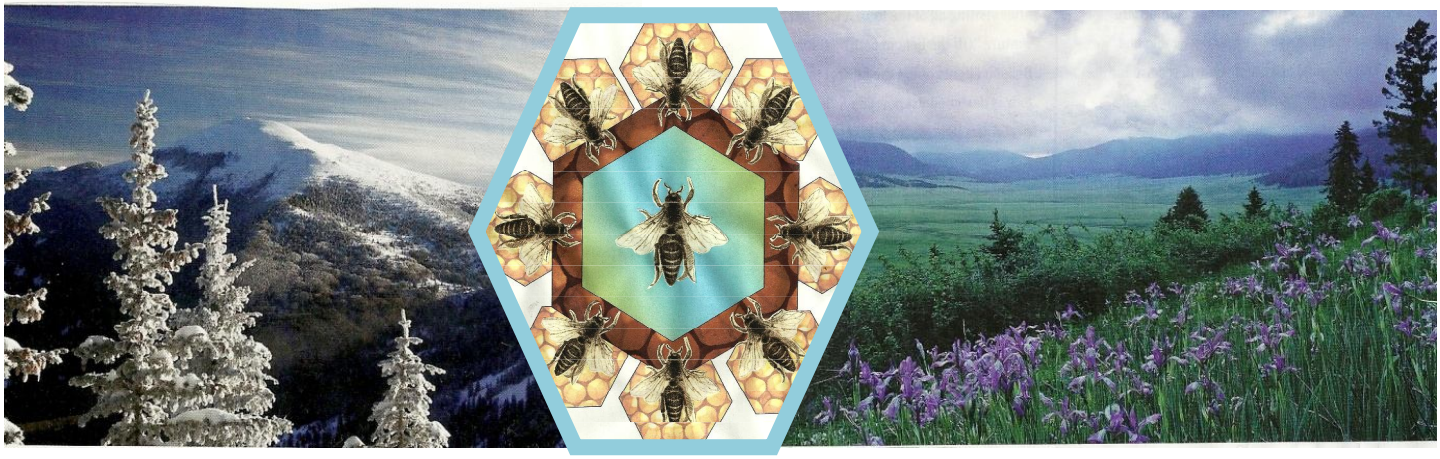
ROCKY MOUNTAIN
SURVIVOR QUEENBEE COOPERATIVE



WSARE* Project OW12-096 Reference Manual

Funded by WSARE 2012—Faciliated by Melanie M. Kirby

2012 PARTICIPATING BEEKEEPERS:

NEW MEXICO	***BEEKEEPER***	***COMMUNITY***	***ELEVATION***
Rio Arriba County	Melanie Kirby	Truchas	8300'/ 2,530m
Mora County	Meg McGee	Mora	7,179'/ 2,188m
	Resa Sawyer	Buena Vista	6,998'/2,133m
Taos County	Moira O'Hanlon	Arroyo Seco	7,629'/2,325m
	Angela Lewis	Arroyo Hondo	6,798'/2,072m
Santa Fe County	Kate Whealen	Santa Fe	7,260'/2,213m
COLORADO			
Huerfano County	Janet Fink	Walsenburg	6,182'/ 1,881m
Arapaho County	Marygael Meister	Denver	5,183'/ 1,580m
Larimer County	Kris Holthaus	Ft. Collins	5,003'/ 1,523m

The RMSQB Cooperative was established in the spring of 2012. It includes 6 NM and 3 Coloradan beekeepers all motivated and dedicated to preserving and promoting conscientious beekeeping efforts. Distance covered 457.62 miles- 7 counties- spreading over 2 states.

The project is intended to promote chemical-free, survivor cross-stock queen honeybee breeding and rearing to enhance apiaries and benefit the diverse communities surrounding each participating beekeeper.

This Manual is intended as a reference guide and serves to provide a foundation for building individual to individual and collective exchanges and for monitoring and integrating healthy and resilient honeybee stock into diverse apiaries.

Sincere gratitude to the many beekeepers and bees who have and continue to assist with this endeavor. Much appreciation to Mark Spitzig for his expertise and shared applications.--MK

[TABLE OF CONTENTS]

