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Physiological Aspects of Post Harvest Berry Drop in Certain Grape Varieties *

by

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Introduction

Berry drop during storage and transport frequently presents a serious problem in the marketing of table grapes. This phenomenon has already been investigated in South Africa (1—7, 10). The appearance of shed berries differ as to variety (2, 7, 9); the Waltham Cross berry shows no open wound, as it is abscissed by means of an abscission layer; such drop is called "dry drop" (1, 3). In a preliminary work (11) we found the same type of "dry drop" in Muscat of Hambourg. The formation of such an abscission layer is rather rare in grapes (1, 9). Most varieties develop a "wet drop" during storage, i.e. after dropping the berries exhibit an open wound (10) caused by cracks around the stem cap and drying up of vascular strands leading into the berry.

Dry drop shed, with which we are concerned in this investigation, was increased in Waltham Cross by low soil moisture (1, 3); hot, dry weather at maturity season (3); early picking (3, 4); picking in the afternoon (4) and a reduced number of seeds in the fruit (2, 5). The effect of these factors on berry drop either became more pronounced or only appeared when introduction of the fruit into cold storage was delayed (2, 3, 4, 7); fruit grown on girdled canes is less subject to berry drop (6).

The observations reported from South Africa led us to conclude that dry drop of berries is likely to be a "physiological drop" possibly dominated by a hormonal system.

This paper presents the results of an investigation of the effect of growth regulator sprays on the dry drop of Muscat of Hambourg and to establish its mode of action as compared to Dabuki on which no dry drop appears.

Methods

In the field trials growth regulator sprays were applied on grape bunch and their environment. The growth regulators were: the Na-salt of naphthalene acetic acid (NAA), p-chlorophenoxy-acetic acid (PCPA), 2, 4, 5-Trichlorophenoxy-propionic acid (2, 4, 5-TP) and Maleic hydrazide (MH). All the stock solutions were neutralized to pH 7. Tritone X 100 at a concentration of 0.1 % was used as a wetting agent. The sprays were applied by means of a knapsack sprayer at 6 lbs. pressure (allowing the spray to drench the bunches) on plots of 4—8 vines in 4 replicates. For the storage tests 4 boxes were taken from each treatment, one box representing each field plot.

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Average sized bunches of export grade were selected, wrapped individually and packed in the vineyard, nine to each box. No disinfectant was added. They were immediately shipped and placed in cold storage within 10 hours after picking.

The fruit was held at 0—1°C for one month and then for 3 days at room temperature fluctuating between 25—30°C. With certain lots placement into cold storage was delayed for 48 hours, the period required to cause a marked increase in berry drop in Waltham Cross (3, 4, 7). In some cases no cold storage was used and the fruit was kept for one week in common storage at room temperature.

After storage the fruit was examined for general appearance, number of "drop berries", and those showing decay. The experiments were conducted during the years (1955 preliminary) 1956—1957.

Results

Fruit drop of Muscat of Hambourg treated on the vine with 10 ppm NAA, and PCPA was investigated after storage under various conditions. Results obtained in 1956 are shown in Table 1.

Table 1

The effect of preharvest sprays and delayed storage on berry drop of Muscat of Hambourg

(percent total berries)
(Sprayed — 12/8/56; picked — 16/8/56)

Storage treatment	one month cold storage						one week common storage		
	immediate			delayed by 48 hours					
Vineyard treatment	unsprayed control	10 ppm NAA	PCPA	unsprayed control	10 ppm NAA	PCPA	unsprayed control	10 ppm NAA	PCPA
Drop	2.3	2.5	2.8	22.2	13.1	13.3	11.9	14.9	10.5
Decay	3.1	2.8	4.9	3.1	6.1	5.1	5.9	3.8	3.6
Sound	94.6	94.7	92.3	74.7	80.8	81.6	82.2	81.3	85.9
	L. S. D. = 5.7								

The data show that considerable berry drop occured in common storage, even by the first week. This was reduced to less than one fourth by cold storage although the fruit was held there for a much longer period. Cold storage was effective, however, only when it was not delayed. If delayed even by 48 hours after picking, drop from untreated fruit increased tenfold as compared to those stored on the date of harvest. Drop in delayed storage was very significantly reduced by spraying the vines 4 days before picking with growth regulators. Such sprays produced, however, no effect on fruit held in common or normal i. e. immediate, cold storage.

The "drop berries" were fully turgid and exibited a dry sealed wound scar. These berries had no off taste or any other signs of breakdown.

In view of the fact that growth regulators had a considerable effect on the shedding of berries when cold storage was delayed, we decided to test the action of a number of growth regulators at various concentrations, under similar conditions. Results are shown in Table 2.

Table 2

Effect of growth regulators (in ppm) on berry drop of Muscat of Hambourg in delayed cold storage (48 hours)

Vines sprayed 4 days before harvest
(percent total berries)
(Sprayed 12/8; picked — 16/8; cold storage — 18/8; examined — 22/9/56)

Spray material	unsprayed control	NAA 5	NAA 10	NAA 20	PCPA 10	PCPA 20	2, 4, 5 - TP 10	MH 30	MH 500
Drop	22.2	10.6	13.1	10.9	13.3	7.9	16.6	17.2	17.5
Decay	3.1	5.7	6.1	6.8	5.1	6.4	2.5	5.2	4.9
Sound	74.7	83.7	80.8	82.3	81.6	85.7	80.9	77.6	77.6
				L. S. D. = 6.4					

All the growth regulators reduced berry drop. The various concentrations of NAA and PCPA decreased the amount of shedding significantly, while with 2, 4, 5 - TP and MH the decrease from control was not significant.

