EFFECTS OF SIMAZINE AND GLYPHOSATE ON OLIVE TREES

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Abstract

The effects of the herbicides simazine and glyphosate on young olive trees (*Olea europaea*) and on the two main annual weeds (*Amaranthus blitoides* and *Lolium rigidum*) of this crop in the south of Spain, are studied in this work.

Both herbicides were used, applied to the leaves, and simazine was also applied to olive tree soil. The levels of chlorophyll fluorescence and leaf chorophyll content were measured only with simazine, and longitudinal growth was measured for each herbicide.

As a result of the simazine applied to the soil, the olive tree showed an increase in the level of fluorescence in those leaves present before the treatment, for doses of 2, 4 and 6 kg ai ha^{-1}. When the leaves that developed after application were measured, it was found that the level of fluorescence had decreased which could have been due to loss of pigment rather than inactivation of the herbicide. In the treatment applied to the leaves, lower levels of fluorescence were found in the adult leaves than in the young leaves. This seems to indicate a tolerance of the olive tree to this herbicide through a lack of penetration of the adult structures. Simazine applied in preemergence was more effective on *A. blitoides* than on *L. rigidum*.

When the herbicide glyphosate was applied to the leaves of the olive tree, this stopped growth at concentrations of 2, 4 and 6 kg ai ha^{-1}. There was also a defoliating action which was greater at higher concentrations. Glyphosate applied in post-emergence showed a total control of both weeds.

1. Introduction

Simazine in pre-emergence and Glyphosate in post-emergence are two of the most important herbicides applied to the olive tree, for the control of *A. blitoides* and *L. rigidum* in the main olive growing areas of Andalusia (Southern Spain).

Simazine is a pre-emergence herbicide that inhibits photosynthetic electron transport (Romera et al, 1990), while glyphosate is a post-emergence herbicide which inhibits the aromatic amino acid biosynthetic pathway (Coggins, 1989).

The object of the present paper is to examine the effects of these herbicides applied to the soil and to the leaves of the olive trees, as well as on *A. blitoides* and *L. rigidum*.

2. Material and methods

One-year-old 'Picual' olive trees were used. Simazine and glyphosate were applied to soil and to leaves of olive trees. Another experiment applied both herbicides to weeds. Formulated simazine ('Hergazina' liquid 500 g ai $litre^{-1}$) was applied to the soil and to the leaves at doses of 2, 4 and 6 kg ai ha^{-1}, and glyphosate ('Roundup' liquid 360 g ai $litre^{-1}$) only to the leaves at the sames doses. Both herbicides were applied to plants using a laboratory track sprayer fitted with a Tee-jet 8001 flat-fan nozzle delivering 275 litre ha^{-1} at 250 Kpa. Levels of chlorophyll fluorescence, leaf chlorophyll content and longitudinal growth were measured in

plants treated with simazine while in the applications with glyphosate only longitudinal growth was measured. Weed control was measured visually.

To determine the inhibition level of simazine on the PSII (photosystem II), chlorophyll fluorescence was investigated. The chlorophyll fluorescence intensity of the youngest fully expanded leaf from treated and non treated 'Picual' plants was measured using a fluorometer (Hansatech Modulated Fluorescence Measurement System) according to the procedure described by De Prado et al 1993. In addition, chlorophyll content was measured on the same leaves using the Minolta model Spad-502.

3. Results and discussion.

Chlorophyll intensity is used as a rapid analysis of leaf samples to determine photosynthetic inhibited herbicide selectivity in the field. The method is based upon the fact that these herbicides increase chlorophyll fluorescence (Ahrens et al, 1981; De Prado et al, 1993). In simazine applied to the soil, the level of fluorescence showed a rapid increase for the high doses, while a lower rise was found for the 2 kg ai ha^{-1} dose with respect to the control. At the end of the first 28 days, there was a decrease in fluorescence, which could be due to a loss of chlorophyll content rather than to the detoxification (figures 1 and 2). Four and a half months after treatment, plants recovered photosynthesis activity (figure 3) and chlorophyll content (although not totally, date not shown) at doses of 2 and 4 kg ai ha^{-1}. The chlorophyll fluorescence measurements of the older and younger leaves treated with simazine are shown in figures 4 and 5. Formulated simazine in youngest leaves inhibited the photosynthetic electron transport, while in adult leaves it did not. In addition, at high doses, the chloropyll content minimum appeared from 5 to 10 days after the fluorescence intensity maximum, while at 2 kg ai ha^{-1}, chlorophyll content values were close to the control (figure 6). For the most part, simazine applied to the soil inhibited longitudinal growth (figure 7), although at the lowest dose the growth was close to that of the control. Meanwhile the effect of simazine when applied to the leaves was less, as the simazine treated plants grew similary to the control (figure 8).

