

POLLINATION ISSUES IN UK TOMATO CROPS

Rob Jacobson, independent IPM and pollination consultant, summarises experiences and opinions of 32 growers who participated in AHDB project PE 031 during 2017



Background

Bumblebees were first introduced to British tomato growers in 1989 via trials on the Isle of Wight. The benefits, in terms of reduced labour and improved fruit set, were so great that by 1992 bumblebees were being used to pollinate virtually all long-season tomato crops in the UK. There followed revisions to hive design but biological pollination was so reliable that growers came to expect perfect fruit set with minimal maintenance.

In the 1980s, three commercial bumblebee producers tested many populations of *Bombus terrestris* to determine which performed most efficiently in culture and which provided the best results in tomato crops. They independently selected two non-native sub-species; *B. terrestris terrestris* (Btt) and *B. terrestris dalmatinus* (Btd). The British native sub-species, *B. terrestris audax* (Bta) was dismissed due to inferior performance. In the 28 years since the first release of non-native bumblebees, there has been no evidence of their establishment outside UK glasshouses or detrimental effects on natural bumblebee populations.

In 2014, Natural England (NE) produced a document which suggested that non-native bumblebees could hybridise with wild Bta leading to the local extinction of Bta. In addition, NE proposed that the use of non-native sub-species could lead to the transfer of harmful parasites and pathogens from commercially reared *Bombus terrestris* to wild bumblebees in the UK. Following an open consultation, NE revised its policy and permission to use non-native bumblebees in unscreened glasshouses was withdrawn from 31 December 2014. Commercially reared native Bta could still be used without a license.

The use of Bta in 2015 proved to be far from the reliable and maintenance-free experience to which growers had become accustomed. In fact, several growers suffered such poor results that they reverted to labour-intensive manual methods of pollination that had not been required since bumblebees were first introduced. The British Tomato Growers' Association's Technical Committee organised an in-depth survey of tomato growers to gather more information about

the current situation. Growers representing 98% of the UK tomato production area participated in this project which provides a foundation of knowledge upon which to construct a practical research programme.



Example of poor fruit set on a truss of tomato cultivar Dometica

Summary of findings

The clearest overall message from British tomato growers was the general belief that Bta are less 'vigorous' than previously used non-native sub-species and more likely to fail to provide adequate pollination should any aspect of flower development or ambient conditions be sub-optimal for their performance.

No growers considered the performance of Bta to have surpassed Btt/Btd but 34% believed that their performance was similar - albeit with many more Bta hives being used. However, 28% of growers said Bta were poorer, 28% said much poorer and 9% said very much poorer than Btt/Btd. One grower estimated that poor fruit set cost his business £50k / ha in 2015. In addition, reduced confidence in bumblebees led to 75% of growers devoting more labour to monitoring fruit set which was an additional cost to their businesses.

Planned Bta hive input schedules varied greatly between suppliers, sites, types of tomatoes and length of growing season. A large proportion of growers' said they required additional hives to those included in the planned schedule. In 78% of cases, the supplier accepted the growers' judgement and provided extra hives without further investigation. To summarise, 28% of growers occasionally ordered extra Bta hives while 69% said this was a frequent requirement.

47% of growers thought Bta colony life was considerably shorter than they had come to expect from non-native bumblebees. Shorter than anticipated colony life could result in gaps in the planned schedule causing a breakdown in the continuity of bumblebee activity which might explain why so many additional Bta hives were ordered. Four growers reported improved results when they changed from fortnightly to weekly hive deliveries which was thought to reduce peaks and troughs in bumblebee activity.

44% of growers linked poor performance of Bta to poor foraging during hot conditions. Such conditions were poorly defined but probably involved temperatures exceeding 28°C for at least 5-6 hours. This may be a direct effect of temperature on the bumblebees or an indirect effect via flower development and pollen quality. The remaining 56% of growers did not express an opinion on this subject.

One third of growers said their staff had asked “*Where are the bees?*” at some point during the season. This related to the apparent lack of Bta activity during working hours. One grower believed that this was because Bta foraged early in the morning and their activity was underestimated. If correct, then Bta activity may be poorly synchronised to pollen release in tomato flowers. This theory requires further investigation.

All types of tomato are affected by poor set but problems are most serious in smaller fruiting cultivars which produce more flowers. The plant may compensate for missed set by producing larger remaining fruit. Assuming those larger fruit are picked loose and sold by weight, then some of the lost yield will be recovered. The issues are more serious where tomatoes are ripened on the plant and harvested as whole trusses. Apart from the obvious loss of fruit, missed set within a truss results in additional labour to make adjustments to those trusses in the pack house.

One grower, who reported a reduction in bumblebee efficacy since the switch to Bta, also reported a move to small fruiting cultivars during the same period. This was typical of an overall UK trend. In 2011, only 28.8% of UK tomato production was of the cherry / cocktail type but by 2016 (*i.e.* post Bta) it had increased to 76.9%. This is clearly an important factor.

Only 12% of growers considered that the condition of plants could be the underlying cause of poor set experienced on their sites during the last three years. Nonetheless, there is a strong belief among some consultants and growers that vegetative, rather than generative, tomato plant growth results in weaker flowers and poorer set. One grower thought that current crop husbandry practice led to poor pollen quality in modern tomato cultivars. In his opinion, if plants

are strong and generative, then pollen flows freely and may not even need disturbance by bumblebees to pollinate. Another grower said that pollen did not flow freely in humid conditions and speculated that Btt/Btd could cope with this but Bta could not. In fact, very little research has been published on flowering and fruit set in tomato since the late 1980s when bumblebees were first introduced. There can be little doubt that flower development and pollen quality in modern tomato cultivars requires further investigation.

Where do we go from here?

The survey suggests that future studies into fruit set should focus upon:

- Bta biology and behaviour under different environmental conditions with particular emphasis on synchrony between bumblebee foraging and optimum pollen flow.
- Bta colony life in greenhouses and the associated impact on hive input schedules.
- The influence of environmental conditions on flower quality and pollen flow in small fruiting cultivars which now make up 76.9% of UK production.
- Changes in bumblebee usage and agronomic practice required to optimise pollination and fruit set

The full report for project PE 031 may be obtained from the AHDB website.