Testing Three Methods of Introducing Russian Honeybee Queens into Italian Honeybee Packages

Interim Report SARE FNE04-506

Submitted by:

Dan Conlon Project Coordinator

William Coli PhD. Extension Specialist

March 12, 2005

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Goals of the Project:

The goal of SARE project FNE04-506 is two-fold:

One is to support plans to expand Warm Colors Apiary. To do this we are increasing the number of honeybee colonies being managed for honey production, as we improve our ability to over winter colonies, and reduce the cost of maintaining our apiaries. By increasing honey production, while reducing the costs of treatments and replacement of lost colonies, we increase income and make Warm Colors Apiary a more profitable farming business.

Our second goal is to establish a sustainable population of Russian bees that are acclimated to our region. This is a key to our plans for future growth. Russian honeybees are known for their disease and mite resistance, they have a higher rate of survival in New England winters, and they produce honey crops comparable to other races of honeybee. Establishing new colonies of Russian bees can be difficult for several reasons. Russian Queens are not always accepted by other races of honeybee (Italians), comb building can be slow, and swarming is common during the first season of development.

The objectives of this project support our goals by providing practical information that can be used to improve our understanding of Russian honeybee colonies. This information will help all Northeast beekeepers improve their procedures for managing Russian bees.

Objectives:

1) To introduce 45 Russian Queens into Italian honeybee populations using different criteria for introduction.
- Identify successful test procedures for introducing Russian Queens into Italian packages and Nucleus colonies.

2) Observe and record colony development.
- Establish a baseline for package and Nucleus colony development.

- From April 2004 through April 2005.

3) Evaluate pre-swarm conditions and the Russian honeybees' tendency toward swarming, or Queen Supercedure.
- Note appearance of Queen cups and cells. Swarm cells or supercedure cells.
- Force swarm conditions in Nucleus colonies by creating congestion in brood nest.

4) Evaluate the Russian honeybee's ability to over winter by measuring strength and health of spring colonies.
- To be completed late March or early April once weather has warmed and conditions allow, frame by frame, inspection of surviving colonies.
- Colonies were observed to be active in February.

Farm Profile:
Warm Colors Apiary became a full-time bee farm in 2000. We own eighty acres in South Deerfield, Massachusetts. Along with our beekeeping activities we manage 60 acres for wood products and preserve 12 acres of wetlands, and open fields as wildlife habitat. We produce honey and beeswax products; sell bees and beekeeping equipment, and offer beginning and advanced programs for beekeepers, school groups, and visitors to our farm.

We currently manage 150 honey producing colonies, in seven apiaries located in western Massachusetts. We raise queens to use as replacements in our operation, and to sell to other beekeepers. During the 2004 season we increased our production colonies by 30 and plan to add another 50 in 2005. Our five year plan is to increase the number of production colonies each season until we are managing 400 colonies. Expansion is necessary to increase honey and wax production to meet the growing demand for our products.

We practice IPM and non-chemical methods of disease and pest control. The Russian honeybee has been proven to be mite tolerant and disease resistant. By using Russians and increasing inspections to detect disease and pests early, we are able to reduce and eliminate the need to treat with chemicals harmful to the honeybee & our products. Our goal is to have a sustainable population of winter hardy, disease and pest tolerant bees that will produce large honey crops. Seventy percent of our colonies are now headed by Russian queens. Our goal of having all production colonies headed by Russian queens will be completed in August 2005.

Participants:
Beekeepers; Jon Parrott, Kate Patterson and Susan Goddard have assisted with the project by managing the test colonies, making the scheduled inspections and completing the data sheets. The forty-five colonies used in the project were located in five different apiaries. Four in Franklin County and one in Hampshire County, Massachusetts.

The collaborating beekeepers were responsible for setting up the hives, introducing the package bees and helping the project coordinator introduce the Russian queens. Once the queens were introduced the individual beekeepers were responsible for feeding the colonies (sugar syrup and pollen substitute), observing the scheduled events, and recording their observations. We were able to complete the observations and record the data as planned. A final inspection will take place in late March, once the weather has warmed sufficiently to allow hives to be opened. All surviving colonies will be checked, frame by frame, to assess the colony's strength, health and condition of its Queen.