Glyphosate applied to soil did not inhibit longitudinal growth in olive trees (date not shown), while when it was applied to leaves it inhibited longitudinal growth and blossom-end rot and the defoliating action of the leaves appearing (figure 9). One month after treatment a regrowth of the axillar buds appeared in olive trees.

Simazine applied to *A. blitoides*, showed a total control with a persistence of 20 days at doses of 1, 2 and 4 kg ai ha^{-1}. When it was applied to *L. rigidum* only with the highest dose, there was a total control in the first 20 days. Glyphosate used in post-emergence (Two-leaf stage) was very effective in both species ten days after treatment, at doses of 1, 2 and 4 kg ai ha^{-1}.

4. Conclusions

These results showed that simazine inhibits photosynthetic electron transport in younger structures, but there is a tolerance to this herbicide through a lack of penetration of the adult structures.

On the other hand, simazine movement in young regrowth is poor and not very clear. Future research on this aspect will include radiolabelling experiments using ^{14}C-simazine. These studies will allow us to more clearly establish absortion and translocation processes of the herbicide.

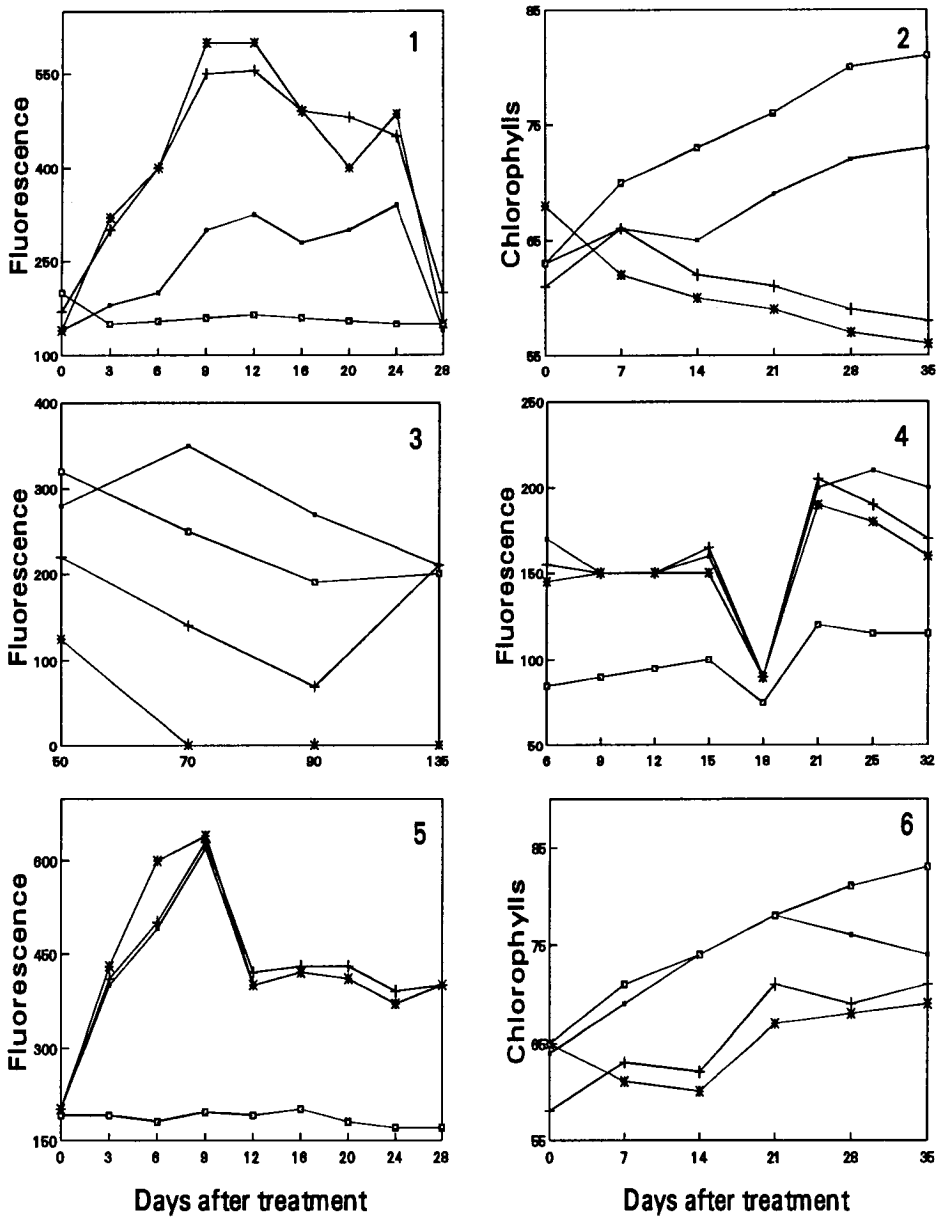

Figure 1. Level of chlorophyll fluorescence (a.u.) and leaf chlorophyll content (a.u.). Parts 1, 2 and 3: simazine applied to the soil. Parts 4 (oldest leaves), 5 and 6: simazine applied to the leaves. (-□-): control plant; (-●-): 2 kg ai ha^{-1}; (-+-): 4 kg ai ha^{-1}; (-*-): 6 kg ai ha^{-1}.

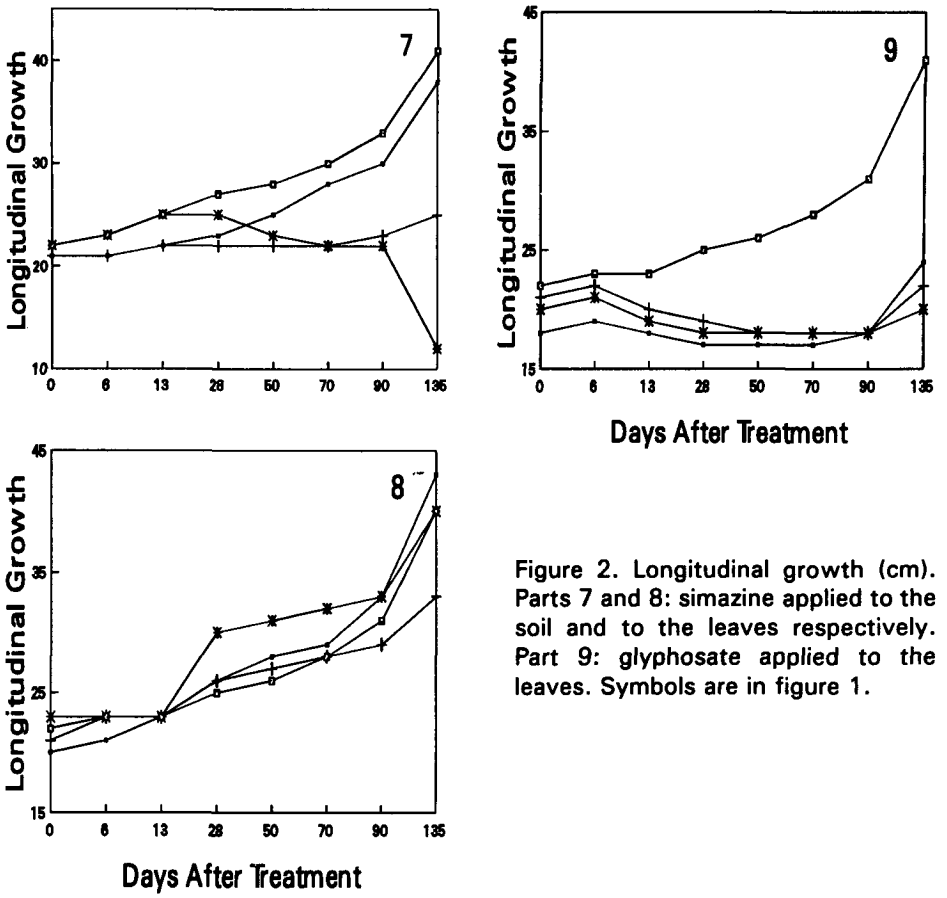

Figure 2. Longitudinal growth (cm). Parts 7 and 8: simazine applied to the soil and to the leaves respectively. Part 9: glyphosate applied to the leaves. Symbols are in figure 1.

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5. References

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