The Use of Asian Honeybees for Sustainable Apiculture in Afghanistan

Zabul ADT, MSG James Doten, July 10, 2012

Background

The use of honeybees in agriculture (apiculture) is a well known technique to improve crop production. In Zabul Province the main agricultural products are almonds, pomegranates, and grapes. Farmers also grow significant quantities of apricots and figs. Pollination is critical for crops such as almonds which require cross-pollination. Natural pollinators exist but successful apiculture can result in a 40% increase in almond yield. Apiculture also significantly increases yields for pomegranates, apricots, and figs. Grapes are self-pollinating and do not benefit from apiculture.

In addition to increased yield, the quality of the product will improve as a result of fully pollinating the flower. An apple requires up to five trips before becoming fully fertilized. Bees are efficient pollinators because of their behavior, known as *foraging consistency*, in only working one plant species per trip. A bee will visit hundreds of flowers each trip, each bee makes about 10 trips a day. If placed near an orchard the bees will consistently pollinate the orchard during its specific bloom. Growers in the United States take advantage of this behavior by moving hives into an orchard near bloom season. As long as the food source is near the bees will pollinate only the desired plants in the orchard. The bees are then moved to another location to match different bloom times.

Apiculture in the United States uses the European honeybee (*Apis Mellifera*). This species is suited for moving across the country and is known for its prolific honey production. Hobby beekeepers maintain small stationary apiaries (where bees and hives are kept) containing the European honeybee. The equipment and practices have been standardized in both commercial and hobby beekeeping.

Problem Statement

Attempts to introduce small-scale beekeeping for rural development in Afghanistan have failed. Environmental threats destroyed previous projects using the imported European honeybee. Using the native Asian honeybee (*Apis Cerana*) shows promise in developing sustainable apiculture by restoring traditional Afghan beekeeping techniques.

Threats

Colony Collapse Disorder

Within the past ten years beekeeping in the United States has been threatened by colony collapse disorder (CCD) and *varroa* mite infestation (figure 1). CCD has been associated with commercial beekeeping and resulting tendency to concentrate colonies from across the country in one location. It has not impacted isolated apiaries of the hobby beekeeper. One of the theories behind CCD affecting commercial operations is their use of high-fructose corn syrup and an associated pesticide found in the syrup. Hobby beekeepers do not use the corn syrup and thus did not experience CCD to a significant degree.

Varroa mite

Varroa mites plague bee colonies and can devastate a colony within months. The mite attacks both adult bees and developing larvae. After feeding on the pupa during development, the emergent bee is infested with as many as six new mites, starting the cycle over. The *varroa* mite problem is growing. First encountered in Florida in the late 1980's the infestation soon spread. The *varroa* mite is the greatest threat to apiculture using *Apis Mellifera* (European). It weakens the bee and also carries the deformed wing virus (DWV). With the mites present, the virus concentrations increase a million-fold. The *varroa* mite is devastating to European honeybee colonies. The mite wiped out all feral European honeybee colonies in the United States. Since the emergence of the mite problem in the United States, beekeeping as a hobby has been reduced by 50%.

The mite infestation requires active intervention to prevent a colony from being destroyed within months. In the United States, efforts are being directed towards developing a strain of bees that exhibit hygienic behavior in removing infected pupae from the hive. These varieties are not well distributed and are unavailable in Afghanistan. Miticides can control infestation, but these are not a cure and are not available to small scale beekeepers in Afghanistan. Essential oils can also reduce infestation levels but are not available to farmers in Afghanistan. The *varroa* mite is native to Afghanistan; its presence makes it hard to develop sustainable small-scale apiculture projects.

Figure 1. Mite infested bee

Previous attempts to develop apiculture in Afghanistan followed the US model. Imported European honeybee colonies were used to start small-scale operations that emulate hobbyist beekeeping in the United States. If infected, the *varroa* mite will destroy these hives within months of infestation.

