PHYSIOLOGICAL STUDIES ON GRAPES

By

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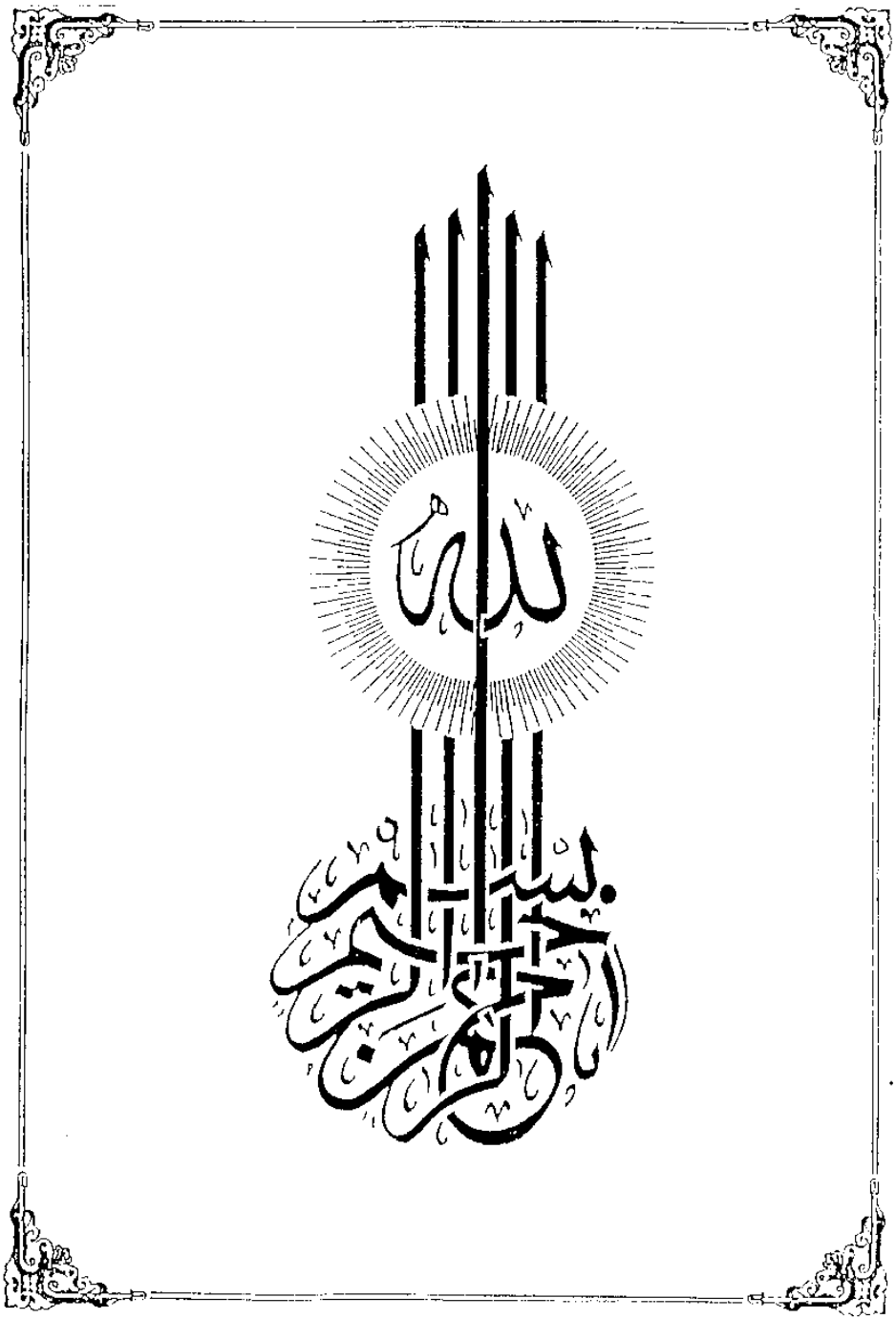

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CONTENTS

The grape production ranks first or second over the world fruit crops (F.A.O. 1967). It is a major crop in Egypt with Saaidi and Red Roumi being the two leading varieties.

Vertical expansion in grape production is one of the major objectives of horticulturists. This expansion can be realized through better cultural practices. One of the major practices that affects the yield markedly is pruning.