Although June is the scheduled date planned to end the project, we will continue to monitor colonies through the second season and collect information on second season development, honey production, and swarming. This additional information will appear as an update on the www.warmcolorsapiary.com website.

Project Activities:
Our desired package installation date, originally scheduled for April, was delayed due to poor weather conditions in Georgia. Dan Conlon loaded and drove the packages from Georgia to minimize the length of time they were caged. This reduced the stress to the bees and very few bees died during the trip. The packages arrived May 16th and were installed on May 16th, 17th and 18th in equipment setup in five locations. We began our test by establishing thirty new colonies using three pound packages of Italian bees purchased from Hardeman Apiaries in Mount Vernon, GA.

In addition to the package colonies we setup fifteen Nucleus ("nuc") colonies using brood and bees from over wintered Italian colonies provided by Warm Colors Apiary. Italian queens were kept caged in each colony and Nuc to maintain morale and continuity until the Russian queens were introduced.

The package bees were placed in a single hive body using ten frames with wax foundation (duragilt). The nucs contained two frames with capped brood, two frames with honey, pollen and the adhering bees. A fifth frame with wax foundation completed the nuc. All forty five test colonies were fed syrup (1 part granulated sugar to 2 part water) continuously and given patties of pollen substitute (Bee Pro) prior to and throughout the Russian queen introduction period.

Objective #1–Introduction of 45 Russian Queens.
The Russian queens were obtained from two different breeders (suggested by Tom Rinderer of the USDA ARS), marked by Dan Conlon, the project leader, (white, green or red) and then introduced to the test colonies. The age of the Queens was three to four weeks old when introduced.

Note: *Research completed by John Rhodes and Doug Somersville (May 2003) showed that successful introduction increased as Queens aged. Italian Queens that were 21-28 days of age had a 90% acceptance rate. Queen age and higher pheromone levels are thought to contribute to this improved acceptance rate.*

Our objective during the introduction phase of the project was to identify conditions that would improve acceptance of Russian queens being introduced into Italian packages. In the past a high percentage of Russian queens have been rejected, or superceded, (replaced by workers) during the introduction period.

Common practices, known to improve a Queen's acceptance during introduction, were used for all test colonies.
These included;

- Feeding colonies sugar syrup to simulate a nectar flow.
- Removing attendant workers from introduction cages.
- Using older mated Queens.

We considered the introduction successful once capped brood appeared in a normal pattern.

Our test was to vary the length of time the queens were kept in cages before being released into an Italian worker population. Three groups of 15 colonies were used:

Group #1 - Queens released after two days in cage (white).
Group #2 - Queens released after five days in cage (green).
Group #3 - Nucleus colonies from over wintered Italian colonies (Red). Queens were released direct into Nucs after 24 hours.

First we removed the caged Italian Queens from the colonies. The Italian Queens kept colony morale and organization intact while the Russian queens were being shipped. This also simulated typical conditions for re-queening of a colony. Re-queening involves removing an established Queen, and then introducing her replacement.

All our Russian Queens were introduced in cages with workers (attendants) removed prior to introduction. It is well known that attendant workers may become defensive and release alarm pheromone. This creates fighting and Queens can be killed during this behavior. By removing the attendants we eliminated one additional condition that may have caused colony workers to reject a new Queen.

Note: Russian Queens were held in a "Queen bank" before being introduced to colonies. A Queen bank is a five frame Queen-less colony containing young emerging worker bees. Six to ten caged Queens (without attendant workers in cages) can be kept for short periods using this method. The young workers will feed and care for all the Queens as they have not developed an attraction to any specific Queen substance.

Colonies were not smoked, but sprayed with sugar syrup before the Queen cages were placed over the clusters. All colonies were being fed syrup & pollen substitute before the Russian Queens were introduced. We had decided not to use smoke as it can be disruptive, and may lead to workers becoming agitated and defensive. Spraying syrup has a calming effect on the bees and distracts the older foraging bees that tend to be most defensive with new Queens.

