Production of Seedless Grapes by Gibberellin Treatment

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Kurosawa discovered in 1926 that a germ of the Bakanae disease secreted a poisonous matter which accelerated not only the growth of rice plant but also those of other plants and is thermostable. Yabuta suggested in 1935 that he would like to name it Gibberellin after Gibberella fujikuroi which is a substance activating the succulent growth of rice plant. This is the origin of the name of Gibberellin.

In 1938, Yabuta and Sumiki succeeded in obtaining the Gibberellin crystal, a substance activating the succulent growth of the plant. Since then, many research workers in England, United States and Japan have pursued the following studies: the mass-producing method of Gibberellin crystal, its chemical structure, its distribution in the vegetable world, its physiological action to the plant, and its composition and metabolism, etc.

Through the test of Gibberellin treatment for grapes, it was recognized for the first time at the Agricultural Experiment Station in Hokkaido in 1957 that Gibberellin has a great effect on the Niagara berry.

The Japanese Society for the Study of Gibberellin was inaugurated in 1957 and study groups were organized according to each field. By communicating with each other, ten stations in this country started fruit-culture tests under the guidance of Kajiura (in Fruit Tree Research Station, Ministry of Agriculture and Forestry) since 1958. The tests were emphasized with the necessity for preventing the compactness and cracking of berry by growing cluster, and it has been proved that seedless fruit can be formed by the treatment before blooming but the forming rate of seedless berries in cluster was not always high.

It was recognized in the tests undertaken at the Fruit Tree Branch of the Agricultural Experiment Station in Yamanashi Prefecture, Kyushu University and the Fruit Tree Research Station etc. in 1959 that set per cent of berries is increased and most of the clustered berries become seedless by the treatment of 10 to 20 days before blooming.

Seedless fruit does not grow large when it is left as it is called "shot berry," which is the cluster having little commercial value, so an additional treatment has been undertaken after blooming for the cluster with seedless berries treated before blooming with the aim to make the berry larger.

Consequently, the successful enlargement of the berry was got with the cluster of a commercial value. The treatment was accomplished by spraying or dipping. Especially, the dipping method adopted at the Fruit Tree Branch, Agr. Expt. Sta. in Yamanashi, for an effective usage of medical fluid proved favorable, thus offering a bright prospect for practical application. At present Gibberellin treatment has been applied mostly to Delaware of Japanese grapes.

Time of treatment

The adequate time of treatment to get the high forming rate of clustered seedless berries

is about two weeks before the full bloom of the untreated-tree. Cluster growth could be increased when treated early but the cluster becomes sparse caused by the decrease in set per cent of berries and all berries of fruit cluster do not ripen simultaneously at harvest time, therefore, they are apt to be of little commercial value.

The range of suitable time for the treatment is about five days, but it has been extended by adding BA, according to recent experimental results.

The suitable time of treatment after blooming is about 10 days after full bloom of the tree treated taking into account the enlarging rate of the seedless berries.

The time of treatment anticipated before blooming has been obtained from the high interrelation between the blooming of grapes and the atmospheric temperature from which the most suitable time for treatment seemed to be in the period of 10 to 20 days before the treated time. This method has been put into practical use in Yamanashi Prefecture.

Concentration of Gibberellin solution

Both treatments before and after blooming are finalized using Gibberellin of 100 ppm and adding a wetting agent of 100 ppm considering from the forming rate of seedless barries and the enlarging effect of berries.

pH of Gibberellin solution

As for the relationship between the formation of seedless berries and pH of Gibberellin solution, it is acknowledged that the intermixing rate of the seeded berries in cluster increases and the amount of seedless berries decreases when the pH value is above 6.3.

Method of treatment

The dipping method is adopted to ensure the effect of treatment and to lessen the amount of the medicine used. Over-production could be prevented if excessive clusters and their shoulders are picked out in the treatment by a standard of "two clusters per current shoot."

It is clear that the effect is decreased when it rains immediately after Gibberellin treatment. In such a case, the treatment must be renewed. The method of treatment is being replaced by spraying because of the recent manpower shortage.

Gibberellin effect varies according to the variety

Varieties which facilitate formation of seedless berries in cluster by the Gibberellin treatment like Delaware are Kyohō, Muscat of Alexandria and Muscat Bailey A. Niagara and Kōshu, etc. possess a low forming rate of seedless berries. In the case of Kōshu, however, the formation of seedless berries is increased in conjunction with an augmentation in Gibberellin concentration used.

Varieties of peduncles likely to be hardened by the Gibberellin treatment are Muscat of Alexandria, Kyohō and Campbell Early. The hardening of peduncle becomes a serious problem in practical application since the quality deteriorates during transportation.

Action and mechanism of Gibberellin

Abnormal form of flower organ treated with Gibberellin is acknowledged, and the pedicel and filament of cluster show a remarkable growth. There is no change in the length of ovary and anther and there is not very much change in the size of pollen.

The germination ability of pollen, the number of the ovule with normal sperm nucleus and fertility are decreased by the Gibberellin treatment.

The growth of the ovule treated with Gibberellin stops five days after blooming. The formation of the embryosac is the same as that of the one without treatment, no matter how the blooming is acccelerated by

Gibberellin treatment. This means flower blooms in an immature condition. Consequently, it is believed that the seed is not formed since there is no fertility of the pistil, even if normal pollen is crossbred in this period.

This could be proved by the fact that a pretty large amount of clusters with seeded berries are formed when Gibberellin is treated as near pre-bloom as possible.

From the viewpoint of biological study on Gibberellin treatment, a strong and abnormal respiration is recognized on the first day after treatment when leaves are dipped in Gibberellin of 100 ppm.

Considering from the investigation conducted on the organic acid content of leaves in that case, it is believed that Glyoxylate cycle is activated and that the abnormal respirataion due to Gibberellin is caused by the inhibition of Malate Dehydrogenase.

Similar respiration, as well as that of leaves, is recognized in the case of the flower-bud. The respiration amount of pollen is decreased by Gibberellin treatment.

According to the investigation of seasonal change in nucleic acid, substances like auxins and polyphenol content in flower bud, it has been found that a relationship exists between the influence which Gibberellin mainly exerts on the respiration metabolism and the formation mechanism of seedless berries.