Most research work conducted on vine pruning included the relation between pruning severity and yield. Presumably, a better knowledge of the physiology of grape vine pruning would result in improving this practice. Thus the major objective of the present investigation was to study the fluctuations in carbohydrate fractions in the canes along with the changes in endogenous growth promoters and inhibitors in the buds. These changes serve as suitable basis for interpreting the data of bud behaviour and yield of the Red Roumi grape vine under different degrees of pruning severity.

Part I : Endogenous growth regulators in relation to bud burst :

Romberg (1949) was the first to propose that growth inhibitory substances might play a possible role in the regulation of bud dormancy.

A number of investigators (Romberg 1952, 1954, 1958a, 1958b; Luckwill 1952; Blommaert 1954, 1955 and Verga & Ferenzy 1956) observed that the end of dormancy in a variety of plant organs was correlated with the disappearance of growth inhibitory substances.

Marines and Romberg (1960) proposed that the acid inhibitors, identified as "inhibitor B complex" by Bennet-Clark and Cutford (1953), were agents controlling the duration of dormancy.

Romberg and Larsson (1961) suggested that growth inhibitors supressed the activity of hydrolytic enzymes.

Doorfling (1963a) reported that the lowest buds of the shoots contained more "inhibitor B" than the higher buds during growth. He also mentioned that it was formed in the leaves and functioned by blocking the synthesis of growth substances.

[illegible] (1963a) [illegible] the activity of [illegible] were primarily controlled by an interaction between "inhibitor β" and the auxins.

Eagles and Wareing (1963) reported that a large number of substances occurring in plant tissues were likely to be inhibitory to growth, but their existence did not indicate that such substances were important in dormancy. They proposed that the term "dormin" (now referred to as abscisic acid, ABA) should be used for the substances which appeared to function as endogenous dormancy inducers.

The same authors (1964) suggested that dormancy might be controlled by an interaction between endogenous inhibitors and promotors.

Libbert (1964) proposed that growth inhibitors might inhibit IAA synthesis from tryptophane.

Pefoli and Turetskaya (1967) mentioned that growth inhibitors did not directly effect any one hormonal factor, but acted on a general process (e.g. ATP synthesis) without which the growth process are impossible.

Wareing (1969) noted that although much work would be required to determine the precise mode of action of ABA

[illegible] in accordance with the hypothesis that ABA might [illegible] may therefore affect [illegible] RNA and protein synthesis. He also reported that earlier workers studying changes in endogenous inhibitors during the rest period of buds observed that there was an increase in auxin levels at about the time of bud-break. He added that the possibility that natural gibberellins might be involved in bud dormancy was suggested by the observation that application of exogenous gibberellic acid (GA_3) would induce bud break in a number of woody species.

Kappeyne and Wolf (1969) however reported that the addition of gibberellin actually prolonged the rest period of Vitis vinifera which required low temperature for termination of rest, while they appeared to shorten rest in many other species.

Vaadia et al (1969) in their investigation on the effect of growth regulators on bud rest in Vitis vinifera [illegible] found that the inhibitory substances were present in buds of St Emilion from December through the dormant period. They disappeared from buds in storage at temperatures increasing the onset of shoot growth.

Part II. [illegible] its relation to pruning :

Winkler and Williams (1945) revealed that the winter disappearance of starch in vinifera grape vine was almost quantitatively accounted for the appearance of an equivalent amount of sugars in the above ground sections. There was no evidence of dormant season carbohydrate translocation, nor the formation or hydrolysis of hemicellulose or materials other than starch and sugars. The conversion of starch to sugar produced approximately equal quantities of reducing sugars and sucrose. They noted also that the decrease in carbohydrates during the dormant seasons indicated a respirational loss of about 0.5 percent per month in the wood of the stem.

Esau (1948) found that the phloem of the vine was inactive at Davis from late November until March. During this period the active plates were coated with a thick layer of callus. This finding clarified the conclusion of Winkler and Williams who stated that there was no dormant season carbohydrate translocation from the trunks of Vitis vinifera to the roots other than a small fall in the autumn.