Project Timeline:

1) May 16th, 17th & 18th - 30 Packages (15 group #1 and 15 group #2) installed in Five Apiaries. Each location had an equal number of Group #1 and Group #2. All 15 Nucs were setup at Warm Colors Apiary. Total of 45 test colonies were started for this project. Italian Queens were kept caged to maintain colony moral.

   Apiary Locations:

   - Red Hen Farm – Florence, Massachusetts - four colonies.
   - University of Massachusetts Agronomy Farm – six colonies.
   - Bar Farm – Deerfield, Massachusetts - six colonies.
   - Urkiels Farm – Whately, Massachusetts - six colonies.
   - Warm Colors Apiary – South Deerfield, MA – eight colonies & 15 Nucs.

2) May 16th through May 20th - Russian Queens were introduced to test colonies.
3) May 19th through May 22nd – Group #1 Queens released from cages.
4) May 23rd through May 25th – Group #2 Queens released from cages.
5) May 16th through May 18th – Group #3 Queens released direct (after two hours in cage) into Nucs.
6) May – eggs, larva and capped brood observed (see attached chart for specific dates). Varied from 2 to 15 days after Queens's release.
7) June & July – second hive bodies added. Varied from 30 to 98 days after Queens's release.
8) July 4th – lost two test colonies to black bear at Warm Colors Apiary.
9) August 18th – lost six test colonies to black bear at Warm Colors Apiary.
10) October – Test colonies entering winter season: Group #1 – 14, Group #2 – 11, Group #3 – 12. A total of 37 test colonies remaining to begin winter.
11) December & January – visual examination on warm days indicted activity in all test colonies. All were active in mid-January.
12) To do: To be completed in late March or early April of 2005 – spring inspection of all surviving colonies.
13) To do: May 1, 2005 – Final Report to be completed.
14) To do: June 2005 – Complete Management Guide for raising Russian Honeybees.

Results: Refer to the charts attached to this report. This shows dates and days mentioned in the following discussion of results. Complete tables including all data collected will be included in our final report.

Objective #1 - The introduction of Russian Queens to Italian colonies showed no significant difference in acceptance as a result of varying release times.

- Of the three test groups only one Queen from each group was not accepted. Two after release into the colony and one was found dead in her cage. This is a 6 1/2% rejection rate for each of the three test groups. We reintroduced a second Queen to each of these colonies and were successful on the second introduction.
  - All three Queens were from the same breeder.
  - Specific reasons that the Queens were rejected are not known.

- No significant difference, among test groups, before egg laying begins;
  - Group #1 (Queens released from cages after 2 days) averaged 4 days.
  - Group #2 (released after 5 days) averaged 3 days.
  - Group #3 Nucs (released after 24 hours) 4 days.

Overall average time before eggs were found, for all groups, was 3 - 4 days after the queen was released from her cage. This was surprising as beekeepers have complained that Russian Queens will take up to two weeks before they lay eggs. We found no difference between Russians and Italians.

- *Check back time* to confirm a Queen is present and laying eggs could be set at 5 days. It is recommended that Italian Queens be checked one week after introduction. Based on our results we recommend Russian Queens be checked after one week for eggs. Queens taking longer to begin laying eggs should be replaced.

Objective #2 – The rate of colony buildup varied among the test groups. We measured the development by counting the number of frames with drawn comb. Honeybees are limited by a lack of comb to store food and raise brood. We were also measuring the comb production by Italian workers during the initial five to six weeks, or until new Russian workers had emerged and the Italian workers had died off. This did not allow us to compare actual rate of comb production between Russian and Italian honeybees. It did provide a baseline for packages started on foundation (using 3 pound Italian packages).

The conversion from Italian workers to Russian workers required four to seven weeks. It was possible to determine the number of Russian and Italians by the color shift on the combs (golden Italians to darker Russians). All colonies were fully Russian after the eighth week. We added a 2nd hive body, after four to eight weeks, when eight of ten frames were drawn in the 1st hive body. These are typically the visual points for beekeepers to evaluate colony strength and progress.

