# Influence of Antitranspirant on Leaf Water Content and Transpiration of Sunflower*

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## ABSTRACT

Leaf water saturation deficit (WSD) and relative turgidity (RT) of sunflower plants (*Helianthus annuus* L.), grown in Tripoli, were significantly affected by foliar spray of the antitranspirant 'vapor gard'. Compared with the control, treatments with 2.5% and 5% 'vapor gard' reduced WSD by 20% and 15%, whereas RT was increased by 6.5% and 5%, respectively.

Highly significant correlation ($r = -0.85$) and regression coefficient ($b = -0.98\%$) were found between WSD and RT as estimated by Stocker's and Weatherley's equations.

Transpiration rates of severed leaves were significantly reduced by treatments with 'vapor gard'. Spraying with 2.5% 'vapor gard' reduced transpiration by 62% and 57% when the whole leaf and the upper surface were treated, respectively.

## INTRODUCTION

Under the semi-arid conditions prevailing in Libya, loss of water vapor through transpiration is considerably high. Moreover, water resources available for agricultural use are very limited in this country. Therefore, water conservation would be necessary under these conditions. One way of fulfilling this purpose is by reducing the water loss from growing plants. Recently, a group of chemical compounds called 'antitranspirants' were studied as a tool for reducing water consumption by crop plants (2,3,4). These antitranspirants when sprayed on plant surfaces form a continuous plastic film over stomata which may retard the loss of water.

Gale and coworkers (2,3,4) have reported that antitranspirant sprays decreased water stress and increased the turgidity of plants growing in the field under conditions similar to those prevailing in libya. Furthermore, better growth and lower water requirements

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* *This work was presented and abstracted at the International Botanical Congress, July 3–10, 1975, Leningrad, USSR (Abstracts, section 14 p. 467).*

were observed as a result of treatment with antitranspirants (3). In view of these findings, the present study was conducted to investigate the influence of one compound of these antitranspirants on leaf water content and transpiration rate of sunflower plants.

## MATERIALS AND METHODS

Sunflower plants (*Helianthus annuus* L.) were grown under field conditions from April to July 1974 at the Faculty of Agriculture Farm in Tripoli. At the end of May, the antitranspirant 'vapor gard' (a formulation of pinoline produced by Miller Chemical and Fertilizer Co., Hanover, Pennsylvania, U.S.A.) was sprayed on plants in four replications at 0.0, 2.5, and 5% concentrations. Hand sprayers were used for applying the emulsion of the antitranspirant in water on both surfaces of plant leaves. Full coverage of the folliage was ensured by letting the emulsion drip off the leaf surface. Two days prior to treatments, the experimental plot was irrigated by sprinklers. At intervals of 2, 3, 4 and 5 days after treatments, leaves were severed and immediately kept in plastic bags for determination of fresh weight soon after cutting. Leaves were placed with their petioles in water in closed jars for 24 hours until they attained full turgidity. After determination of the leaf saturation weight, they were kept overnight in an oven and finally, dry weight was obtained. From these values the water saturation deficit (WSD) was calculated according to Stocker's equation as cited by Hewlett and Kramer (5):

$$\text{WSD} = \frac{\text{Saturation wt.} - \text{Fresh wt.}}{\text{Saturation wt.} - \text{Dry wt.}} \times 100$$

Also, relative turgidity (RT) was estimated using Weatherley's equation (6) as follows:

$$\text{RT} = \frac{\text{Fresh wt.} - \text{Dry wt.}}{\text{Saturation wt.} - \text{Dry wt.}} \times 100$$

The effect of antitranspirant on the leaf transpiration rate was studied using the Ganong potometer technique (1). Before noon, at 10 to 12 a.m., single leaves were severed from untreated plants and placed in the potometers under field conditions for determination of transpiration rate. After enough steady-state readings were recorded, the upper surface of the same leaves were sprayed with 2.5% emulsion of the antitranspirant. Water loss from the treated leaves was recorded and then the lower sur-

Table 1 Effect of the foliar spray with the antitranspirant 'vapor gard' on water saturation deficit (WSD) of sunflower leaves (%).

| | Days after treatment | | | | |
|---|---|---|---|---|---|
| Treatment | 2 | 3 | 4 | 5 | Average |
| Control (untreated) | 20.4 | 23.8 | 24.3 | 35.6 | 26.0 |
| Sprayed with 2.5% 'vapor gard' | 17.4 | 15.6 | 20.8 | 29.5 | 20.8 |
| Sprayed with 5% 'vapor gard' | 17.4 | 18.1 | 21.3 | 31.8 | 22.1 |
| Average | 18.4 | 19.1 | 22.1 | 32.3 | — |

L.S.D. for spray treatments: At 5% = 2.7%, at 1% = 3.6%.
L.S.D. for measurement intervals: At 5% = 3.2%, at 1% = 4.2%.
Interaction was not significant.

faces were sprayed. Potometer readings were then taken for leaves with both surfaces treated. The experiment was repeated four times. Transpiration rate was estimated as gm $H_2O/dm^2$ of leaf area/hour.