CHAPTER 1: QUEEN REARING- CYCLE OVERVIEW

CHAPTER 2: SELECTION OF BREEDERS & ESTABLISHING GENETIC POOL

CHAPTER 3: DRONE IMPORTANCE & SUPPORT

CHAPTER 4: ESTABLISHING & MAINTAINING CELL-BUILDERS

CHAPTER 5: NUTRITION

CHAPTER 6: WALK-AWAY SPLITTING

CHAPTER 7: THE ART of GRAFTING

CHAPTER 8: HARVESTING, INCUBATING, CARING & SHIPPING of CELLS, VIRGINS & MATED QUEENS

CHAPTER 9: MATING NUCLEUS COLONIES & ZONES

CHAPTER 10: EXCHANGE CALENDAR

[CHAPTER 1:
QUEEN REARING CYCLE OVERVIEW

Queen rearing is the art of producing queenbees that can be used to replace old hives, increase hive numbers and for adding genetic material to your apiary. It is the science of breeding and genetics coupled with basic beekeeping management and advanced beekeeping techniques. There are many details to beekeeping and many more so when it comes to rearing queens. There are several key components to rearing quality queens-

1. Quality Genetics

2. Quality Production

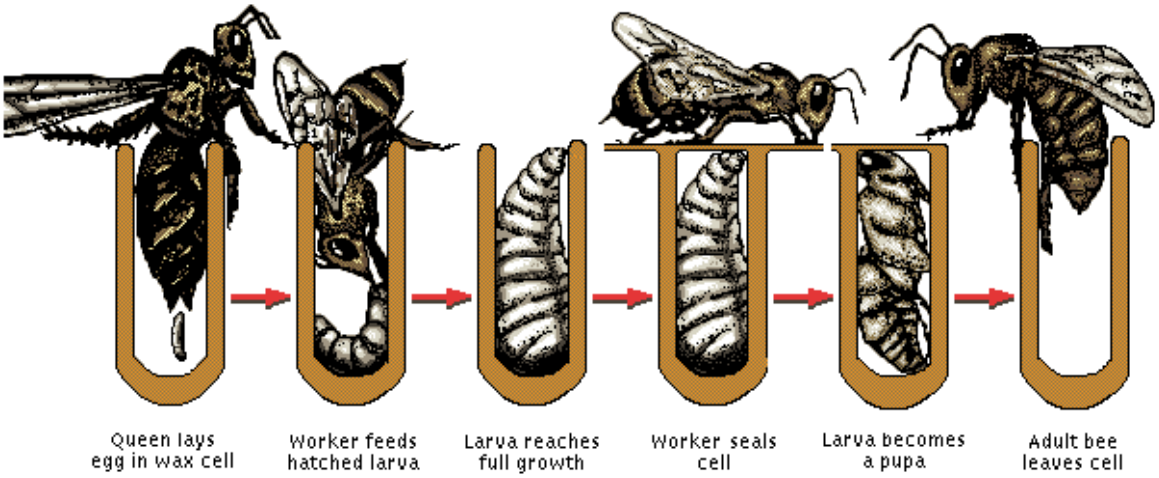
3. Quality Management

We will discuss all three facets to producing quality queens with the focus on survivor genetics and its reasoning. Survivor genetics indicates honeybees that have been exposed to a variety of conditions and have survived multiple seasons in a no-treatment system. Regardless of what queen rearing efforts you or others practice, the true nature of rearing queens that perform well and last lies in diligent record keeping. Honest record keeping is crucial to your development of a breeding paradigm and protocol. There are historical records of hives and their lineage to keep track of as well as graft and emergence dates of virgins and catch/harvest dates.

One can have the best genetics in the world but they offer no positive attributes when the quality of those genetics is compromised by poor management and production practices and to nutritional deficits or other internal or external conditions. On the other hand, one can have great production methods but if they have inferior bees (poor traits, undesirable genetics) then this compromises quality as well. Many before us have developed well coordinated and inspiring protocol for rearing quality queens. There are too many names to mention- but we do so appreciate everyone's efforts and are inspired and committed to developing and nurturing your and our own regional individual and collective efforts.

Goal: Bee Steward complements bees' own natural tendencies to rear queens-within the confines of the seasons and other conditions. We cannot rush nor fight Nature. But we can work alongside as best we can to emulate and replicate- biomimicry. The bees know best.

Honeybee lifecycle goes through 4 stages: egg, larvae, pupae, adult. For grafting and rearing of queenbees, it is essential to adhere to the natural calendar and cycles of the bees.



CASTE ⇨ STAGE ⇩	WORKER	QUEEN	DRONE
Egg	Days 1-3	Days 1-3	Days 1-3
Larvae	Days 3-9 capped	Days 3-8 capped	Days 3-10 capped
Pupa	Days 11-20	Days 9-15	Days 11-23
Adult	Emerge day 21	Emerge day 16	Emerge day 24

In Nature, honeybees rear queens under 3 conditions: *Swarming Season- Supercedure-Emergency*

Each condition presents itself with different circumstances in both hive health and morale.

