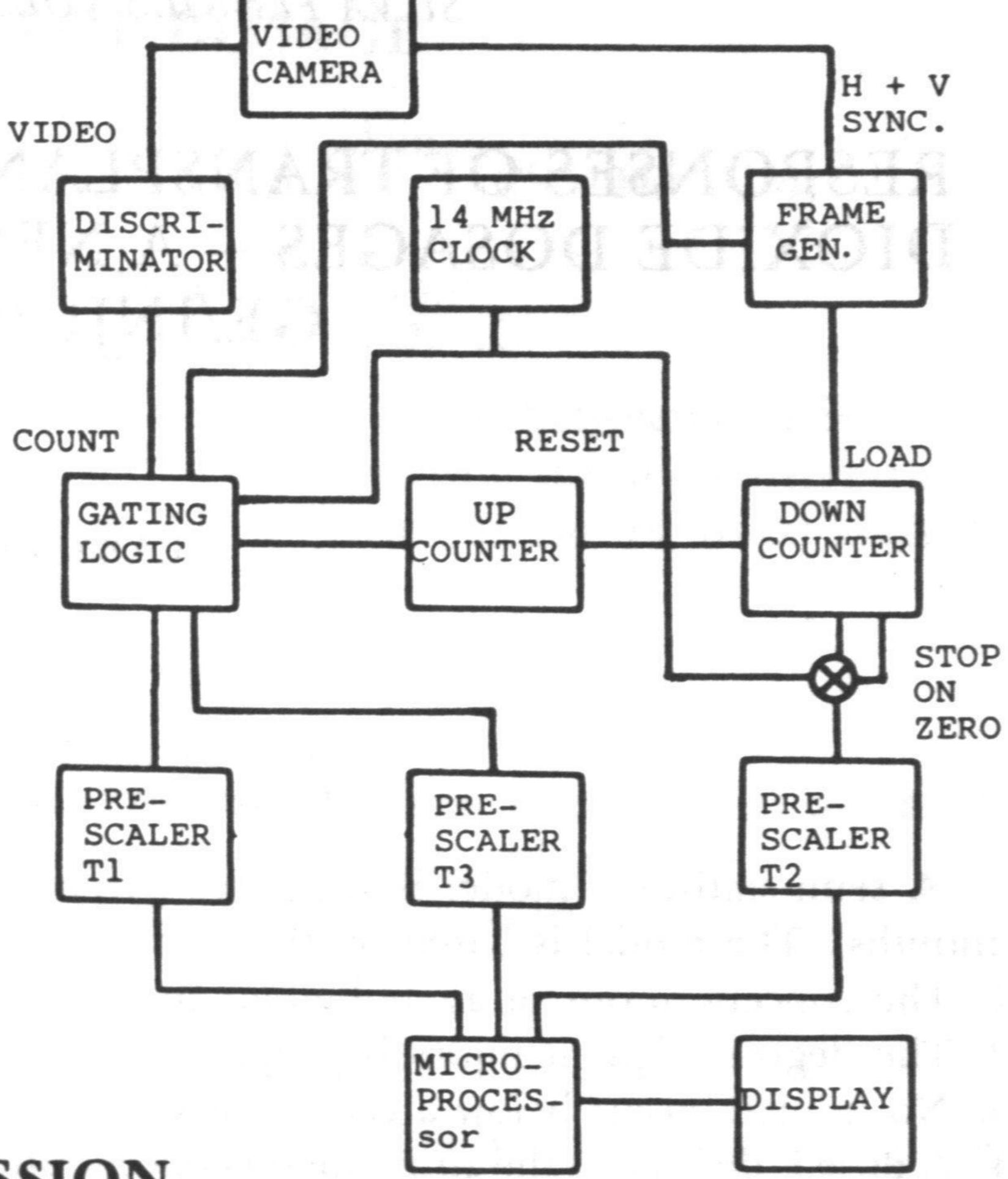


Figure 4. Block diagram of the TV-scanning system.

DISCUSSION.

objective and that photographs can be distinguished from ozone damage. The taken in the field without harming the same applies to frayed and concave leaf plants and by unskilled personel. It will edges. The importance of these effects is therefore be possible to compare results now being investigated. obtained with plants at different locations The performance of the system is at and scored by different persons.

problems. The tobacco variety used is very wind sensitive, and often suffers mechanical damage in the field. This may appears as holes in the leaf or frayed leaf edges. Holes in the leaf appear as dark spots on

The advantage of this method is that it is the negatives and thus can not be

present limited by the resolution of the There are, however, some unsolved video camera which is ca. 0.5 % of the frame width. The use of a better camera is being considered and the frequency of the clock oscillator may be raised to obtain a better time resolution.

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