

FINAL REPORT

Project Title: A new pollinator from the homeland of apples
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Year initiated: 2001
Terminating year: 2005 (with no-cost extension)

OBJECTIVES:

- 1) to characterize the pollinating behavior of Tien Shan Mountain bees within regions of the wild apple forest and on cultivated apples.
- 2) to establish collaborators within this region and apiaries for queen rearing and importation
- 3) Initiate the importation, quarantine and field testing of stock.
- 4) Develop protocol for the dissemination of selected honey bee stocks to queen producers and beekeepers that serve the tree fruit growers of Washington State.

Explanation of deviation from original objectives or schedule (Relevant for objective 3 only). Importation and quarantine of *Apis mellifera pomonella* was delayed initially due to lack of availability of quarantine facility in Grande Terre Island, LA, in 2004 due to sabbatical leave of P.I. and in 2005 by a political coup in Kyrgyzstan that led to travel warnings for US citizens by the state department.

SIGNIFICANT FINDINGS:

Obj. 1 - Data analysis from field and apiary studies indicated that the honey bees of the Tien Shan Mountains belong to a previously undescribed subspecies. The new subspecies was named scientifically *Apis mellifera pomonella*, in reference to its role as a pollinator of wild apples in their original range and area of endemism. Two articles about the new subspecies and its potential as an apple pollinator were published in The Goodfruit Grower and Bee Culture. The subspecies description was published in Apidologie, an international journal of bee research. Foraging data indicated that this subspecies forages for pollen at temperatures lower than reported for Italian honey bees in common use in the U.S.

Obj. 2 – Two areas within the homeland of the Tien Shan Honey Bee were evaluated as sources of honey bee germplasm for subsequent importation. **Kazakhstan:** Mr. Urazajev Zufar, a local beekeeper from the village of Jabagly agreed to provide honey bee stocks collected from a nearby genetic reserve. Mr. Zufar had assisted in the initial “discovery” of this subspecies during a WSU-USDA expedition (Unruh and Sheppard, 1999). Dr. Roman Jashenko of the Institute of Zoology in Almaty agreed to assist with all exportation permits. As President of the NGO Tethys, Dr. Jashenko is highly familiar with the regulations and procedures needed to export scientific material from Kazakhstan. **Kyrgyzstan:** Mr. Hugh Brown, Chief of Protocol of the ACIDI-VOCA office facilitated travel in 2003 to 4 remote village areas in western Kyrgyzstan. The remoteness of the area surveyed, together with extensive interactions with local beekeepers and evaluation of *A. m. pomonella* from these locations, indicated that the honey bee stocks were unlikely to have any genetic introgression from European sources (unlike the Jabagly region). Collaborations were established for the importation of bees from the following specific areas: Zerger Village – Malik Joldoshabaev (school principal with knowledge of local beekeepers); Kyzyl-Kol – Beishenbek Kenjebaev (school principal,

beekeeper, with knowledge of local beekeepers); Kara-Suu – Arstanbai Shaidyldaev (beekeeper, leader of local bee association, knowledge of local beekeepers); Kara-Jygach - Mr. Bazabak (Deputy village administrator – limited knowledge of local beekeepers), Mr. Duishenbek (beekeeper)

Obj. 3 - Initiated importation protocols with USDA-APHIS and LA Department of Agriculture to bring queens into USDA quarantine on Grande Terre Island (LA). Actual importation of germplasm was delayed due to quarantine issues, Sheppard sabbatical leave in 2004 and presidential coup in Kyrgyzstan in 2005. Grande Terre will be returned to quarantine duty in 2006 (after clean-up completion from the 2005 hurricane) and WSU is negotiating for use of the facility in 2006. Importation funds will be provided through the Thurber endowment to complete this phase of the original project following the termination of WSTFRC support. The bees will be available for evaluation and inclusion in the WSU breeding program immediately after their release from USDA quarantine.

Obj. 4 – Selective breeding of mite and disease resistant stocks for use in tree fruit pollination. We have selected and maintained 8 genetic lines of honey bees for apicultural traits of interest to PNW beekeepers. These populations express high levels of hygienic behavior (a characteristic known to be linked to related to disease and mite resistance), overwintering and spring build-up ability under PNW conditions, honey production, gentleness and evidence of disease resistance. In 2005, mite levels measured in WSU apiaries were below our estimated IPM thresholds and we omitted any chemical control for *Varroa* mites. The ability to maintain colonies without miticides represents a significant jump in the selection pressure we can use to develop mite-tolerant honey bees. Collaborative arrangements with the WA State Beekeeping Association were made in 2005 to establish WSU-WSBA (Washington State Beekeepers Association) apiaries. Each apiary will contain queens of all 8 genetic lines from the WSU honey bee breeding program. This will serve as a model to distribute selected honey bee stocks to the industry in a rapid manner, as these apiaries will be used by Washington beekeepers to make daughter queens or to use as drone source for their own selection programs.

METHODS:

As part of a continuing WSU Honey Bee Breeding Program, the new subspecies will be assessed for overwintering ability, pollinating activity, disease resistance and other apicultural. The breeding program was initiated concurrently with the WSTFRC Project with the primary goal to develop mite and disease resistant lines for beekeeping under PNW conditions and to provide beekeepers with better adapted honey bee stocks for tree fruit pollination.

The original pool of germplasm for selective breeding was assembled by purchasing queens from all available commercial US honey bee stocks in 2001 and 2002. From this pool of several hundred colonies, we have selected and maintain 8 genetic lines through 2005. The eventual composition of the stocks maintained within the program will include 10 genetic lines, one of which will be the Tien Shan Mountain Bee.