Swarming Season is indicative of prosperous times for the bees. The weather has warmed, bloom has commenced and they are gaining population and density. They realize the need to create more space and thus their pro-creative act of swarming ensues. As a beekeeper, it is this ultimate process of procreation that can be utilized to promote colonies of bees. As a hive begins to run out of space, they will commence rearing virgin queens. Swarm cells are usually found in quantity on the outer edges of combs.

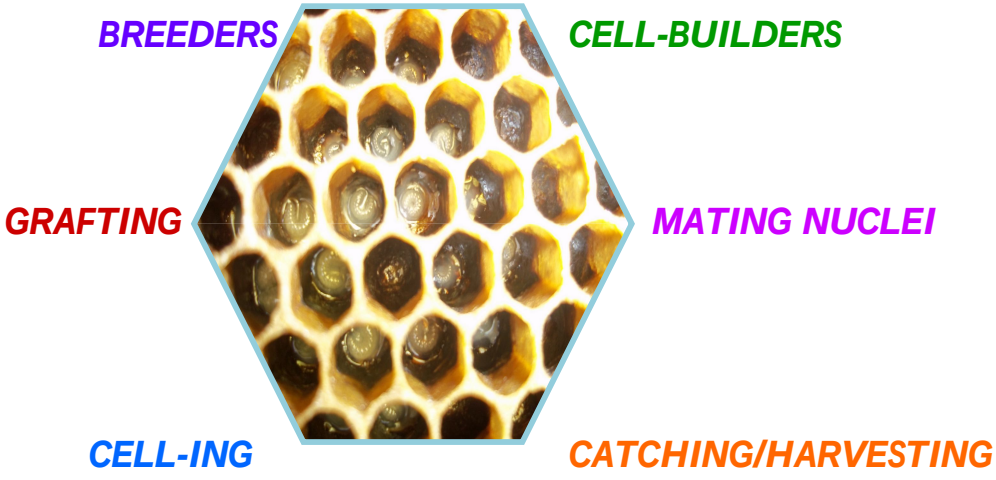
Supercedure is an interesting scenario within a hive which can indicate several concepts and some issues. In some instances, a queen has fallen ill and her bees decide to replace her.

Another scenario is as a queen ages, a few physiological changes occur. Her pheromone levels drop, her egg laying slows and the semen level in her spermatheca empties. When this occurs, a colony may decide to replace their aged queen. This process presents a phenomenon of queens replacing themselves- or colonies replacing their queens while allowing for the continuation of the hive to remain active and productive. We should keep an eye out for these mother-daughter

queens residing in the same hive. Supercedure cells are normally found isolated from much of the brood and queen and in the middle of combs. Normally, there is only one or two pulled.

Emergency queens are those queens which are reared in times of duress for the hive. When a queen has been "lost", killed, or dies unexpectedly, the bees will search for an appropriate aged larvae to rear into a replacement. If they do not have the right age larvae, they may attempt to rear an inter-caste queen. On occasion, laying workers may manifest if a fertile queen isn't introduced in time. Emergency queen cells are most often found in multiple cells adjacent to each other anywhere they find the right age larvae

QUEEN REARING CYCLE COMPONENTS



DEFINITIONS OF TERMS:

Breeders: Hives & their Queens propagated for generating additional hives and queens.

Cell-Builders: Nursery colonies created or modified to rear and nurture larval queens.

Grafting: Transfer of 3-5 day old fertilized honeybee larvae from selected breeders into nursery cell-builders.

Mating Nuclei: Queenless mini-hive families/satellite hives composed to house and care for individual virgin queens as they emerge from their ripe cocoons (queen cells) and adult virgin queens as they mature into viable mated queenbees.

Cell-ing: Process of transferring ripe queen cells (pupating cocoons) into awaiting mating nuclei or queenless splits.

Catching/Harvesting: Retrieval of mated queenbees from mating nuclei on or after appropriate calendar date.

Steps to composing your calendar

1) Establish & Select Breeders for Mother and Drone Breeders

2) Select apiary locations for breeding stock, drone support colonies and mating nuclei

3) Prepare Cell-Builders and Conduct grafts/splits off of Mother Breeders (3-5 day old larvae)

4) BEGIN CALENDAR:
Record Graft: Day 4, Pull Cells: Day 10-14, Install before or on Emergence Day 15, & Harvest Mated Queens: min. 21 Days after emergence

5) Prepare Mating Nuclei & Install grafted cells or queens

6) Record date on calendar for review & harvest

7) Harvest & mark queens.