Ibrahim (1952) studied carbohydrates' [illegible], reducing sugars (mainly monosaccharides + sucrose), sucrose, and starch in different parts of the grape vine. In the one year sprouts the amount of reducing sugars was high in the prevegetative period (March), it decreased during the early growth (April), increased gradually during the following time (June), decreased again while approaching the full physiological maturity (August and September), and raised again during the autumn-winter resting time. The amount of sucrose ran parallel to that of reducing sugar while that of starch showed an inverse trend. In the perennial sprouts the relative carbohydrate changes, though less pronounced, were similar to those in one year sprouts. He noted also that the hydrolyzing activities of invertase and cytase ran parallel with the increasing amount of reducing sugars and the decreasing amount of starch respectively.

Bosnak and Burshova (1955) in their investigation to determine the time of pruning noted that the maximum assimilative activity of grape vine leaves was not reached at the time of grape ripening or harvesting but it was reached at the end of October. The accumulation

of plant hormones [illegible] in the grape vine [illegible] increased [illegible] at first. Therefore pruning in autumn had to be postponed as far as possible.

Bosun'Ka (1960) revealed that the content of total carbohydrate increased in the autumn by 150-200%. The starch changes simulated that the changes in total carbohydrates. In the autumn the maximum starch was the same as the total carbohydrate maximum. Sugar changes presented a reserve picture. The minimum starch content occurred when sugar content was more.

Weaver and Stanley (1960) reported that the samples of vine parts made at various times showed that less available carbohydrates accumulated in basal shoot segments and roots of overcropped vines. They concluded also that it was fortunate that most varieties could endure considerable abuse by overcropping before being killed. Even died vines had a considerable amount of starch.

Rhodes (1963) noted that after leaf fall an intensive hydrolysis of starch and accumulation of sugars took place in the shoots of all the six vine varieties

stalks. [illegible] of reducing sugars [illegible] that of starch decreased.

The same author (1965) noted that after leaf fall the content of starch decreased and that of sugars increased reaching a peak during the coldest part of the year (the end of January or early February).

Winkler (1965) stated that the food materials accumulated as stored reserves in all parts of the vine during summer and fall. They remained stored, without appreciable movement until the following spring, when they were used in the starting of new growth. Considering these results one might safely say that pruning at any time after leaf fall and before the start of growth in spring, could have little or no effect on the amount of carbohydrate reserves of the vine.

Bouard (1967) revealed that in the winter a high percentage of reducing sugar was noted in the grape vine. The maximum content of the insoluble sugars was independent on the date of leaf fall. During rest period the increase in the [illegible] of soluble sugars depended upon

[illegible] their constituents of the shoots rather than to translocation of sugars from the roots and stems.

Kliewer (1967) noted that sugars in the canes generally were highest during dormancy (Dec. through Feb.), lowest in July and August, and somewhat intermediate during leaf senescence (Oct. and Nov.).

Guhgare and Mukherjee (1969) reported that there was no appreciable transfer of carbohydrates from the cane to other parts of the vine during the dormant season so variation in the time of pruning in the dormant season might not have any marked influence on the carbohydrate status of the cane. The total carbohydrate level in the canes remained stable, and the winter disappearance of starch was almost quantitatively accounted for by the appearance of an equivalent amount of sugar.

Part III. A- Pruning severity in relation to bud burst:

Artchiff et al (1955) in their pruning experiments in which the number of buds per vine was kept constant,

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[illegible] canes were varied [illegible] clearly showed that the apical dominance could be demonstrated on vines with canes with variable length. The two terminal positions were free from any inhibition of burst, while all other positions were inhibited.

Martin et al (1962) in their observation over 3 years period on Aligote' vines, pruned to leave 30 or 60 or 90 buds per plant, reported that increasing the number of buds increased the number of fertile shoots.

Rangelov (1965) in his pruning experiments on Pinor noir variety noted that, pruning to leave longer branches increased percentage shoots and bunches. When the number of fruit buds on each vine was increased, the percentage of bud opening decreased, whereas the numbers and percentage of fruiting shoots and bunches increased.

Kamel et al (1975) on their investigation on Red Roomi grape vine noted that when the number of buds per cent varied from 2 to 8, the percentage of bud fertility and fruitfulness increased progressively from bud 1(basal bud) to bud 3 , then more markedly