SOME EFFECTS OF THE HERBICIDE FLUAZYFOP–BUTYL ON THE PHYSIOLOGY OF JOHNSON GRASS (*Sorghum halepense* (L.) Pers.).[1] /

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Resumen

*Se investigó el efecto del herbicida fluazyfop-butil sobre la respiración y los pigmentos fotosintéticos del pasto Johnson (*Sorghum halepense*). En las semillas la respiración fue deprimida en relación directa con la concentración del producto pero no llegó a cesar en ningún caso. En rizomas provenientes de plantas tratadas con fluazyfop-butil al 0.2% estando de 10, 20 y 40 cm de alto, la respiración se va deprimiendo y llega a ser casi nula a los 20 días, excepto en plantas de 10 cm. Los pigmentos fotosintéticos se analizaron con el espectrofotómetro. La absorción de las radiaciones azul-violeta y azul se deprime primero y poco después las radiaciones amarillo y rojo. La depresión de los valores de absorción es más rápida en plantas de 10 cm que en las de 40 cm pero en ambos casos los pigmentos clorofílicos han desaparecido para los 20 días de la aspersión.*

Introduction

Recently two herbicides have appeared whose chemical structure is a pyridyloxy-phenoxy-carboxilic acid. Anderson includes them among the diphenoxy-carboxilic herbicides "for lack of a better place at this time" (1). These herbicides are the fluazyfop-butyl (PP-001) and the haloxyflop-methyl ester (Dowco 453). Fluazyfop-butyl appeared in 1980 (4) and was tried on Johnson grass (*Sorghum halepense*) (5) and other grass weeds. It has afforded excellent control in sunflower (7), squash (6), field beans (8) and other crops.

To date, not enough physiological studies have been made to explain the mode of action of these new products. In the diphenoxy-carboxilic, like dichlofop-methyl, selectivity lies in the differences of foliar metabolism and the phytotoxic effects are: a) chlorosis and necrosis in leaves due to membrane damage; b) inhibition of cell divisions in meristems (1). However, it is uncertain whether the mode of action of the pyridyloxy-phenoxy is the same of the diphenoxy.

Materials and methods

Treatment of plants

Johnson grass plants for the experiment were grown in plastic bags with soil in the greenhouse from seed collected in the field in March, 1985. When the plants reached the desired height, they were sprayed with a De Vilbiss sprayer using a 0.25% solution of fluazyfop-butyl (0.05% a.i.), which corresponds to a field application of 2.5 cc/l; that is, 1 l/ha (250 g i.a.) in 400 l water.

Plants were sprayed at different ages (sizes): 10, 30 and 40 cm high. There were 25 plants/treatment and six treatments in all (0 an 0.25% herbicide; 10, 30 and 40 cm high). Five plants were taken at different dates to investigate the respiration in the rhizomes and the photosynthetic pigments in the leaves.

Methodology for respiration

Herbicide effects on respiration were sought in the "seeds" (caryopsis) and in the rhizomes. For seeds, 0.5 g of seed without glumes was immersed in

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herbicide solutions of 0.0, 0.20, 0.25 and 0.30% for three hours. Then they were allowed to respirate in presence of NaOH 0.2 N after the technique based on titration of OH^- by HCl 0.2 N (11).

The rhizomes were collected from the leaf-sprayed plants in the greenhouse several days following application. Respiration was evaluated using the same procedure as in seeds.

Methodology for photosynthetic pigments

From each treatment, five plants were taken at 2, 10 15 and 20 days after application. Foliar pigments were extracted and analyzed by spectrophotometry: the absorption spectre was determined from 400 to 750 nm reading at 20 nm intervals. The value at 652 nm was used to gauge the chlorophyll content of the leaves, applying Beer's Law using the short method presented by Ross (10) in the Appendix of his manual.

Experimental results

Symptoms of toxicity

Plants sprayed when 10 cm high showed toxicity signs two days after treatment: reddish color in leaves and stems, followed by chlorosis and necrosis mostly at stem nodes. Death occurred 12 to 15 days after treatment. In plants 20 cm high, symptoms appeared at the 5th day. In plants 40 cm high symptoms were slower to develop; however, 15 days after treatment, damage was generalized and the plants died days later.

Effect on respiration

Table 1 presents the effects of the herbicide on seed respiration. There is a depression of respiration directly related to the concentration of fluazyfop-butyl. However, respiration did not cease even though seeds were exposed directly to the herbicide action by immersion in its solutions.

Respiration in rhizomes collected from sprayed plants is shown in Table 2. Fluazyfop-butyl effect was evident very soon, but became significant 10 days after application. After 20 days of spraying, respiration was very low except in plants 10 cm high, which seems strange. After the respiratory test, rhizomes were placed in conditions favoring bud development, which some rhizomes presented; none of the rhizomes from sprayed plants presented bud growth.

Table 1. Respiration of "seeds" (caryopsis) of Johnson grass (*Sorghum halepense*) previously immersed in fluazyfop-butyl solutions during theree hours. Data from 0.5 g seed respirating 72 hours.

Fluazyfop-butyl sol. %	0	0.20	0.25	0.30
CO_2 exhaled (mg)	80.5	71.2	50.1	30.0
CO_2 exhaled (%)	100	88.4	62.2	37.2

Table 2. Respiration of rhizomes from foliar sprayed plants of Johnson grass (*Sorghum halepense*) with 0.25% sol. of fluazyfop-butyl, collected at several dates after treatment. Data from 5 g rhizomes respirating 48 hours.

