

RECENT DEVELOPMENT ON POLLEN SUPPLEMENTS

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This discussion, which is based mainly on research carried out at the Wait Institute in South Australia, will deal with only two aspects of recent research on pollen supplements. These are the concept of a commercial pollen supplement candy, and the way in which the behavior of bee influences the use and value of pollen supplements in commercial beekeeping.

A. Commercial Pollen Supplement Candy

The most efficient and the most economical method of providing protein supplements for honey bees in commercial beekeeping is to use a form of candy, which can be placed inside the hive. However, practical difficulties have prevented commercial beekeepers in general from making full use of pollen supplements in any form, and a new approach to the whole problem has been needed.

This need is met in the concept of a manufactured pollen supplement candy, packed either in the convenient individual packs for immediate use, or in bulk packs, which can be wrapped and used as required by beekeepers. A commercial candy of this type must be so constituted that it retains its consistency and does not deteriorate during storage for periods of up to twelve months or when left unused in the hive for several weeks and it should moreover be held by distributors throughout the main beekeeping regions, so as to be available to all beekeepers at short notice when required. The resulting pack was presented at the XX1st International Apicultural Congress - Maryland - USA 1967.

The Waite Institute pollen supplements Krawaite was developed with these requirements in mind. Acceptance of the pollen supplement by Australian beekeepers has substantiated the validity of the original concept.

Despite the difficult conditions imposed on the industry by drought and depressed export market for honey sales of the pollen supplement have increased steadily. The failures which are inevitable whenever a laboratory project is translated into a practical technique have been due both to a lack of knowledge of basic features of the use of pollen supplements and particular of certain deficiencies which as is now obvious, are common to all pollen supplements. Our main concern now must lie in the direction of understanding these deficiencies and of developing practices which will enable beekeepers to make maximum use of the currently available but somewhat inadequate pollen supplements.

In general, pollen supplements have been recommended only for use in late winter or spring, to stimulate early brood rearing. However, in Australia, pollen deficiencies - either a physical shortage of pollen, or deficiencies resulting from the poor quality of some Australian pollens - may occur at any time of the year. In our research therefore, we have used pollen supplements continuously, and have studied their performance at all times of the year. As a result of these studies, we have accumulated further information on many aspects of the behavior of bees using pollen supplements. This information, properly applied, should help to eliminate much of the confusion surrounding this most complex of beekeeping problems.

Chemical Components in Pollen

In all research projects at which pollen supplements have been compared with pollen in caged colonies, supplements have proved inferior to pollen, and in particular, bees have always consumed more of the pollen than of the artificial food. However in field trials, all the pollen supplements have produced both good and bad results. In the complete absence of pollen, brood rearing and vitality of the bees begins to decline after three to four generations, and this is probably the results of nutritional deficiencies.

Cholesterol, fatty acids, gibberellic acid, plant growth hormones and some trace elements, all of which occur in pollen, have all been found to improve the food quality of pollen supplements as determined by the development of bees and by the amount of brood reared. But these results have also been uneven.

At the present time, the addition of these chemicals to pollen supplements for commercial beekeeping would be difficult, and probably far too expensive to contemplate and further research is needed in this sector of bee nutrition.

Our work in Australia has however demonstrated very clearly that a major weakness of all pollen supplements is that they lack these chemicals to which bees respond, either by collecting pollen in the field, or feeding on it in the hive.

Earliest studies, in the United States, France and Australia, suggested that the function of these chemicals might be limited to eliciting pollen collection or feeding behavior in bees. But our recent studies have suggested that they may have other important effects in the hive.

It is becoming apparent that the varying results obtained in research with pollen supplements are due in part to the behavior pattern of young bees.

In general, bees up the age of seven or eight days are reluctant to leave the brood area. This reluctance is primarily a preference for the temperature of the brood nest although it may possibly be reinforced by some other factor associated with the presence of brood.

This behavior of young bees, which have the highest requirements for pollen supplements, appears to inhibit them from leaving the brood area to feed on pollen supplements.

