Distinctions Between Russian and Italian Breeds of *Apis mellifera* as Seen in Northeastern Beekeeping

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Introduction & Background

The European honeybee, *Apis mellifera,* has been facing issues leading to an alarmingly high mortality rate across the world. In the past few years colony collapse disorder (CCD) has been identified as a main condition affecting bee populations.[1] CCD is a phenomenon that occurs when the majority of worker bees in a colony disappear and leave an otherwise healthy hive. CCD significantly damages bee populations affecting agriculture and biodiversity, although its exact cause is unknown, many factors are theorized.

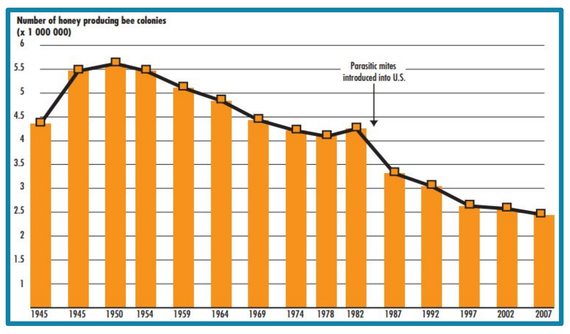


Figure- 1
This chart depicts the honeybee population in the United States, noting the introduction of the parasitic mite *Varroa destructor* to the nation.
Figure Source- U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service (NASS)

The current suppositions break down into three categories: parasites, pesticides, and infections.[1] The mite *Varroa destructor* is considered to be a major cause of CCD and their infestation is highly prevalent. Varroa mites, originally parasites of the Asian honeybee *Apis cerana,* are vectors for several diseases and generally causes the dangerous condition known as varroosis.[2]

Figure- 2
The image on the left shows a Russian honeybee queen with its distinctive dark coloring. On the right is an Italian queen with its light coloring
Image Sources-
Google images, labeled for reuse.

One of the most promising solutions involves the switching from the Italian honeybee to the hardier Russian honeybee breed. Italian bees, the subspecies *Apis mellifera ligustica*,[3] have become very popular in the United States. The Russian bee is specially bred, first in Russia and now by the *Russian Honey Bee Breeders Association, Inc.* in the U.S., to surviving mite infestations with various biological mechanisms. Because of the benefits of possibly limiting Varroa infestation, the USDA has recently started to support the use of Russian bees in the United States.[4] Beekeepers have expressed interest in switching to Russian or Russian hybrid bees but are uncertain due to lack of information. Russian honeybees are widely believed to be more aggressive, produce less honey, and swarm more often.

Problem Statement

The overarching aim was to establish quantifiable differences, the advantages/disadvantages, between Italian and Russian breeds of bees in order to demonstrate the benefits of each for beekeepers in the Northeast.

Hypothesis

- The Russian honey bees will have **greater mite resistance** than the Italian breed
- However, the Russian breed will **produce less honey** and be less beekeeper friendly

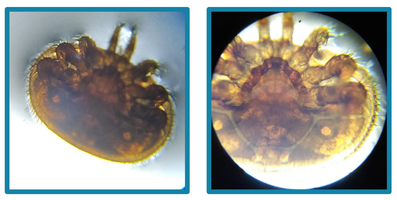
Materials & Methods

Materials

- Two **three-pound packages** of Italian honey bees, each consisting of approximately 10,000 honeybees and an Italian queen,
- Two Russian Honey Bee Breeders Association **certified Primorsky queens**
- **Isopropyl alcohol(C_3H_8O)** with a concentration of 91% by volume was used as the washing agent for mite counts.
- Four **36"x15"x12" top-bar hives** constructed of untreated plywood
- Four standard-sized **mason jars** with a lid containing a **1/8th inch wire mesh**.
- Standard beekeeping equipment, consisting of a **jacket, veil, and gloves,** utilized for safety

Figure- 3
The experiment's hive setup. The left two hives are the Italian ones and the right two were the Russians.

Figure- 4 ➡
The images depict ventral views of mite *Varroa destructor,* photographed on 7/8/18 under 100x magnification.



⬅ Figure- 5
Setup of mite infestation rate alcohol shake test. Sample taken on 7/8/18 shown.