[CHAPTER 2:
SELECTION OF BREEDERS
& ESTABLISHMENT OF GENE POOL

SELECTION OF BREEDERS & ESTABLISHMENT OF GENE POOL

Determining what race(s) of bees match your management and location can be a life-long endeavor. Lucky for us, there are many who have tested different kinds of bees in various locations and have determined them to be more conducive to a particular environment or situation. Many people move their bees- whether on a small scale to follow seasonal blooms throughout their region or trans-continentally trucking their bees from crop to crop to assist in pollination. Because of this practice, the American beekeeping industry is in need of bees that can maintain and thrive in a variety of conditions. Our global landscape is quite diverse. Finding, keeping and propagating bees that work well for you and your community will require cooperation and fortitude.

Like any grass- roots effort, establishing a quality pool of genetics from the ground up can take several seasons to establish. Our reasoning behind survivor trait selection comes from trial and error and also personal and professional philosophies. It seems evident that beekeepers should select from their own stock those colonies that exhibit above average performance. Selecting for one trait can enhance a lineage. But also selecting for multiple traits can develop an umbrella of positive attributes to pass from one generation of bees to another. The more diverse genetics that are within a single hive organism, the more developed is their overall network of health and resistance to various pests and diseases. ***By selecting colonies that have been given time to display their characteristics in a variety of conditions and through multiple seasons- the overall lifetime merit can be ascertained. Longevity traits among hives are true indicators of quality genetics and the umbrella of various traits.*** It has long been known that long-lived queens and their hives display a wide range of quality genetics and rightly should be propagated and shared.

Genetics of honeybees in the U.S. is diminished and is continuing to diminish. Import laws currently forbid the introduction of any new bee strains. Many researchers and bee geneticists are working to develop a safe and healthy importation standard and protocol in order to bring in more diverse genes to add to the existing pool.

For the purposes of The Rocky Mountain Survivor Queenbee Cooperative, we will be testing various stocks and cross-stocks over the course of two winters and will exchange stock that we already possess as well as incorporate crosses of grafted breeder queens with each participants' home area stocks.

Beekeeping posses selecting cell-builders and preparing them for grafts

Unfortunately, not all the bees will do well in the USA and more specifically in the southern Rockies. Not to mention that the risk of importation of unknown pests and pathogens is the major concern.

Within this cooperative, we will monitor all of our bees, whether we reared them ourselves or purchased them from others- for their whole lives. When new, we can place a colored plaque on the outside of the hives indicating the year of birth. This allows us to scan a bee yard and know who and what we have in the apiary without even having to open the hive. One can keep track of age very easily with this same or a similar method for marking.

This plaque will stay with each queen for as long as she lives. Every revision of the hive will be recorded as well as demeanor/temperament and production of brood and food stores. After a colony has overwintered successfully through two winters, we review their records and if they have a standing history of high performance, we deem them breeders. Each season we will strive to induct new breeders and to share their progeny with each other and interested community members.

A new 2012 inductee: 2 year old breeder Mink Gorda. Mink (F) is from Vermont Survivor stock whose daughter queen (F2) was out-crossed in northern NM then resided in Santa Fe for 2 years. She will now share her daughter queens (Mink F3/Gorda F2) for as long as possible and retire as a drone support breeder. Long-live the Queens!

Incorporating and monitoring diverse stock is an ongoing process and one that is sustainable- should our bees last. We will share stock with other queen bee breeders and rearers and our neighboring colleagues who have deemed breeders with quality traits. This will enhance our individual and group methods for allowing the continued introduction of new genes.

SELECTING BREEDERS:

1. Select first and foremost from your own bees- you know them and how they perform for you.

2. Select those hives which exhibit qualities that you deem beneficial: gentleness, pest/pathogen resistance, production, longevity, overwintering ability, spring build-up pace, etc.

3. Keep records of all hives! Too much info is better than not enough- especially when trying to ascertain what you have and what you want in your bees.

Hive #/Name	Location	Queen Kind/Age	Observational Notes	Plans
Mink Gorda	Velarde	Russ. X 2 years	Great overwintering; steady spring build up; gentle	2012: Move to home yard to serve as Mother breeder, spread drone comb out to mating yards

4. When purchasing queens/bees from other producers- do your research into health and genetics of bees, production methods and reputation. Not all producers offer the same bees nor produce them in the same manner. Inform yourself of the common and individual practices and decide whether you are comfortable with those practices. The more of us that delve into this specific survivor protocol, the more options we will soon have and partnerships and networks that we can help establish.

Motivated and Dedicated Survivor Stock Beekeepers!

5. Diversity in & within colonies is a true benefit. Do not be afraid to mix it up. The more diverse genes around in any area where virgins may fly to mate, the less likely chance of inbreeding. While some inbreeding can bring forth positive traits it can also deteriorate many positive traits of a hive.