The *varroa* mite is native to Afghanistan. It is a pest to its natural host, the Asian honeybee, *Apis Cerana* (figure 2). *Apis Cerana* is one of four honeybee species native to Afghanistan, but the only one capable of being kept in hives. The Asian honeybee coevolved with *varroa* mite and developed a grooming behavior that reduces it from a threat to a nuisance. The Asian honeybee lifecycle, when compared to European honeybee, also does not allow as many mites to develop in the egg-laying stage during pupation.

Figure 2. *Apis Mellifera* (left) and *Apis Cerana* (right)

Wasps

Another threat to European honeybee projects in Afghanistan is the presence of large wasps (hornets) native to the region. The wasps (figure 3) overwhelm the bees' defenses, kill the bees defending the hive, and then steal the larvae and honey. When attacking, the wasps can destroy a European honeybee colony within four hours.

Previous U.S. Army European honeybee projects in Zabul were destroyed by wasps before the *varroa* mite could have an effect. Interviews with local farmers show that the wasps are prevalent throughout the province. ZADT developed local wasp traps, but they are not 100% effective in preventing hive loss from wasp predation. The wasps are aggressive and make it difficult for farmers to work in their orchards.

Figure 3. Wasp

The wasp is a natural predator of the bees. The imported European honeybee does not have defense against the wasp. They attempt to sting the intruder; however, their stinger cannot penetrate the thick skin of the wasp. The Department of Agriculture, Irrigation, and Livestock (DAIL) employees reported the wasps destroyed their European honeybee colonies soon after starting the project. None of the DAIL apiculture projects using European honeybee lasted more than three months.

The native Asian honeybee coevolved with the wasp and has developed an effective defense despite being 1/3 smaller than European honeybee. The Asian honeybee surrounds the wasp in a ball with 100 to 150 bees. The bees beat their wings to increase the temperature inside the cluster in a defense known as *thermal-balling* (figure 4). The temperature is raised above a lethal level for the wasp but below that of the Asian honeybee. The wasp will kill solitary foragers of the Asian honeybee without triggering the defense mechanism. However, when the wasp tries to enter the hive, the Asian honeybee actively defends the entrance. Villagers with colonies of the Asian honeybee reported the bees successfully defeated wasp attacks. ZADT members witnessed this defense at a demonstration project.

Figure 4. Thermal-balling

The Asian honeybee has coexisted with these wasps throughout its territory. The Japanese are actively restoring their traditional beekeeping traditions using *Apis Cerana* in Japan. Part of the reason for switching from the European honeybee is the large Japanese hornet. Japanese scientists studied the thermal-ball defense and were the ones to discover how it works. In Japan the Asian honeybee honey commands a price four times as high as the European honeybee honey. Sustainable apiculture using the Asian honeybee is wide-spread throughout southern and southeastern Asia.

Comparison

Table 1 summarizes The International Centre for Integrated Mountain Development's (ICIMOD) comparative study for small-scale rural apiculture development projects.

Table 1. ICIMOD *Apis Cerana* versus *Apis Mellifera*

Parameter	Apis Cerana (Asian)	Apis Mellifera (European)
Initial investment	Very low	High
Colony management costs	Negligible	High
Risk involved	Low	High
Potential for stationary beekeeping	Suitable	Not suitable
Susceptible to mites and predators	Resistant	Susceptible
Eco-services	High	Low

The University of California – Davis (UC-Davis) developed an economic analysis of honeybee business in Afghanistan. The results of the UC-Davis study found that stationary beekeeping with the Asian honeybee is profitable even at small scales. They found it well-suited for small stationary beekeeping projects. They also concluded that the European honeybee requires at least 100 colonies before it is economical. In addition, the UC-Davis study found that the European honeybee was well suited for migratory beekeeping. It tolerates movement around the province to follow key crop blooms.

Once established, the Asian honeybee does not tolerate moving the hive. The Asian honeybee is only for stationary beekeeping. Studies show the Asian honeybee is a more efficient pollinator than the European honeybee. Crop yields are higher using the Asian honeybee. The Asian honeybee operates at lower temperatures, so they begin pollinating earlier than the European honeybee. This is critical in Zabul Province's almond production which begins to bloom in March. The Asian honeybee is more effective in pollinating key crops and can pollinate a higher variety of plants. With smaller hives and colonies, the Asian honeybee requires less forage for survival.