Days to adding Second hive body after queen was released. Refer to chart for comparisons.

- Average number days for all test groups = 45.
- Group #1 = 59 days.
- Group #2 = 43 days.
- Group #3 = 34 days.

We had predicted that Group #1 would develop faster than #2 as the Queens were released three days earlier. It was surprising to see #1 having a higher average number of days. The release time had little to do with development. More significant was the amount of drawn comb workers had available for brood rearing.

- Nucs having the advantage of starting with capped brood and four frames of drawn comb took 9 to 25 fewer days to move into a 2nd hive body.
  - Russian colony development can be accelerated by starting packages with four or more frames of drawn comb, and at least one frame containing capped brood.

- Nucs were also started with honey & pollen. This is also a factor in rate of development.

- Population, race of bees, and comb production. Groups #1 & #2 were started with 3 pounds of package of Italian worker bees (approximately 10,500). The age of the workers, and delay in raising new workers has some impact on a colony's ability to draw new comb and maintain a larger brood nest. Our observations did not give us specific information to measure this but it was a factor when combined with below average temperatures and wet weather during the early buildup period.

  - During the Race conversion (Italian to Russian) the rate of new comb production did not appear to increase until weeks eight and nine. This was also the point when the population was mostly newly emerged Russian workers at the peak of their wax producing abilities. During the August nectar flow most of the Russian colonies finished drawing comb in both hive bodies, and one medium honey super. Thirty colonies produced some surplus honey before winter.

  - The average age of worker bees is 3 to 6 weeks during the summer.
  If all workers were less than ten days of age when installed in the hive, that would leave a life span of five more weeks for the Italian workers.

    - It requires 21 days for a worker to develop from an egg and emerge as an adult.
    - Three weeks after the Queen begins to lay eggs the first new replacement workers begin to emerge. This is also the earliest appearance of Russian workers from the new Russian Queen.

Note: *Natural swarms created to propagate new colonies are made up of 70% workers less than 10 days of age. This gives the new colony the maximum life span of its work force to draw new comb and raise replacement workers before the population dwindles below a sustainable level. Package bees are artificial swarms shaken from large colonies into cages. The age of package bees is likely to have a greater age variation and if older a tendency to dwindle in a shortened period of time.*

- Dwindling (loss of bees) of package bees was rapid. Many colonies lost an estimate half of their population before the first new brood emerged.
  - Loss of workers and cool weather kept brood nest size small limiting the rate of population growth after three weeks.
  - Samples were tested for tracheal mites but levels were very low.
  - At the UMass Agronomy Farm end hives increased due to drifting of foraging bees leaving middle colonies with fewer bees. This was the result of windy conditions during the first week, and colonies being too close during package installation.

- Russian populations increased well during August into September. This coincided with a strong fall nectar and pollen supply.

Objective #3 – Tendency of Russians to swarm or supercede. During the Queen introduction and race conversion phases of the project, we lost no swarms but did observe swarm cups and swarm cells. Swarming began in weeks seven and eight, with many Queen cups being found in our test colonies. All Queens were marked and we could easily verify any lost Queen due to swarming or supercedure.

Note: *We did not prevent the test colonies from swarming. Interference would have changed the findings that we hoped would provide a baseline for future management. We intended to allow them to develop without swarm prevention or intervention. Our only prevention was the additional space created as we added a 2nd hive body or honey super.*

A total of twelve colonies swarmed during our project. Six colonies swarmed in their seven (2) and eighth (4) weeks. Six swarmed after twelve weeks.

- Queen cups appeared in a few colonies after week three and were commonly found in most colonies after week nine.
- The incidence of Queen cups and Swarm cells increased as the population converted from Italian to Russian workers.
- Russian bees do produce Queen cups and remove them without actually swarming. This can be very annoying to beekeepers as it does not necessarily indicate a colony intends to swarm.
- Swarming was most common with colonies and nucs that had drawn most of the comb in a given space. Early swarms appeared before, or immediately after adding the 2nd super with eight or more frames drawn. This also occurred in weeks seven and eight when Russian bees had become the dominant race.
    - In all swarming colonies the hive bodies had several frames of foundation.
    - Comb space not foundation appears to be a factor in swarming.