The following season berry drop of Muscat of Hambourg in immediate and delayed cold storage was compared with that of the Dabouki variety (Table 3) which does not develop an abscission layer.

Table 3

The effect of cold storage delay on berry drop of Muscat of Hambourg and Dabouki grapes.

(percent total berries)

Variety	Muscat of Hambourg		Dabouki	
Storage	immediate	delayed	immediate	delayed
Drop	0.5	13.5	7.9	8.2
Decay	0.9	2.6	3.0	6.3
Sound	98.6	83.9	89.1	85.5

As in the previous year berry drop of Muscat of Hambourg showed considerable sensitivity to cold storage delay although the effect was this year somewhat weaker. Dabouki, however, was not adversely affected. Delay of storage increased the amount of decayed berries in both varieties. This was to be expected because of the favorable incubation conditions during the 48 hours preceding cold storage.

The incidence of decay in Dabouki was about three times that of Muscat of Hambourg. This could be explained as Dabouki belongs to the varieties which develop wet drop. The wet drop of Dabouki, however, is due to the cracks in the berry peel near the cap stem caused by handling. The beginning of rot could often be detected at the fringes of the wound.

The relative effectiveness of growth regulator sprays in controlling berry drop with these two varieties (Muscat of Hambourg and Dabouki) was tested. Growth regulator applications were made on the fruit either 10 days after set or 4 days before picking. The results are presented in Table 4.

Table 4

The effect of application date of growth regulators on drop berries of Muscat of Hambourg and Dabouki in delayed storage (percent total berries).

Spray (ppm)	unsprayed control	Naphthalene acetic acid 10		Naphthalene acetic acid 20		p-chlorophenoxy acetic acid 20	
time of application		Early *)	Late **)	Early	Late	Early	Late
		Muscat of Hambourg					
Drop	13.5	12.5	7.8	13.0	5.0	14.2	7.7
Decay	2.6	3.4	2.0	3.0	3.1	1.9	1.0
Sound	83 9	83.1	90.2	84.0	91.9	83.9	91.3
		L. S. D. = 2.6					
		Dabouki					
Drop	8.2	6.5	5.1	6.9	6.6	6.4	7.5
Decay	6.3	5.1	8.9	7.2	6.0	6.4	6.1
Sound	85.5	88.4	86.0	85.9	87.4	87.2	86.4
		L. S. D. = 4.9					

*) 10 days after fruit set
**) 4 days before harvest

Spraying with growth regulators before harvest on fruit of Muscat of Hambourg as already shown in the previous experiment significantly reduced the amount of drop berries when cold storage was delayed. The early spray, however, had no effect whatsoever.

Applications of growth regulators on Dabouki produced no significant difference in berry drop, whether applied early or late in the course of fruit development.

Discussion

Dry drop of Muscat of Hambourg similar to that of Waltham Cross in South Africa (3, 11) is connected with the development of an abscission layer, i.e. the morphological result of a physiological process. The formation of an

abscission layer leading to fruit drop is a well known process which can be delayed by pre-harvest growth regulator sprays (8). Such sprays, as we have seen, reduced berry drop in Muscat of Hambourg, but obviously could not be effective with a mechanical "wet" drop such as that of Dabouki.

To be effective on the abscission layer, sprays had to be applied shortly before picking. The early spray was not applied in order to affect the abscission layer, but rather to affect the structure of wet drop varieties; but they were unsuccessful with Dabouki. But we should call attention to the fact that there exists more than one type of "wet drop" in grape varieties. Thus, as Dabouki has a very rigid pedicel attachment mechanical injury can be reduced only by more careful handling; in such varieties as Queen of Vineyard which also develops wet drop, the drop is connected with structural weakness (1, 7, 10) which is more likely to be modified by physiological means.

Still, even with Muscat of Hambourg the growth regulators were effective only when cold storage was delayed for 48 hours and even then a certain amount of drop could not be prevented. On the basis of the above discussed data it may be suggested that two separate factors, "A" and "B" are involved in the shedding mechanism of varieties with an abscission layer.

Factor "A", in order to appear, needs a period of 48 hours at room temperature after picking. If the fruit is immediately cooled, this factor can be prevented. Factor "A" is never affected by growth regulators.

In the absence of factor "A", factor "B", which is suggested to be active during the whole cold storage period, will fail to appear. Factor "B" appears only if the fruit is stored for a longer period i. e. one month. It can be retarded if the fruit is sprayed with growth regulators shortly before picking.

The appearance of factor "B", in our experiments, only in cold storage, may be explained by the need of a slow metabolism for the factor to accumulate (3).

Summary

Storage experiments were conduced with fruit of two grape varieties, Muscat of Hambourg and Dabouki.

I. The drop of Muscat of Hambourg is a "dry drop" while the Dabouki has no definite drop. Shed berries in this latter variety were due mostly to mechanical injury.

II. The dry drop due to an abscission layer was found to be a „physiological drop".
This drop could be:
1) Prevented by subjecting the fruit to cold store immediately after picking.
2) Reduced by spraying the fruit 4 days before picking with 10 — 20 ppm of NAA or PCPA if storage has to be postponed for more than 36 hours.

III. Growth regulators as well as delayed cold storage had no effect on the drop of Dabouki berries during storage.

IV. A mechanism for the shedding in varieties with a physiological drop was suggested.

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