## RESULTS AND DISCUSSION

Table 1 shows the effect of the foliar spray with 'vapor gard' on water saturation deficit (WSD). As an average of all measurement intervals, treatments with 2.5% and 5% 'vapor gard' highly significantly reduced WSD by 20% and 15%, respectively, as compared with the control. No significant difference was found between the two concentrations. This may be explained by the fact that once an intact plastic film was formed over the leaf, the passage of water vapor was hindered regardless of the thickness of the film. However, in the present study the period during which the film remained effective was not examined beyond six days after spraying.

The relative turgidity (RT) of leaves was significantly increased with the antitranspirant spray (Table 2). Compared with the control, treatments with 2.5% and 5% 'vapor gard' increased the relative turgdity by 6.5% and 5% respectively, irrespective of measuring intervals. As with WSD, the difference between the two concentrations with respect to RT was not significant.

Since both terms, WSD and RT, as indices for leaf water content were estimated by two complementary equitions, it seemed interesting to determine their relation to each other. The correlation coefficient ($r = -0.85$) and the regression coefficient ($b = -0.98\%$) between WSD and RT were highly significant. A negative linear association was observed as indicated by the scatter diagram and the regresion line (Fig. 1). These data suggest that similar estimations of leaf water content could be obtained either by applying Stocker's equation for WSD or by Weatherley's equation for RT provided that the whole leaves were used.

Table 3 represents the effect of the antitranspirant spray on transpiration of sunflower leaves. Spraying either the upper surface only or the whole leaf with 2.5% 'vapor gard' highly significantly reduced the transpiration rates of severed leaves. However, spraying the whole leaf had the same degree of effect as spraying the upper surface only. Compared with untreated leaves, spraying the upper surface only reduced trans-

Table 2 Effect of the foliar spray with the antitranspirant 'vapor gard' on relative turgidity (RT) of sunflower leaves (%).

| | Days after treatment | | | | |
|---|---|---|---|---|---|
| Treatment | 2 | 3 | 4 | 5 | Average |
| Control (untreated) | 79.6 | 78.7 | 74.7 | 64.7 | 74.4 |
| Sprayed with 2.5% 'Vapor gard' | 82.6 | 84.4 | 79.9 | 68.7 | 78.9 |
| Sprayed with 5% 'vapor gard' | 82.6 | 81.9 | 78.9 | 68.6 | 78.0 |
| Average | 81.6 | 81.7 | 77.8 | 67.3 | — |

L.S.D. for spray treatments: At 5% = 3.6%.
L.S.D. for measurements intervals: At 5% = 4.2%, at 1% = 5.8%.
Interaction was not significant.