- Colonies that were given a 2nd hive body containing seven frames of drawn comb, and nucs that were transferred to ten frame bodies with five frames of foundation before swarm cups appeared did not swarm or swarmed late in August.
- We did not have any actual supercedure of Queens. We did see numerous Queen cups on the upper sides of frames indicating supercedure, but all marked Queens were accounted for and were not replaced.

Supercedure did not occur in our test colonies. This was unexpected as beekeepers had reported Queen supercedure as a problem with Russian Queens. Supercedure happens when workers sense a Queen is failing, is injured or is otherwise unable to continue egg laying. This may indicate a problem with specific breeding stock or methods of queen rearing by commercial breeders. If their queens our not healthy or properly mated this would result in early supercedure. Our Queens were acquired from breeders known for producing high quality Queens and having access to the best Russian stock.

The other consideration is that new lines of selected Russian stock are being released each year to commercial Queen Breeders. The USDA ARS test laboratory, in Baton

Rouge, selects to improve breeding stock and reduce undesirable behaviors in each new release. There are now at least fifteen lines of Russian stock being used in commercial breeding programs. Queens used in our tests may reflect some of these improvements.

Objective #4 - Over wintering ability – prior experience and other beekeepers suggests that Russians will survive our winters. As of February all colonies were observed to be active. Our test colonies will be evaluated in late March or early April.

Conditions Affecting Our Project Results:
Weather during the early test period was mild and dry. It did not have an effect on our introductions. Spring and summer were below average temperature with higher than normal rainfall. Cool wet weather may have slowed comb building and resulted in delaying colony growth. The cool temperatures, particularly at night, require bees to generate more heat. This limits the comb area that can be maintained at the proper brood incubation temperatures. The result is fewer bees being raised until a sufficient population of new bees has been raised. When we compared the test colonies to other package colonies, containing Italian Queens, most were lagging behind the Italians in comb building by 6-8 frames. Cooler wet conditions also reduced the bee's ability to forage and find adequate nectar and pollen. This may have also affected their development. We have concluded that Russians tend to raise large populations only when sufficient pollen and nectar are available, and they will self-limit brood rearing in times of low natural food supplies. Beekeepers may help this situation by providing supplemental feeding between nectar flows.

Varroa mites were more prevalent this year than we have observed in the past few seasons. They did not appear to be a factor in our test colonies, but may have sped up their infestation in apiaries shared by other mite infested hives. We will compare over wintered test colonies, isolated from sources of mite infestation, with those sharing apiaries to determine if there is any significant difference in mite loads.

Black bears are now a common problem for crop farmers and beekeepers in western Massachusetts. Black bear populations have grown each year in spite of record numbers being killed by hunters. We lost eight of our test colonies to bears. All colonies lost did not have the protection of an electric fence. We lost no colonies kept within electric fences. Colonies reported by members of county associations were estimated to be around 150 lost or severely damaged.

Individual beekeepers were not always on schedule with inspections and feeding. The number of observations required during this project was demanding and it was not always possible for each participant to meet every scheduled inspection. This may have had some impact on our project results. Overall we did collect the information as planned and the findings did not indicate any extreme variation that may be caused by occasional delays in inspections or feeding.

Expenses: includes all costs associated with this project, to date. SARE funds and cost to Warm Colors Apiary.