Methods

- The packages of Italian honey bees, ***Apis mellifera ligustica,*** were hived in two of the four top-bar hives .
- After three weeks the Italian **colonies were split**, where half of the worker bees were placed in two separate top bar hives and **requeened** with certified Primorsky queens.
- **Mite infestation rate** (MIR; the number of mites per honeybee) was calculated from a sample of approximately **100 bees**
- Each sample was then placed into a mason jar containing approximately **200 mL of isopropyl alcohol**, killing the bees and enabling mite counts.
- After a sample from every hive was taken, each jar was **vigorously shaken** for approximately thirty seconds.
- The jars, fitted with a lid containing a wire mesh filter were then dumped into a clear plastic cup. Holding each cup up to a light, the **number of Varroa mites** was counted. Mites were distinguished from debris based on their distinctive orange color and characteristic elliptical shape and were **confirmed with microscopy.**
- After the alcohol wash, the jars were filled with a comparable amount of water and the procedure was repeated
- The number of honeybees in each sample was then counted to calculate **(# of mites)/ (# of bees).**
- The metric of honey surplus collected weekly and was defined as **complete bars of honey** that contain no other kinds of comb cell.
- Weather data from the National Oceanic and Atmospheric Administration **(NOAA)** was included in this experiment. This data, from the nearest recording location to the testing site Danbury CT, is public access online through NOAA's website.
- Data was collected weekly, starting on **July** 8, 2018 and ending on **September** 30, 2018.

Results & Analysis

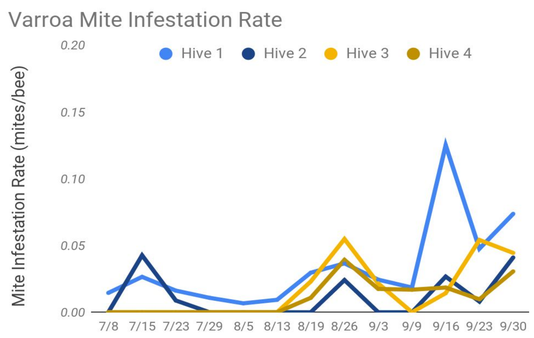


Figure- 6
Percent varroa mite infestation of each hive. Italian hives in blue and Russian hives in yellow.

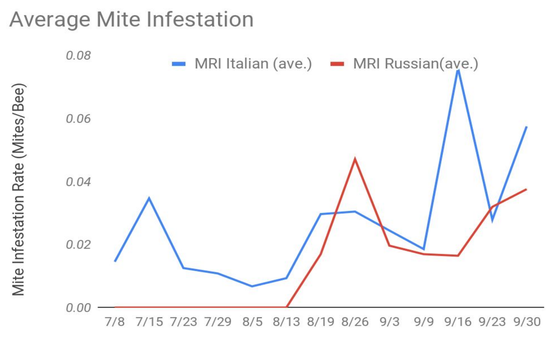


Figure - 7
Infestation rate averaged for Italian and Russian experimental groups. Italian hives in blue and Russian hives in red.

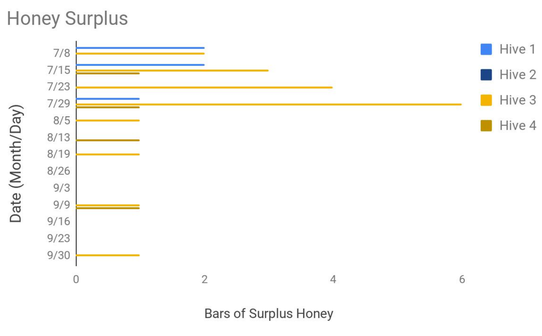


Figure- 8
Bars of honey surplus of each hive. Italian hives in blue, Russian hives in yellow.