This inhibition may be overcome by a "starvation factor" resulting from a shortage of pollen in the brood area but our experiments and observations suggest that the chemicals in pollen which attract bees to feed are another factor helping to overcome this reluctance to leave the brood nest. Pollen supplements which contain pollen or a suitable extract of pollen are used more earlier by young bees than the same supplements without these attracting additives.

In general young bees feed more readily on a pollen supplement placed in the cells of the brood combs than they do on the same supplements placed outside the brood area.

If in cold weather the brood cluster is towards one side of the hive and the supplement is placed on the top bars of the brood combs but on the other side of the hive it is in general not eaten readily and must be assumed to be physically inaccessible to the bees.

A recent experiment in South Australia has given indications that the chemicals in pollen may in fact influence some of the more fundamental processes of the hive. In this test, colonies on an autumn honey flow suffered from severe shortage of pollen, and were not using the pollen supplement.

Queens continued to lay eggs, but over a three week period less than 20% of the eggs produced grubs.

Some colonies were then given Krawaite to which had been added pollen, or an extract of an equivalent amount of pollen. These colonies were examined at five-day intervals. The addition of the pollen or pollen extract resulted in an immediate increase, both in the number of eggs laid, and in the number of eggs producing grubs so that five days after the experiment began all eggs were producing grubs.

The control colonies continued to rear grubs from only a proportion of the eggs laid, and the differences between the two groups of colonies remained consistent until the colonies were moved to a new area where there was abundant pollen. Only after this move did the control group rear grubs from all eggs laid. The rapid response of the bees to the improved pollen supplements suggests that this was not only a factor of improved food. It is possible that following a period of pollen shortage, the production of larval food, and the rearing of brood, by bees which were in a suitable physiological state was initiated by some of these chemicals in pollen. There was also some evidence to suggest that egg-laying by the queen was stimulated by chemicals in pollen which may have acted directly upon the queen rather than their effect on the feeding of the queen by the young bees.

It has also been obvious in all our tests that pollen supplements are consumed in relatively large quantities by bees which are past the brood rearing stage. The close correlation between the consumption of pollen supplements and the amount of brood reared indicates that consumption of the candy was not due solely to the fact that pollen supplement candies contain honey or sugar. The consumption of protein food by older bees is known to increase their longevity, and it is probable that the continued high populations and great increases in honey production in our colonies which receive Krawaite continuously were due in part to the longer life of older bees eating the pollen supplement.

These and other observations suggest that it may always be essential for bees to have some pollen in the brood combs to supply the requirements of newly emerged bees until they are ready to leave the brood area.

It may well be that the failure of all pollen supplements to maintain brood rearing in the absence of pollen is related to this fact, and that the performance of pollen supplements may be improved if some means is found of placing it in the cells of the brood combs.

As a consequence of the use of pollen and pollen supplements together, and probably as a particular consequence of the use of pollen supplements by older bees, colonies provided with pollen supplements are usually found to larger areas of stored pollen. This at times may prove to be a problem, owing to the reduction of laying area available to the queen but current studies at the Waite Institute have been concerned with developing practical methods of utilising this habit.

If pollen supplements are fed for instance in late summer, or early autumn, it may be possible to ensure that all colonies enter the winter with adequate stores of pollen which may be extended and supplemented during the winter by further use of pollen supplement.

The effects of such feeding in the autumn should be reflected in stronger colonies and more rapid breeding in spring.

Conclusions

It is clear that in any future research on pollen supplements, account must always be taken of the intake of pollen, and the amount of pollen stored in the colony since this influences the acceptability of the supplement.

A great deal of current confusion on pollen supplements may be obviated if the terms "pollen supplement" and "pollen substitute" are re-defined.

Bees which are receiving pollen supplement candies continue to collect and store pollen.

It is apparent therefore that a pollen "substitute" would in fact be a pollen "supplement", excepting when there was a complete shortage of pollen.

The term "pollen substitute" could profitably be discarded from beekeeping literature.

Scientific research to identifying in the future must be directed towards those chemicals which must eventually be added to pollen supplements to increase their attractiveness and food quality but the most important practical research in the immediate future should be aimed at obtaining a further understanding of the behavior of bees using pollen supplements, so that beekeepers may be shown how to make the best use of the present relatively inadequate, but still very useful pollen supplements.