OBSERVATIONS ON THE FLOWERING AND FRUCTIFICATION OF THE GROUNDNUT, *Arachis hypogaea. II*

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SUMMARY

Experiments conducted with pot plants of the Schwarz 21 variety (bunch type) the flowers of which were first counted and then removed at a moment when fructification could not occur, showed that it was possible to prolong the flowering and growth of these plants very considerably. Flowering was not only prolonged until practically the end of the vegetation periods, but the number of flowers reached an unprecedented level.

It was also found that the vegetation period of groundnut plants can be prolonged to more than twelve months by inhibiting fructification.

INTRODUCTION

Fortanier's thesis deals with the effect of removing flowers and gynophores, viz. the prevention of fructification after the flowering of plants of the Schwarz 21 variety. His conclusion is that the presence of fruits has an inhibiting effect on the flowering of *Arachis*. The greater the number of fruuits reaching maturity, the stronger the inhibition. In a series of eight plants which he first allowed to grow without, and subsequently with fruits, he already found more than 4,000 flowers, or an average of 500 per plant. His graph shows that when less than four gynophores (fruits) were present per plant, the number of flowers increases rapidly from normal to super normal numbers. Since, however, he only was interested in the effect which the degree of fruiting has on flower production, he paid no attention to the effect which the degree of fruiting has on the duration of growth of the plants, but the following shows that this effect may be very considerable indeed.

As was demonstrated in a previous article (see BOLHUIS, 1958), there is no fundamental difference between plants of the Schwarz 21 variety grown in pots and grown under field conditions as regards flowering, fructification and growth. Simultaneously with series I, referred to in the said article, consisting of plants of which flowers only were counted, a second series of 15 plants grew up the flowers of which were first counted and then clipped off at the base of the calyx tube at 7 a.m. daily. The corresponding untreated plants of series I were harvested after withering at an age of 105 days.

RESULTS OF THE EXPERIMENT

It soon appeared that the number of flowers, produced by plants of which the flowers were removed, rose from normal to super normal. Although most plants did not show typical signs of dying off, nevertheless after some months symptoms indicating a greatly reduced power of growth appeared. New secondary axes were continually formed on the main stem and lateral branches of the first order, but the internodes of these axes became increasingly shorter and the leaflets smaller, resulting ultimately in a cramped, bushy habit of the

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plants. It is very unfortunate that photographs made of these plants were lost owing to wartime conditions.

A number of data were assembled on the various plants and are included in table 1.

Table 1.

No. of plant	Vegetation period in days	No. of pods at harvest	Total no. of flowers	Condition of plant at harvest	Date of harvest	Last date of flowering
1	345	4	1710	dead	29-10-38	4-10-38
2	422	—	1251	„	14- 1-39	6-11-38
3	345	2	1679	„	29-10-38	13-10-38
4	488	—	1530	„	21- 3-39	14- 3-38
5	289	—	277	„	18- 8-38	27- 4-38
6	488	—	2590	„	21- 3-39	2- 3-39
7	281	—	1667	main axis dead	10- 8-38	6- 8-38
8	281	—	1673	dead axis	10- 8-38	9- 8-38
9	281	2	267	nearly dead	10- 8-38	9- 8-38
10	109	2	81	dead	7- 3-38	20- 1-38
11	366	1	865	nearly dead	19- 4-38	28-10-38
12	373	4	1734	„	26-11-38	2-11-38
13	345	2	1767	dead	29-10-38	28- 9-38
14	318	2	1357	diseased	16- 9-38	—
15	109	2	124	dead	7- 3-38	8- 2-38

The data in table 1 show a considerable variation between the behaviour of the various plants.

In the case of plants nos. 5, 7 and 9, it was noted that during the vegetation period on 27.5.38, 10.7.38 and 5.5.38 two young plants appeared next to the parent plant, apparently from a pod which had developed at a much earlier period from a flower which had either completed its flowering subterraneously or had been unnoticed. In connection with this a marked temporary reduction in flowering intensity was observed in the data of about 3 months previously, indicating that the development of this fruit had caused an inhibitive effect. No explanation can be given of the divergent behaviour in the various plants (narrow spacing may have been a factor).

It is noticeable that certain plants continued flowering until they had more or less stopped their growth, whereas others had long since ceased to flower. It has already been remarked that long-living plants produced leaves which gradually became much reduced in size, but nothing was observed of any reduction in size of the flowers.