Personnel: including Project leader and Warm Colors employees..
Dan Conlon 232 hours x $20.00 = $4640.00
Bonita Conlon 65 hours x $16.00 = 1040.00
Matthew Odman 40 hours x $12.00 = 480.00 $6160.00

Materials & Supplies:
Pollen substitute patties (Bee Pro) 160 x $2.40 = $384.00
Granulated sugar for syrup 900 lbs. x .50 = $450.00
Duragilt foundation 850 sheets x $1.00 = $850.00 $1684.00

Travel:
1000 miles x .36 = $360.00 $360.00

Direct Costs:
Postage $35.00
Telephone $30.00
Photocopying 700 x .10 = $70.00 $135.00

Consultants:
William Coli PhD. Extension / Technical Advisor $480.00
John Parrott $300.00
Kate Patterson $250.00
Susan Godard $450.00 $1480.00

Additional Cost to Warm Colors Apiary:
(Additional labor for assembly & setup included under personnel)
30 complete hives with new woodenware at $100.00 = $3000.00
30 packages of bees at $55.00 = $1650.00
15 Nucs with brood frames = $900.00
50 Russian Queens at 14.50 = $725.00 $6275.00

Total to date: $16,094.00

Assessment:

Based on our testing and observations it appears that Russians can be introduced successfully using procedures described in this report. The next step will be to establish a program that will identify Queens to use as breeding stock. A breeding program that selects for winter survival, gentle behavior, less swarming and honey production will, over time, improve our stock. This will lead to a sustainable population of Russian honeybees.

Note: *Africanized honeybees are now established in the Southwest (Texas to California) and have recently been found in Alabama and Florida. This is a serious threat to commercial package and Queen Producers, and their ability to maintain breeding stock*

without the genetic influence of Africanized bees. This further underlines the importance of establishing a permanent population of honeybees in the Northeast.

Our observations also show that Russians may take a longer period to draw comb resulting in a slower population buildup than Italian honeybees. We observed that Russian brood nests would increase when natural pollen and nectar were available, and slow when nectar flows stopped. Further testing using food to stimulate faster increase in brood rearing is needed. A study comparing food would be useful in improving the rate of colony development. Although we did not specifically compare syrup to honey, or pollen substitute to natural pollen, it was observed that the Russians increased brood nest area rapidly when natural pollen was plentiful. This may indicate that feeding honey and pollen would stimulate brood rearing. Also Russians may benefit by stimulative feeding during times when natural food sources are scarce.

Swarming is a considerable problem for Russians. Losing swarms decreases colony populations and reduces honey production. Late season swarms were a particular problem. There are many manipulations that can be used to prevent or stop swarming. A swarm prevention program that works would be a valuable tool for managing Russians.

Outreach:

As of this writing Dan Conlon, project leader, has made presentations to the Massachusetts Bee Association, Franklin County Bee Association, Hampden County Bee Association, and Bristol County Bee Association. During these presentations Dan has described the results of the SARE project, and suggested procedures for managing Russian honeybees. A follow up presentation is scheduled for the Massachusetts Bee Association at the spring meeting in April, 2005.

Three presentations have been made to members of the Northeast Organic Farmer Association (NOFA): At the annual winter meeting, a special day long workshop at Warm Colors Apiary, and at the summer conference. Our focus was on non-chemical beekeeping and using Russian honeybees to achieve that goal.

Several newspaper articles have been written & appeared in the Springfield Republican (Sunday Edition) and Hampshire Gazette featuring Dan's work with Russian honeybees. Again much of the information learned from this SARE project was described in the articles.

Dan was presented the 2004 Divelbiss Beekeeper of the Year Award by the Eastern Apicultural Society. It was, in part, do to his work studying Russian honeybees. This is a direct outcome of receiving this SARE grant. Project results will be shared at the 2005 annual conference to be held at Kent State in Ohio.

A draft of the Management Guide is now completed. It is included in this report. Please recognize it is a first draft, and not yet ready for distribution. Many of the specific recommendations for Russian honeybees are not included. Specific recommendations will be added as we finalize our evaluation and conclusions. Once the text is revised it

will be given to a graphic artist, and formatted into a booklet before presenting it to the public. The final draft should be completed in late April.