ESTABLISHING A GENETIC POOL:

We will be practicing "open mating" in our individual operations for our queen virgins. This means that we do not artificially, nor instrumentally inseminate (II) them, but rather allow them to mate on their own- in the air with drones from surrounding hives. Drones will fly a great distance to mate and so while you may be keeping track of the daughter virgin, whom she mates with is relatively unknown and uncontrolled, especially if surrounded by many beekeepers with various hives from diverse sources.



This can work for us and against us. If you have any doubt as to the quality or temperament of surrounding drone stock, you should look to find a suitable, isolated area whereby you can try to control the genetic pool better. Of course additional factors apart from isolation will need to be considered, such as suitable forage and climactic conditions. Below is a list of items to consider when trying to establish or join a mating area and develop the genetic pool of both queen and drone stock.

1. ***Become aware of your neighboring beekeepers and their management practices.***
   What sort of bees do they keep- are they healthy and have positive traits to share?

2. ***Work with what you have and build off it.*** This concept will be repeated throughout the varied sections- it is integrative.

3. ***Look to regularly add new stock that you have tested***- yearly or every few years.

4. ***Communicate!*** Beekeepers are motivated, innovative individuals (usually!). However, we tend to keep to ourselves: we work better with bugs than with people ☺

We are a busy lot especially during the bee season (all the time really). There is not much time for sharing and storytelling- however, it has become evident since the emergence of CCD that this is precisely what needs to occur among beekeepers, researchers, institutions and industries in order to decipher what the current status is of our bees and how to sustainably promote and protect them. I so appreciate every single one of you and your decision to participate. We will sweat comb together and will make this project what it ends up being- a cooperative endeavor to share quality honeybee stock for the betterment of our area bees and our apiary managements.

5. ***Bee Patient!*** Most definitely with your bees and with yourself. It can be an arduous, complicated, puzzling, daunting, and physically exhausting endeavor to keep bees. Add breeding and rearing and you are even more humbled at how marvelous it all is. ☺

[CHAPTER 3:
DRONE IMPORTANCE
& SUPPORT

Oh, Daddy- What a Stud!

Drones are a very interesting species indeed! They are just as much a chamber of the heart as their mother queens. In fact, they are an exact genetic copy of their mother because they are haploid. Drones contain only their mother's genetics. Since the egg they hatched from is unfertilized, and it did not require sperm- for development.

Support colonies serve several key functions as stock testers,
and as producers for honey, brood and drone support.

It takes both sperm and egg for worker bees to develop (Y & X carrying chromosomes respectively). Thus, a worker's genetics is composed of both her mother's and father's chromosomal input. Her father is one of the many drones with whom her mother mated. This establishes sister and sub-sister families, who share their mother's genetic input along with diverse fathers' inputs. Selecting drone supports and breeders is as important as selecting mother breeders for daughter queen rearing. Both genetic pools can be contained within each other yet the introduction of new stock will need to occur regularly to avoid collapsing of the genetic pool.

Drones can fly up to 15 miles to mate. Of course, when the pheromone is on, the closest and fastest ones get there first. Establishing nearby drone support yards near your mating apiaries is critical to sufficient mating. Well-fecundated queens are recognized and nurtured by their hives and are more readily accepted.

A white-eyed drone that we spotted in one of our mountain hives a few seasons past- what a strange mutation! White-eyed drones appear normal until they begin to fly and then it becomes obvious that they are blind.

***The following excerpts are taken from
Queen Rearing and Bee Breeding by Laidlaw & Page- Wicwas Press 1997

"It is of paramount importance to the queen producer, and to the beekeepers who buy the queens, that an abundance of drones of a designated stock be present at the mating area and surrounding areas to ensure complete inseminations and with drones of the desired stock."
Chap. IV p. 91

"The "conscientious" queen producer will not rely on feral or neighboring stock in numbers sufficient to saturate mating areas. A drone comb in the brood nest of every colony headed by queens of selected stock, and two drone combs in the brood nests of breeder and potential breeder colonies is not exorbitant."
Chap. IV p. 91

CONSIDERATIONS:

Pesticides, herbicides and fungicides can leave toxic residue on plants that workers bees visit. What is collected is then fed to young larvae, the queen and all members of the hive. There is recent research evidence that shows that some of these toxic residues are affecting sperm viability of drones and of the queen's ability to store sperm in her spermatheca. Location of mating apiaries/zones and drone supports as well as location of breeders and other supports requires detailed consideration for possible "tragedies" that can affect mating and success of rearing quality queens.

Taking drone brood from selected breeder comb for adding to a mating nuc - ensuring that desired drone stock is present in mating zone for out-crossing.