Height of plants when treated (cm)	CO_2 exhaled at the days after treatment indicated (% of control) 2	10	20
10	89	60	26
30	68	62	9
40	74	68	6

Effect on photosynthetic pigments

The effect induced by fluazyfop-butyl on the photosynthetic pigments was analyzed by spectrophotometry. When the product was applied to plants 10 cm high, the absorption spectre began to change two days later; absorption values in the blue region were lower, but values in the red region were similar to the control, indicating chlorophyll was not affected (Fig. 1A). After 15 days, the spectres of treated and control plants were quite different; absorption values in the red region were almost zero in sprayed plants, indicating total destruction of chlorophyll (Fig. 1B). This was supported by quantitative analysis showing that, at this date, chlorophyll content in sprayed plants was 4% as compared with 100% in control plants.

In plants 40 cm high, the effects were much slower in developing; 10 days after treatment the absorption spectres of both sprayed and control plants were very similar except in the violet-blue region (Fig. 2A); however 15 days after treatment absorption values in sprayed plants were down from the control (Fig. 2B). Twenty days after spraying the absorption spectre of plants 40 cm high was no different than that of plants 10 cm high. Quantitative analysis showed that at this date the fluazyfop-butyl treated plants had a chlorophyll content of 2% compared with 100% in the control plants.

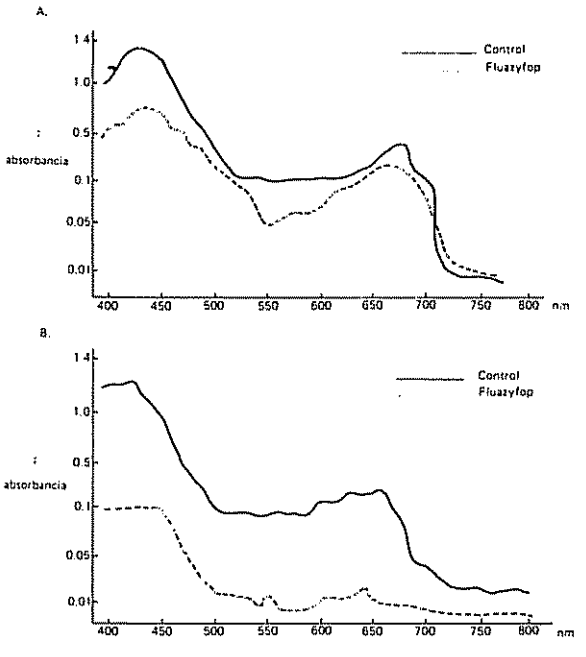

Fig. 1 Absorption spectre of Johnson grass (*Sorghum halepense*) plants sprayed at 10 cm height with fluazyfop-butyl sol 0.25%. A. Spectre 2 days after treatment. B. Spectre 15 days after treatment.

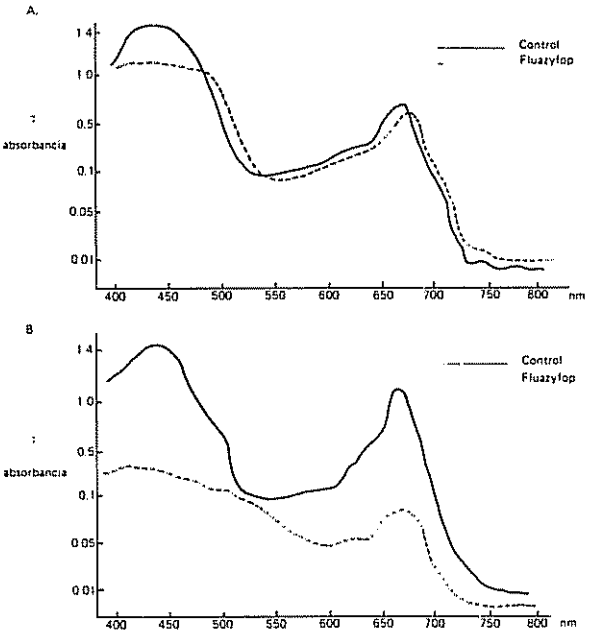

Fig. 2. Absorption spectre of Johnson grass (*Sorghum halepense*) plants sprayed at 40 cm height with fluazyfop-butyl sol. 0.25%. A. Spectre 10 days after treatment. B. Spectre 15 days after treatment.

Discussion

Occurrence of symptoms in the greenhouse confirm that young Johnson grass plants are very susceptible to fluazyfop-butyl, whereas older plants become resistant, as observed in the field (5).

The relatively weak effect of the chemical on seed respiration is comparable with the effect shown by the "brother" herbicide haloxyfop-methyl (9). The very strong repression of respiration in rhizomes is in accordance with field data on supression of regrowth from rhizome in foliar sprayed plants. This fact indicates a good translocation of the chemical, as investigated by Handley and Dicks (3).

The absorption spectres of fluazyfop-butyl-treated plants show deviations from the normal and are very similar to spectres reported for haloxyfopmethyl-treated Johnsongrass (9); also, the analysis by spectrophotometry shows differences in susceptibility between young and older plants. The changes induced in the absorption spectre are in accordance with the

hypothesis that diphenoxicarboxilic inhibits the carotene synthesis first and the destruction of chlorophyll codes after, because of the loss of the light-shielding carotene layer (12).

It is interesting to note the great difference in the effect on respiration between seeds and rhizomes; also it is interesting that rhizomes from plants 10 cm high are less affected than rhizomes from plants 40 cm high. It seems to indicate that meristems and very immature cells are less affected than cells at the differentiation stage; this is in accordance with the reports on haloxyfop-methyl effect in germinating Johnson grass seeds (9). However, Barrett and Olson (2) did not find interaction of these herbicides with auxin.

Summary

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