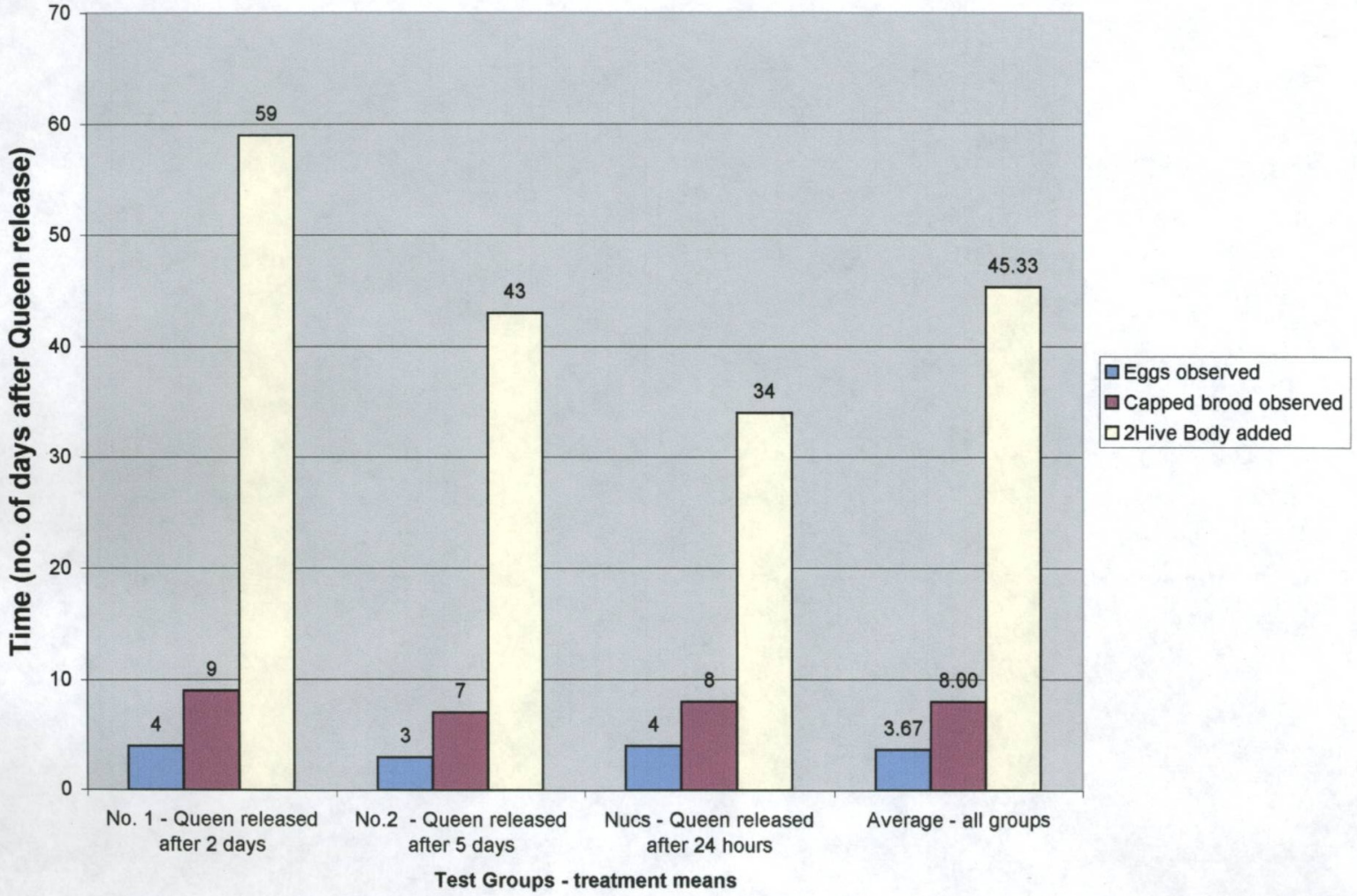
Articles summarizing this project will be submitted to Bee Culture Magazine and the American Bee Journal for publication in June.