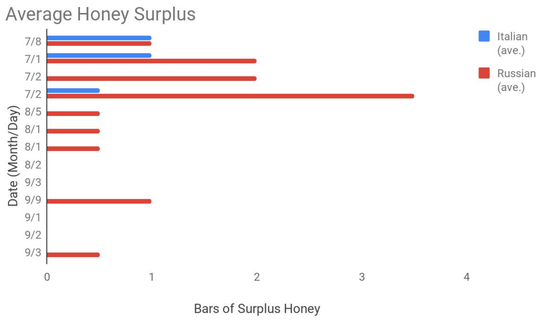


Figure- 9
Average bars of honey surplus of each breed Italian hives in blue and Russian hives in red

Mite Infestation- The mite infestation rate (MIR) was monitored for the Italian and Russian bee populations over a period of 13 weeks. Overall, the MIR was on average 1.28% higher for the Italian bees compared to the Russian bees, determined by a global average of the difference between weekly MIRs in the Russian and Italian experimental groups.

Honey Production- The majority of the excess honey, for all four hives, was observed in the first month of data collection, July, whereas the months of August and September saw very low production in comparison. The highest amount of surplus honey for an Italian hive was two bars on July 8th/15th while the Russian hive three has six bars on July 29th. It was found that the Russian hives stored, on average, a honey surplus of 1.3 bars of honey more than the Italians

Climatological Variables- No correlation was found between with Varroa mite infestation rate and Climatological variables tracked over the data collection period.

Discussion

The data supports the hypothesis that Russian bees show greater *Varroa destructor* resistance, with an infestation rate of 1.28% less than the Italians. Although, the Russian bees produced an average of 1.3 more honey bars, contradicting the assumption that the Italians are superior producers. It is likely that the Russian bees demonstrated superior mite resistance as they were bred to have improved hygienic behavior, mating patterns and frugal brood rearing.[5] Attempts were made to explain discrepancies in the data where Russian bees demonstrated higher infection rates with use of climatological data. However, no correlation was found between these metrics, except in the case of precipitation and honey production which occurred regardless of breed.

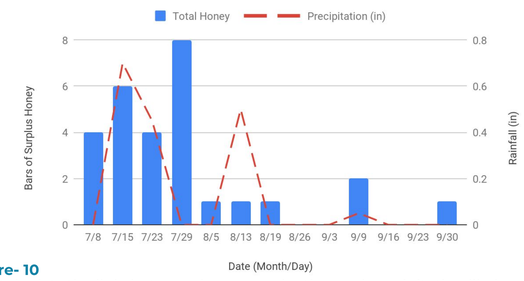


Figure- 10
Chart depicts the link between honey production and precipitation likely related to the relationship between plant's never stores and the ecosystem's water availability.

The results of this experiment must be considered within the scope of its limitations. The small sample size was in no way enough to draw generalized conclusions and advanced statistics. There may have also been flaws in conserving the genetic purity of the experimental groups. The close proximity of the two groups introduced a strong possibility of cross-breeding. Lastly, the unorthodox top-bar hive style chosen for the experiment concealed the true amount of honey produced by each hive.

Impact

The positive conclusions drawn about the Russian breed of *Apis mellifera* can serve as a strong incentive for beekeepers, both locally and elsewhere, to switch to the Russian bee and help end the global pollinator crisis.

Future Research & Conclusion

More studies, with a greater sample sizes, would allow for confirmation of this study. Additionally, there are many other vacancies in the scientific literature with many assumptions being based purely off of anecdotal evidence. It may be useful to conduct a widespread survey of beekeepers throughout the United States to gather statistics on problems and experiences they have had with different kinds of bees, colony collapse disorder and parasite infestation.

⬅ Figure- 11
Honeybee packages before processing and re-hiving.

Figure- 12 ➡
Researcher Julia Balch performing a routine hive inspection.

References

- [1] vanEngelsdorp D, Evans JD, Saegerman C, Mullin C, Haubruge E, et al. (2009) Colony Collapse Disorder: A Descriptive Study. PLOS ONE 4(8)
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- [3] Franck, P., et al. (2000) Hybrid Origins of Honeybees from Italy (Apis mellifera ligustica) and Sicily (A. m. sicula). *Mol Ecol*. 9(7): 907-921
- [4] Rinderer, T., et al. (2001) Resistance to the Parasitic Mite Varroa destructor in Honey Bees from Far-Eastern Russia. Apidologie 32(4): 381-394
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