The selective criteria and scoring system include:

- 1) overwintering ability under PNW conditions. Colonies that survive the winter and build up well in the Spring are given a numerical bonus
- 2) short term weight gain through the honey flow. This measure is known to be correlated with the trait of honey production and colonies are comparatively ranked.

3) gentleness and behavior on the combs. Colonies are given a numerical score during each inspection and a final average score for behavior at the time of selection.

4) hygienic behavior. Colonies are subjected to a freeze-killed brood assay that measures their propensity to clean out dead brood within a specified time. Hygienic behavior has been positively linked to disease resistance and possibly Varroa mite tolerance.

5) freedom from disease symptoms. Colonies that exhibit disease symptoms are removed from breeding consideration.

The breeding scheme uses family level selection to reduce the effects of inbreeding. Each of the 8 genetic lines are used to produce daughter queens for the next generation. Within the pool of daughters of each “family” or line, the highest scoring queen is used as the queen mother to produce virgin queens for the subsequent generation. All matings are done at our genetically isolated mating station on Smoot Hill, near Albion, WA. Up to 100 daughters of each line are produced and evaluated annually.

Beekeeping/grower input. Beginning in 2004, WSU selected lines were provided gratis to interested beekeeper collaborators to provide us with feedback on the progress of selection. In 2005 a USDA-SARE grant application was submitted that will continue the breeding program for 3 additional years and formalize the transition to higher levels of WA State Beekeeper involvement. In 2006, two collaborative WSU-WSBA apiaries will be established (run by WSBA members) to permit more widespread use of WSU selected stocks by WA beekeepers. A new project to test these stocks in large scale commercial beekeeping and pollinating operations began in Jan 2006. Two commercial collaborators (running 8,000 and 4,200 beehives, respectively) will take part in a large-scale experiment to compare WSU selected stocks and typical Italian commercial stocks under commercial pollinating practices in apples and alfalfa.

RESULTS AND DISCUSSION:

The Results have been largely addressed above in Significant Findings. Unquestionably, this WSTFRC-funded project has significantly improved our understanding of the native range and genetic potential of the honey bee. It led to the discovery and naming of a honey bee that was new to science (*A. m pomonella*) and native to the wild apple forests of central Asia. Just as this region is fundamentally important to the exploration for germplasm diversity within apples, the region holds the potential to unlock improved pollinating potential within the honey bee. Current honey bee populations in the US are primarily descendents of bees from the warm Mediterranean climate of Italy and, while these bees are well suited for commercial beekeeping and honey production when managed without significant overwintering, we can reasonably expect that honey bees from the native homeland of apples in the Tien Shan will be better-suited to climatological conditions that are ideal for apple production.

The biggest challenge to Washington beekeepers at present remains the parasitic mite *Varroa destructor* and the commitment of WSU to work to actively breed honey bees for tolerance to this mite has been substantial. In 2005, after 4-6 years of selection within the different genetic lines – progress was demonstrated by the overall low mite levels found in our apiaries in the Fall. In this year, for the first time since the advent of *Varroa* treatment in the 1990,s, we DID NOT TREAT for *Varroa destructor*. We plan to continue this selection and breeding program and, importantly, continue to also select honey bees for mite tolerance and other traits of importance to the industry (honey production, overwintering, build-up, behavior). The inclusion of *A. m. pomonella* within the

breeding scheme is an important component of our plan to optimize honey bees for use in the PNW. With *pomonella* we will include an additional selective criterion, low temperature foraging activity, and combine it with our mite tolerant characteristics. I believe that this will result in a honey bee that is both highly desirable for WA State beekeepers and better suited to fulfill the pollination needs of the WA tree fruit industry.

The support of the WSTFRC has been a significant help in making this research possible. It is generally known that breeding programs involve a rather lengthy time horizon and bee breeding is no exception. However, I am committed to build on the progress made possible by WSTFRC funding and will use WSU Thurber endowment funds available to me to complete the germplasm importation in 2006 or 2007 (depending on USDA quarantine allotments). This importation will represent the only non-USDA importation of honey be germplasm for breeding purposes since 1922. A pending USDA-SARE grant will enable us to complete the transition from a research effort and breeding program involving a few hundred colonies to widespread availability of the genetic stocks to Washington beekeepers.. The exigencies of the market and industry forces remain an unknown, but the dire straits brought about by *Varroa* mite losses will clearly contribute to providing exposure and testing of the WSU-WSBA honey bee lines by beekeepers for use in tree fruit and other pollination activities.

ANTICIPATED BENEFITS AND INFORMATION TRANSFER:

The primary goal of this research is to facilitate the importation and distribution of a honey bee more appropriate to the pollination of tree fruit crops under the climatic conditions of Washington State. Results will be transferred via subsequent extension efforts to promote the use of these bees by queen producers and state beekeepers. Commercial honey bee populations will benefit through enhanced genetic diversity brought about by the inclusion of new bee germplasm. The goal is to incorporate desirable features into a stock better suited for the cool pollinating conditions of Washington State.

BUDGET: 2001-2005	28,145
ITEMS	
Beekeeping and analytical supplies	13,355
Equipment	5,512
Pending assignment	9,278.....



Zerger village Kyrgyzstan. Wild apple and walnut forests, apiary of *A. m. pomonella*

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[Apiary of A m pomonella in Russian style chest hives](#)