[CHAPTER 4:
ESTABLISHING & MAINTAINING
CELL-BUILDERS
& NURSERY CHAMBERS

Strong, well populated colonies with ample nurse bees make excellent cell-builders.

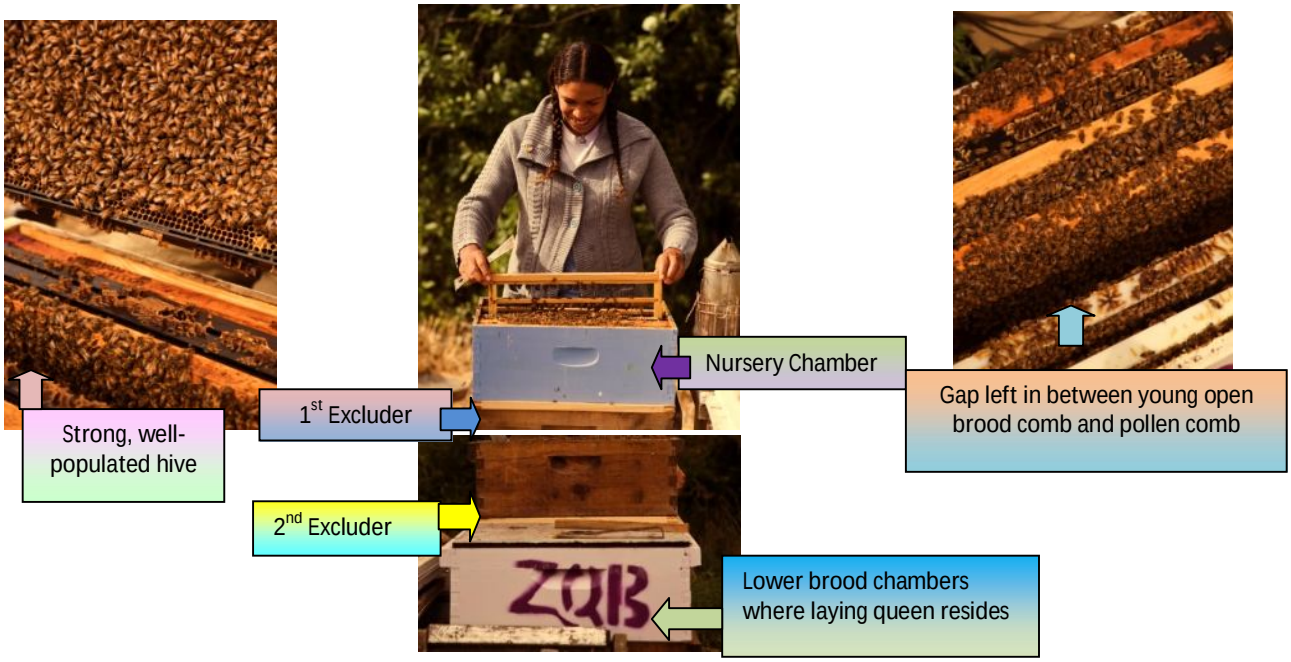
Q? What is a cell-builder?

A! A cell- builder is a hive or a set of hives that serve to "start" and "finish" the curing of queen cells. They can be either queen-right or queen-less. Our discussions will include both queen-right and queen-less cell-builders as well as the concepts of starters and finishers and their fusion.

Queen-right Cell Builders

Queen-right Cell builders are hives which have a queen or multiple queens which have been excluded in the brood chamber. Cells are reared in an adjacent chamber that has been organized to hold pollen frames, open brood, nurse bees and honey.

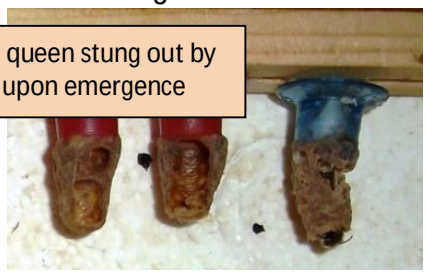
In a Langstroth system, the queen is excluded below in either a single or double brood chamber. A middle super is added whereby the bees can fill it with pollen and nectar. An additional excluder is placed on top of the middle super and then the actual rearing chamber box is placed on top of this second excluder.



