

Fruitfulness in grapevines: Effects of daylength

by

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Introduction

The number of bunch primordia (fruitfulness) which are present in buds on grape-vine (*Vitis vinifera* L.) shoots, after they have developed for 3 months following bud burst, can be determined by dissection. Under 16-hour days, the number has been found to increase from zero at 20° C to a maximum at between 30° C and 35° C, followed by a fall-off. In addition, an increase in light intensity within the range available in the growth cabinets, up to 3600 foot candles (f. c.), resulted in increased fruitfulness (3). It was not known whether day-length had any effect on fruitfulness of grape-vines, and this paper reports results of a series of experiments done to provide some information.

Material and Methods

Plants of the variety Muscat Gordo Blanco (syn. Muscat of Alexandria) were grown in growth cabinets (1) and the fruitfulness of new-formed buds determined after growth for 13 weeks (3). The experiments were done under a 25° C (16 hours)/20° C (8 hours) regime. Details of individual experiments appear in the Table.

Results

Buds on field-grown plants of the variety Gordo have between zero and three bunch primordia, and the numbers developing under different daylengths in these experiments are shown in the Table. In addition, the fresh weights of certain primordia have been included. In unfruitful treatments very few primordia were available for weighing and it was not possible to make a statistical analysis of weights.

The findings may be listed as follows:

1. A direct comparison of day-lengths is available between experiments a, b and c. Fruitfulness under both 8- and 12-hour days was low, and the two values did not differ significantly. Fruitfulness under 16-hour days was four times as great as under the shorter days. Some effect of daylength seemed indicated. Furthermore, 57,600 f. c.-hours supplied as 2,400 f. c. over 24 hours (experiment g) resulted in greater fruitfulness than 57,600 f. c.-hours supplied as 3,600 f. c. over 16 hours (experiment a). In addition fruitfulness with 24-hour days at 900 f. c. (experiment h), giving a light energy supply of 21,600 f. c.-hours, was at least as great as that with 8-hour days at 3,600 f. c. (experiment c), with a light energy supply of 28,800 f. c.-hours.
2. The interruption of a long night with 1 hour of photosynthetic light intensity (experiment d) did not overcome the short day unfruitfulness (experiment c).
3. Similarly the substitution of a low-intensity incandescent light for the long night (experiment e) did not result in higher fruitfulness (c. f. experiment c).

Table

Mean number of bunch primordia per bud for buds 1–12, and mean weight of the basal bunch primordium in bud 12, following growth, for 13 weeks after bud-burst, at 25° C (16 hours)/20° C (8 hours), under light regimes as listed. Mean plant dry weights (leaves + stem + roots) at 13 weeks are also tabulated.
There were 20 replicates for each experiment

Experiment	Light regime	Primordia		Plant dry wt. g
		No.	Wt. µg	
a	3600 f. c. 16 h/dark 8 h	0.89	19	56
b	3600 f. c. 12 h/dark 12 h	0.23	3	39
c	3600 f. c. 8 h/dark 16 h	0.17	10	26
d	3600 f. c. 7 h/dark 8 h/3600 f. c. 1 h/dark 8 h	0.20	7	24
e	3600 f. c. 8 h/low intensity incandescent light 16 h	0.17	20	35
f	3600 f. c. 12 h/dark 4 h/3600 f. c. 4 h/dark 4 h	0.75	22	57
g	2400 f. c. 24 h	1.23	65	57
h	900 f. c. 24 h	0.34	14	28
L.S.D. ($P < 0.05$)		0.20	n.a.	11

n.a. = not assessed.

4. Sixteen-hour days could be given either as 16-hours continuous light (experiment a) or in two periods interspersed with 4-hour dark periods (experiment f) without any change in fruitfulness.

Discussion

The number of bunch primordia recognizable at 13 weeks did not depend on day-length in the normally-understood context of responding to low-intensity light, nor did the length of uninterrupted night have an effect. The results do indicate a response to the total number of hours of high intensity ("photosynthetic") light given per day. If the total duration of such illumination exceeded 12 hours per day the response appeared to be related more closely to hours of light than to actual amount (intensity) of light energy (experiment a vs. g). This could be interpreted as indicating either that the relevant light-requiring mechanism was more than light-saturated at the higher intensities employed, or conversely that the mechanism uses light more efficiently at lower intensities. The response of the plant in terms of total dry weight (Table), in contrast to fruitfulness, was related to total light energy rather than hours of illumination. This means that the mechanism leading to induction of fruitfulness, despite its requirement for high-energy light, is not identical to the mechanism leading to dry weight accumulation, namely net photosynthesis. MAY (4) found evidence with Sultana that the amount of light actually falling on the bud itself could influence fruitfulness in that bud. From this it may also be concluded that light does not affect fruitfulness via whole-plant photosynthesis. It must not be overlooked, however, that results reported in this paper are for the variety Gordo. As ALLEWELDT (1) has shown, there may be varietal differences in

response of vegetative growth to daylength, and the same could apply in respect of fruitfulness.

Summary

Grape-vines were grown in cabinets for 3 months. Fruitfulness of new buds depended on the daily duration of high-intensity light, but not on low intensity light nor on length of uninterrupted dark periods.

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Literature Cited

1. ALLEWELDT, G., 1959: Das vegetative Wachstum 1jähriger Reben in Abhängigkeit von der Tageslänge. *Vitis* 2, 101—112.
2. BUTTROSE, M. S., 1968: Some effects of light intensity and temperature on dry weight and shoot growth of grape-vine. *Ann. Bot. (Oxford)* 32, 753—765.
3. — — : Fruitfulness in grape-vines: effects of light intensity and temperature. *Bot. Gaz.* (in press).
4. MAY, P., 1965: Reducing inflorescence formation by shading individual Sultana buds. *Austral. J. Biol. Sci.* 18, 463—473.

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