The European honeybee colonies are larger and produce a large quantity of surplus honey. Asian honeybee colonies are smaller, producing less honey. The foraging range of the Asian honeybee is one half that of the European honeybee. This means it covers only a quarter of the area. However, the range of the European honeybee exceeds the requirements of most villages. The Asian honeybee adequately covers a village and surrounding areas.

Strengths

Apis Mellifera

The European honeybee is well suited for large scale, commercial operations of at least 100 hives. At this scale equipment and maintenance costs are covered by honey production. The species works well for migratory beekeeping. It works best in monoculture environments such as an almond orchard. They have a larger foraging area than the Asian honeybee and produce more honey per hive. Migratory beekeeping on a large scale returns $2 for every $1`invested. The high initial investment and low returns make it unprofitable at smaller scales.

Apis Cerana

The Asian honeybee is well-suited for small scale stationary operation. It is economical at any scale because of the small initial investment, simple equipment requirements, and negligible operating costs. Small-scale

Asian honeybee projects return $4.5 for every $1 invested. The Asian honeybee is a more efficient pollinator resulting in greater increases in village income through pollination services more than the European honeybee**.** One estimate cited by UC-Davis claims $14 benefit for every $1 invested due to increased production. The Asian honeybee is native to the region and tolerant of pests and diseases such as mites and wasps that destroy imported the European honeybee**.**

The equipment is simpler, smaller, and less expensive than that for the European honeybee. By using simple designs such as the Japanese box pile hive, villagers can locally reproduce the hives easier than standard European bee equipment. The Asian honeybee can sustain itself even when orchard crops are not blooming by foraging in the surrounding area for desert flowering plants. The Asian honeybee is known for its ability to survive and thrive in harsh, marginal conditions.

Weaknesses

European honeybee

The European honeybee is an exotic, imported species that is vulnerable to environmental threats such as mites and wasps. It is more expensive than the Asian honeybee to set up and complicated to maintain. It requires a minimum of 100 hives before breaking even. The high initial investment and low returns make it unprofitable at smaller scales. The European honeybee requires migration, intensive management, standardized equipment, and a larger foraging area with a monoculture-based agriculture. European honeybee projects usually fail in Afghanistan despite extensive intervention.

Apis Cerana

The Asian honeybees have a smaller foraging range and are ill-suited for migratory beekeeping. They produce less honey per hive but the honey is considered more valuable in overseas markets. The Asian honeybees cannot be raised near areas where European honeybees are used as they will raid honey from the European hives.

Analysis

Army sponsored apiculture projects previously focused on the European honeybee for several reasons. Past projects concentrated on honey production rather than pollination as the primary desired result. European honeybees are superior honey producers with its larger hives. Also, practices in the U.S. solely use the European honeybee as our techniques were adopted from Europe. The European honeybee is well suited for the type of agricultural practices in the United States. Army practitioners from the United States are only familiar with the European honeybee and are unaware of the Asian honeybee as an alternative.

The Asian honeybee is the traditional honeybee used by Afghan beekeepers, particularly in the mountainous, border areas of Pakistan. Prior to the Soviet invasion, large-scale commercial beekeeping was practiced using the European honeybee similar to the United States. This capability was destroyed in the resulting occupation. Our attempts to rebuild apiculture mimic how we do it in the United States. The focus is on small-scale, income-building for vulnerable populations. Given the high initial costs, these were largely subsidized operations. Given the intensive management requirements of the European honeybee in this environment, the project success rate is likely very low, if not near zero.

Recommendation

Using the Asian honeybee as an alternative provides the Army a sustainable apiculture option that is economical. It restores traditional Afghan practices and is well suited for the environment. The Asian honeybee provides more efficient pollination. This will significantly improve rural income through better yields and improved quality of key agricultural products. It will require additional training of Army personnel to learn about the Asian honeybee and how it differs from the European beekeeping. The Asian honeybee is well suited for small-scale, village level rural development. The European honeybee is still relevant. However, it use should be concentrated on developing large-scale, migratory commercial or cooperative operations.