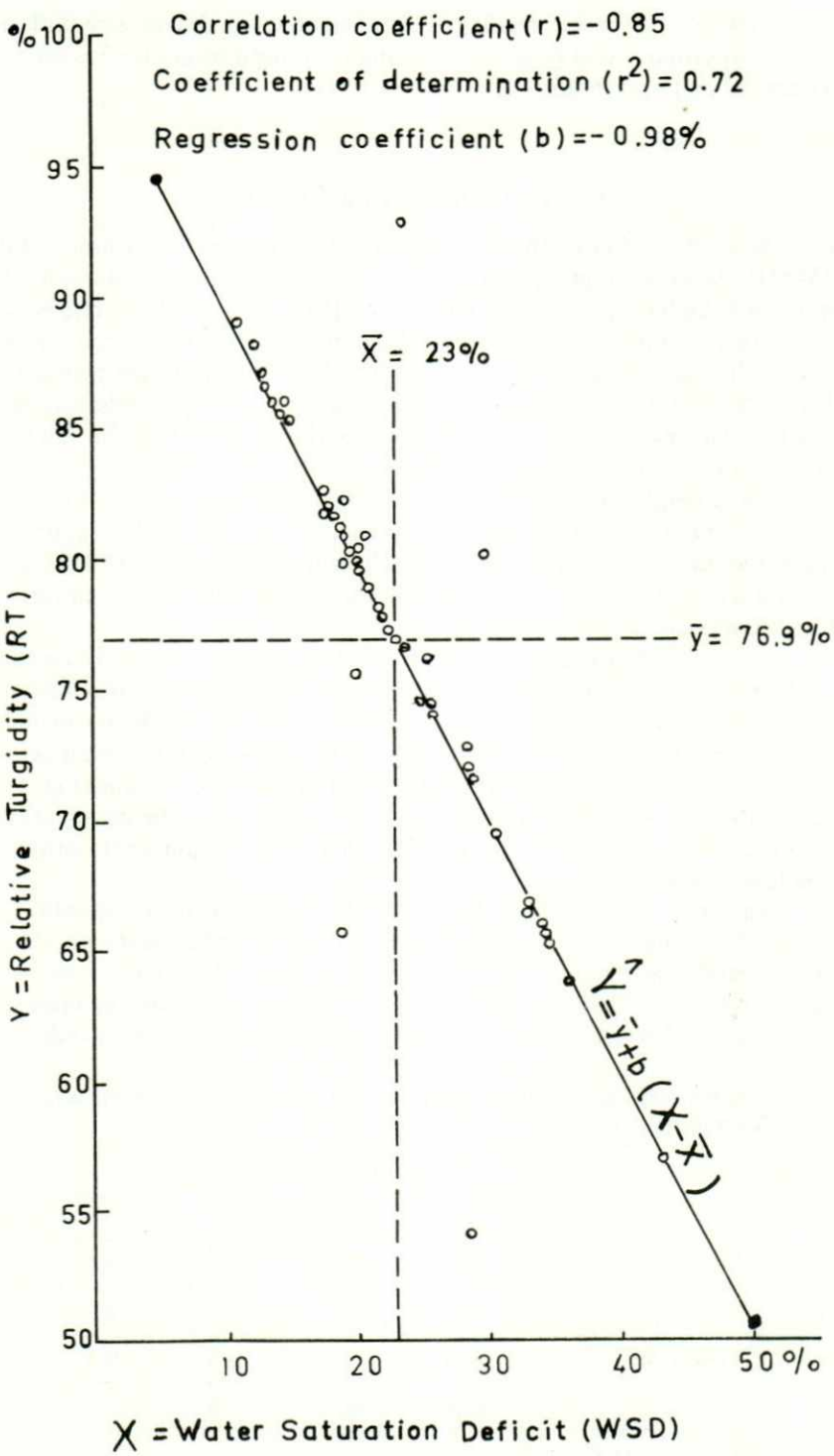


Fig. 1. A scatter diagram and the regression line showing the relationship between the relative turgidity (RT) and the water saturation deficit (WSD) in sunflower leaves.

Table 3 Effect of the foliar spray with the antitranspirant 'vapor gard' on transpiration rate of severed sunflower leaves ($gH_2O/dm^2$/hour).

| Treatment | Transpiration (g $H_2O$/dm²/hour) |
|---|---|
| Untreated | 1.440 |
| Upper surface sprayed with 2.5% 'vapor gard' | 0.620 |
| Both surfaces sprayed with 2.5% 'vapor gard' | 0.545 |

L.S.D. (5%) = 0.476 g $H_2O/dm^2$/hour.
L.S.D. (1%) = 0.721 g $H_2O/dm^2$/hour.

piration rates by 57%; while spraying the whole leaf reduced transpiration by 62% only (Fig. 2). Therefore, it may be concluded that the effectiveness of the antitranspirant in decreasing the leaf water deficit by reducing transpiration rate is very pronounced even with spraying only the upper surface of sunflower leaves.

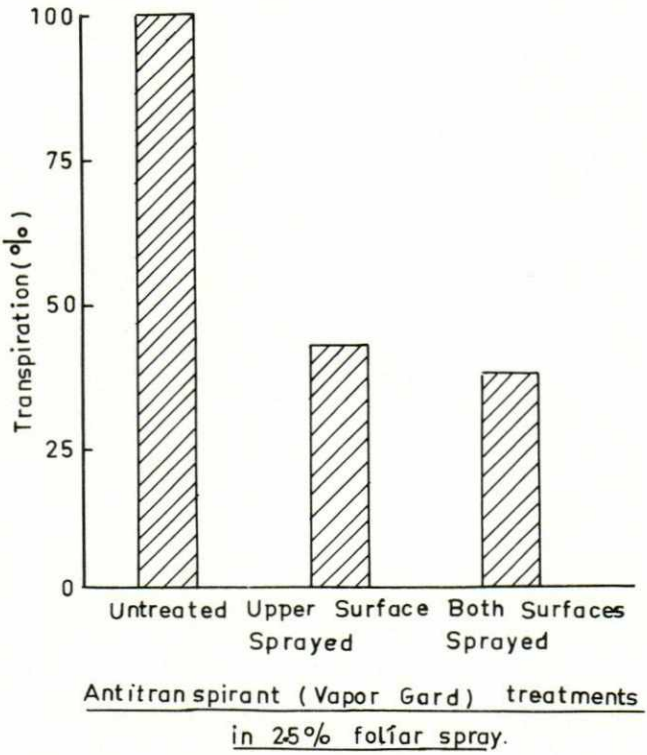


Fig. 2. Effect of antitranspirant spray on the transpiration of severed sunflower leaves measured at 10 to 12 a.m.

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