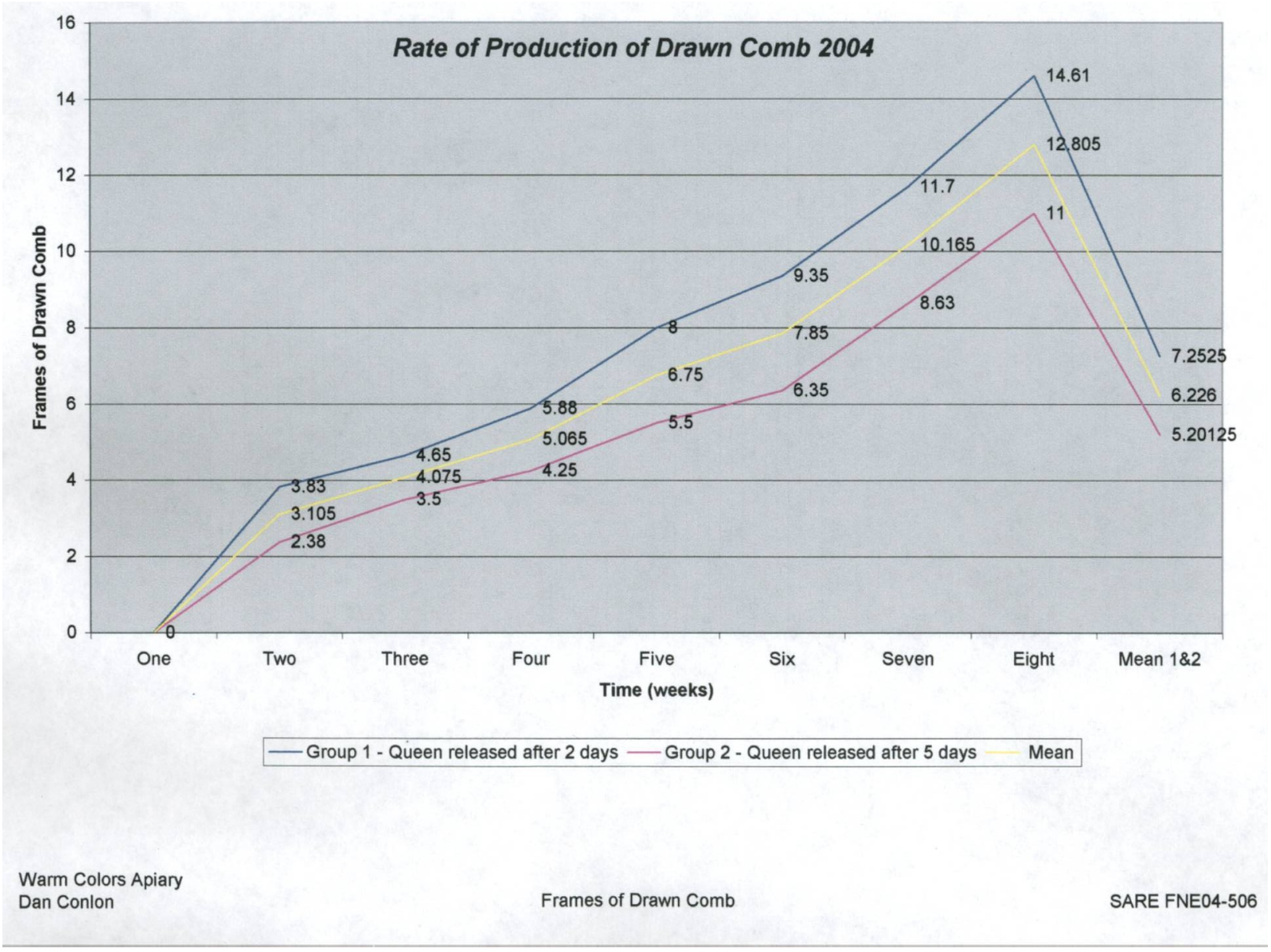
The Warm Colors Apiary website www.warmcolorsapiary.com will feature a page that includes a report on this project. This will be ready for June 2005.

Report submitted by,
Daniel Conlon
Warm Colors Apiary
March 15, 2005

Warm Colors Apiary
Dan Conlon 2004

SARE FNE04-506





Warm Colors Apiary
Dan Conlon

Frames of Drawn Comb

SARE FNE04-506