PLANT HORMONES AND FLOWERING IN COFFEE

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SUMMARY

Coffee plants are short day plants; the developing buds go into dormancy after having reached a considerable length.

This dormancy can be broken by: 1) rain after a dry spell, 2) application of GA. It can be maintained by the application of ABA.

1. INTRODUCTION

The physiology of flowering of coffee plants *(Coffea arabica* L. and *C. canephora* Pierre*)* is very interesting and therefore it has been the object of many studies.

Coffee is a typical short day plant.

PIRINGER & BORTHWICK (1955) found that no flower buds are formed when the day length exceeds 14 hours. Days of 12 hours or shorter cause the formation of flowers after 2½ to 3 months. After the induction of the flower buds, these buds develop in clusters in the axils of the leaves until they reach the length of 1 to 1½ cm, after which they go into dormancy. The buds remain dormant until after a period of drought the first rain wets the plant and the soil. One or two days after that rain, the flower buds resume their growth; one week to 10 days after the shower the whole plantation is in flower which flowering lasts only two days. Much speculation has been done about this breaking of dormancy of the buds.

MESS (1955) considers the dormancy of the buds to be caused by shortage of water. Therefore as soon as enough water is supplied the dormancy will be ended and flowers will open.

WENT (1955) thinks that, in analogy with the cause of flowering in *Zephyranthes*, it is not the rain but the drop in temperature during and after the rain that must break the state of dormancy in the flower buds of coffee plants.

WELLMAN (1961) in his book on coffee cultivation states that the development of the dormant to the open flower appears to be a shock effect that may be induced by several environmental changes. The most common of these appears to be showers.

A very interesting study on the subject is that of ALVIM (1961). He showed that not only the rain is necessary but also, before the rain, a period of drought. If the water content of the soil was kept high flower buds were formed but remained dormant during many months. If, however, the soil was allowed to dry out until the water content came below 10%, than, after watering, the plants were in full flower 9 or 10 days afterwards.

ALVIM (1958) also showed that the theory of Went, that the drop in temperature was triggering the flowering, must be wrong. By treating branches with flower buds with water of 35 °C better flowering was obtained than with water of 25 °C; water of 15 °C had no effect at all.

Treatment of dormant flower buds with the known plant hormones was also tried. Several investigations with IAA had no effect at all (WORMER 1965).

However, much success was obtained by applications of gibberellic acid (GA), although it seems that publications of these results have remained rather unknown, as even Wormer in his review on the physiology of coffee in 1965 does not mention any of these papers.

ALVIM (1958) induced flowering after spraying plants with dormant buds with water containing different concentrations of GA. Flowering occurred 9 days after treatment with concentrations higher than 20 ppm. The amount of water that was sprayed was not enough to induce flowering.

PAGACZ (1959) working in a greenhouse in Belgium could confirm these results. In the greenhouse where the supply of water always remained rather high, in short days many flower buds were formed. They remained dormant during 6 to 8 months after which they died or developed into "sterretjes" "(aborted, sterile, small flowers). Good flowers were obtained after spraying the plants two or three times with GA solutions of 50 to 100 ppm.

As the present author did not see any more recent literature on the influence of GA on dormant flower buds of coffee and the experiments mentioned were done with GA solutions in water, it might be worth while to try to confirm these results without the use of water.

Also it might be of interest to investigate whether abscissic acid (ABA) could play a rôle in the maintenance of dormancy.

2. EXPERIMENTS AND RESULTS

The experiments were done in a greenhouse of the Botanical Laboratory in Utrecht, mainly with the species *Coffea canephora*, var. *robusta*. During winter many flower buds were formed all of which remained dormant as long as enough water remained available. In early spring several clusters of flower buds were treated with a small quantity of lanolin paste containing 1 % of GA. The cluster of buds in the axil of the opposite leaf was used as a control; these buds received lanolin paste without GA.

The results gave a very good confirmation of the work of Alvim and of Pagacz. Practically all flower buds treated with GA flowered after 10 days while all controls remained dormant. Similar treatments with IAA and with kinetin had no visible effects.

A few plants were exposed to drought by not watering them during a few weeks. Of these plants a few clusters were treated with lanolin paste containing 200 ppm. abscissic acid (ABA). Again the cluster at the opposite side of the node was used as a control in the same way as in the GA experiments.

After the plants were heavily watered the flower buds started their further development and were in full flower after 10 days. Only the clusters treated with

ABA remained dormant during 3 or 4 months more and than deteriorated or developed into "sterretjes" like normally happened in the greenhouse.

Because only very little ABA was available the experiments could not be repeated. Still they seem to indicate that ABA may cause dormancy in the flower buds while GA breaks this dormancy.

3. DISCUSSION

In the short-day plants *Coffea arabica* and *C. canephora* the flower buds, when induced develop until they are 1 to 1½ cm long and than go into dormancy. This dormancy is broken by rain (or watering the soil only) after a dry spell. The necessity of the dry spell before the rain was shown by ALVIM (1961). In unpublished experiments made in Djember, Indonesia, many years ago, the present author could show that the dry spell could be very short but all the same it was necessary for flowering. *C. canephora* plants were cultivated on nutrient solution for several years. In their third year they developed many flower buds but these remained dormant. When, however, early in the morning the nutrient solution was cooled by adding several pieces of ice, the plants wilted more or less at 10 or 11 a.m. but recovered in the afternoon when the solution was warmed up again to the normal temperature. A week later the plants were flowering abundantly, while the control plants retained their flower buds in a dormant condition.

Because GA too can break this dormancy under conditions when normally flowering would not occur, one might suppose that rain after a spell of drought may cause the production of GA in the dormant buds.

It might be interesting to investigate whether coffee, being an obligate short day plant might react with flower bud formation in long days when ABA is given. WAREING & EL-ANTABLY (1967) could induce flowering under long days in the short day plants *Ribes nigrum* and *Ipomoea nil.* We intend to do this kind of experiments with coffee as soon as more ABA will be available.

Long day plants often can flower in short days after application of GA. So it is likely that under long day circumstances more GA is formed. However, we never did observe that long days could break the dormancy of coffee buds.

Therefore the flowering of coffee plants is probably not controlled by a simple equilibrium of ABA and GA but the experiments certainly indicate that these two hormones may exercise an important influence on the process of flowering.

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