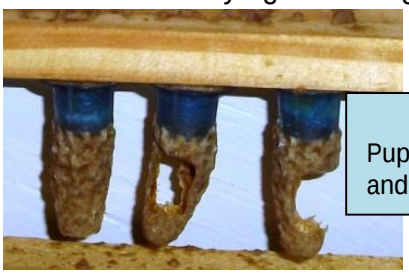
The middle super serves as a barrier in a few capacities:

1) It blocks the laying queens' pheremonal scents from reaching the top cell rearing chamber

2) Being sandwiched between two excluders, it serves as double defense for preventing the queen from having access to the cell chamber and destroying the curing cells,



A virgin queen stung out by a sister upon emergence



A Chew Down:
Pupae stung out by other virgin and then cleaned out by nurse

3) It gives the foragers space between both sections for storing needed food for feeding the laying queen and her brood below as well as the grafted cells in the rearing chamber. This third reason helps to prevent plugging out of rearing chambers during high nectar flows. Supers can be added as needed "sandwich" style and on top of rearing chamber in a normal fashion.

Queen-right cell builders can be managed as self-sufficient hives and starters/finishers. Brood and food stores are moved between the laying queen's bottom chambers and organized in the top rearing chamber. As brood emerges and food consumed, the empty combs can be rotated back down to the lower chambers for use by the laying queen. This "recycling" of brood and food combs within one hive for rearing regular batches of cells can be quite sustainable. On occasion, support colonies may share needed brood, nurse bees and food stores to rearing chambers and weak cell builders.

Queen-less cell builders are hives which have been de-queened. There is no need to use excluders. Queen-less cell builder/nursery rearing chambers are arranged similarly to queen-right rearing chambers. Queen-less cell builders are also referred to as "swarm boxes" and can be modified to rear large quantities of cells from one hive. These are usually composed of loose bees.

Without the immediate presence of queen pheremones, the bees are keen to rear new mamas. If there isn't much other brood to feed and care for- the nurse bees can give all their attention to the grafted larvae and pull out more cells in a short amount of time. Queen-less cell-builders are not self-sustaining hives. They need regular attention. They are mainly used as only "starters" for starting the curing of grafted larvae. After a couple of days, the grafts are moved to "finishers" which are usually queen-right colonies/incubators that have their queens excluded below.

To remove cells, gently make space by removing outer frame/comb. Gently pull labeled graft frame out. Presence of lots of nurse bees indicates that grafts were accepted and queen larvae are being fed royal jelly. Holding the frame up can help to better assess graft acceptance count. Handle frame gently when both removing and re-inserting into nursery chamber.




The idea behind starters vs. finishers is that much energy is needed to fill the demand for royal jelly for a large graft. Once started and filled with jelly, then the cells need only be capped in beeswax- which another colony can handle.

Harvested cells are packaged and placed into orange cell protectors for shipping

Top Bar Nuclei Nursery Chambers also serving as mating nucs- curing pupating queen cells.

A full-size top bar with dividers serving as false walls creating dual rearing chambers

Considerations: For those who utilize horizontal top bar hives, rearing queens can be done in smaller nursery chambers (nuc size top bars) or by modifying a long box with a few alternate set ups. Excluders can be cut to shape and dimension of inside of box- insert and secure either one or two whereby the queen can be confined to a certain section (or removed to her nuc) and cells reared in the queenless sections. Cells can be finished in a queen-less cell builder as well.

Note: Regardless of cell-builder style, cells must be pulled and installed into mating nucs according to their calendar. This time frame is one that cannot be postponed. Check all brood combs to ensure no naturally drawn queen cells are left which can emerge and damage additional grafts or kill laying queens in brood rearing chambers (in queen-right cell builders).

CELL-BUILDER & NURSERY REARING CHAMBER SET-UP

In order to rear well nourished queens- the rearing chamber requires a set up akin to that of the normal brood chamber and laying space for a laying queen. The order in which bees layout their brood chamber is as follows from the one end to the other: Honey, Pollen, Brood, Pollen, Honey. Very young brood is not recommended as it can pose competition to the cells needing royal jelly. The following box shows ten slots for ten frames/bars and the order which is recommended for care of grafts (condensed version include open brood & pollen in center positions.

Single graft Configuration
1. FEEDER –if needed
2. **HONEY**
3. OPEN COMB/FOUNDATION
4. **SEALED BROOD**
5. **OPEN BROOD**
6. **GRAFT**
7. **POLLEN**
8. **SEALED BROOD**
9. **HONEY**
10. OPEN COMB/FOUNDATION

Multiple age grafts in one nursery chamber
1. Feeder- if needed
2. **HONEY**
3. **SEALED BROOD**
4. **GRAFT 1 (min. day 8 /capped- 4 days before G2)**
5. **POLLEN**
6. **GRAFT 2**
7. **OPEN BROOD**
8. **SEALED BROOD**
9. **HONEY**
10. OPEN COMB/FOUNDATION

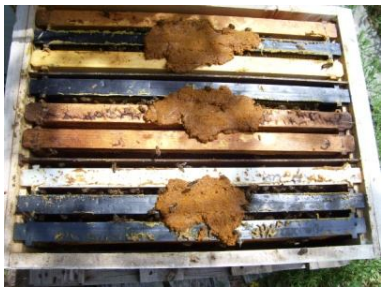
Urban Backyard breeder & cell –building apiary. Blue box is a queenless cell-builder holding multiple age grafts.