A remarkable feature was the greatly increased intensity of flowering. Whereas normally flowering plants seldom produce more than three or four flowers daily, this number increased to more than 20 on certain days in the case of the experimental plants. Remarkable in this connection was an obvious periodicity occurring in the intensity of flowering, short periods of high or very high flowering frequencies alternating with periods of lesser or scarce flowering, a phenomenon which SMITH has already drawn attention to.

Although the numbers of removed flowers counted at Buitenzorg in a number of cases were not particularly large, in each case they proved to be many times greater than the numbers to which the plants are originally predisposed, which indicates that the majority of these flowers were formed as a result

of the flowers being removed or the fructification being suppressed. Hence it would seem that this removes an inhibition which in plants of this variety normally restricts the number of flowers to 60—80 per plant.

The above data were confirmed by the results of a similar experiment conducted in the same year. These results are shown in table 2. When evaluating these results it should be borne in mind that this experiment, which was designed for a different purpose, was terminated when the plants were 212 days old, at which period they were all still completely green and in full bloom.

Table 2.

No. of plant	Total no. of flowers	No. of pods at harvest	No. of plant	Total no. of flowers	No. of pods at harvest
1	2308	1	11	2091	1
2	1042	—	12	974	2
3	1472	1	13	2093	1
4	1227	2	14	1629	1
5	917	3	15	1490	—
6	797	—	16	1643	2
7	1240	2	17	1334	1
8	1086	2	18	1245	—
9	1106	3	19	1665	1
10	1192	2	20	1666	2

From these two tables appears that, respite the fact that the flowers were cut off at the base of the calyx tube at 7 a.m., some fructification still occurred in a number of plants, although, compared to the total number of flowers, the percentage is extremely low. The reason for these errors (?) could not subsequently be ascertained. Three possible causes may be assumed, viz.:

a a few poorly-developed but fertile flowers went unnoticed;
b a flower formed low down remained underground;
c at the time the flowers were clipped off, the pollen tubes were already past the cutting point.

In view of the occurrence of plants without fruits and the very low percentage of fructification, and in the light of certain still unpublished investigations, the last would appear to be the most plausible explanation.

Discussion

The results in tables 1 and 2 demonstrate the enormous stimulus which the suppression of fructification yields to flower production. Under such conditions the number of flowers produced is many times greater than those produced under normal conditions. It is quite certain that the plant is not naturally predisposed to produce such a large number of flowers, so that they must be formed subsequently, but the mechanism of this process is still an open question. The new formation may conceivably occur as the result of a substance which stimulates flowering (florigen?), although it might also be caused by the absence of inhibition, or nutritional competition of the developing fruits.

The results listed in tables 1 and 2 do not convey the impression that inhibition of flowering is proportionate to the number of fruits developing,

as postulated by FORTANIER. We shall have to assume, however, that the fruits found on the plants during harvesting were not formed until a later stage in the vegetation period of the plants; this is already indicated by the reduced intensity of flowering towards the end of the vegetation period. As was already stated in the case of plants 5, 7 and 9 in table 1, early fruits eventually become detached from the plant and begin to germinate, thus again removing the inhibition to flowering. But it will probably also be necessary to take into account the possibility that plants with an abnormally long period of growth require less fructification in order to check the flowering process and initiate the dying off process. As is known, the latter process requires at least six pods per plant in the variety of groundnut employed (see BOLHUIS, 1955).

In addition to the greatly increased intensity of flowering exhibited by plants without pods, we see that the life span of the plants is very much prolonged. The untreated plants which grew up simultaneously with the experimental series were harvested in an entirely ripe state when 100–105 days old. Among the experimental plants an age of 488 days is even to be observed in two cases, so that these plants assume the character of biennials.

According to SMITH peanuts and cotton are "both native to the tropics or subtropics, are indeterminate in growth, and can survive as perennials in frost-free zones". FORTANIER disagrees with this, since, according to his view, the groundnut wilts towards harvest time even when the water supply and temperature are adequate. Hence, although, as shown in table 1, the groundnut is able to assume a biennial character, this only occurs under very abnormal conditions. In the long run the pods formed become detached from the parent plant owing to the gynophore rotting away, but under normal conditions this will not occur until the plant has reached such an advanced stage of wilting that recovery into renewed growth and flowering may deemed to be impossible. Although the case is somowhat different with the runner-type plants used by SMITH, in our view, his generalisation would still seem to be incorrect.

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