Smaller unpainted mating nuc boxes are walk-away splits serving as both nursery cell-building chambers and nucs. They will have extra pulled grafted cells removed and will be relocated to an out yard.

[CHAPTER 5: NUTRITION

- Nutrition is critical at all times of the rearing process. Breeders must have healthy nutrition in order to rear healthy progeny. Cell-builders and nursery chambers must be contructed with ample honey and pollen stores for easy access by nurse bees feeding queen larvae. Mating nucs should have sufficient food stores in order to nurture mating queens and to encourage healthy laying and well fed brood. Maintaining necessary nutrition is essential for promoting longevity, pest/disease resistance, productivity and gentleness.
- Multiple grafts can be inserted into the same rearing chamber on a rotating basis. Calendar coordination is necessary to ensure that older curing cells are not competing with new grafted cells for royal jelly feedings and for waxing of cells.

Mark's Supplemental Pollen Patty Mixture
8lb Protein Supplement
Yields a total of 8 pounds
can make 8- 1 lb. patties or 4- 2 lb. patties



Granulated Pure Cane Sugar *Do not use brown sugar, or molasses	2.5#
Brewer's yeast + 1 lb. Nutritional Yeast (optional)	1#
Mega Bee	1#
Canola Oil (disrupts scent of tracheal mite)	1 cup
Powdered Garlic 1 TBS/Pound of Patty	
2:1 ratio syrup (honey/sugar) (.95# H20: 1.85 # sugar)	2.8#

SYRUP RECIPE: granulated pure cane sugar and water ratios by weight. *Heat water to warm and add sugar. Do not boil sugar with water! Do not use brown sugar, agave syrup, molasses or powdered sugar for liquid syrup recipes. Herbal tea (such as chamomile, spearmint, and lemongrass) can be made with water; allow to cool slightly before adding sugar.*

Spring Syrup 1:1 = 1 gallon of H2O to 8 Pounds of Sugar.
Fall Syrup 1:2 = 1 gallon of H2O to 16 Pounds of Sugar.

Zia Abeja Elixir- herbal essential oil supplement **Add to 7-8 gallons of syrup*

1 cup water
1 tsp lecithin
1/8 oz. spearmint oil
1/8 oz. lemongrass oil

Heat water with lecithin until dissolved.
Put water/lecithin mix into sealable, shakable jar/container.
Pour in essential oils. Shake well.
Add to 7-8 gallons of either 1:1 or 1:2 sugar/honey syrup.
Elixir can be fed directly or spritzed on combs (avoid brood cells).

- *Fresh garlic (Powdered garlic if dissolved well) can be steeped in tea before adding to syrup or diluted honey.*

[CHAPTER 6:
THE ART OF GRAFTING

Grafting is the process in which the grafter (the beekeeper), selects and transfers the appropriate aged larvae and transfers each into cell cups that are clean. Unlike plant grafting, there is no slicing or dicing involved- merely transfer of larvae from one cell in the brood comb to a prepared queen cell cup.

You can make queen cell cups out of beeswax. Or you can buy the plastic version- by JzBz (several styles available). In our operation, we use JzBz cell cups for queen rearing and pure beeswax cell cups for royal jelly production. Beware that bought beeswax cell cups and even beekeeper made wax cell cups can be contaminated depending on the source of the wax.

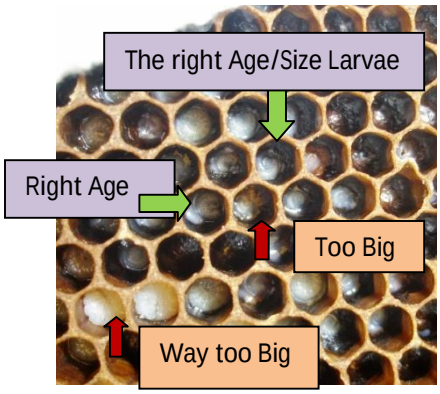
You can have the bees "polish" the cells- whether plastic or beeswax prior to grafting but this is not always necessary. If you note that the bees are not accepting your grafts and you have deduced all other reasons for such (i.e. Dried out larvae, inappropriately aged larvae- too old, too big, damaged larvae, cell-builder issues, etc), then perhaps it is the cups which are being used.

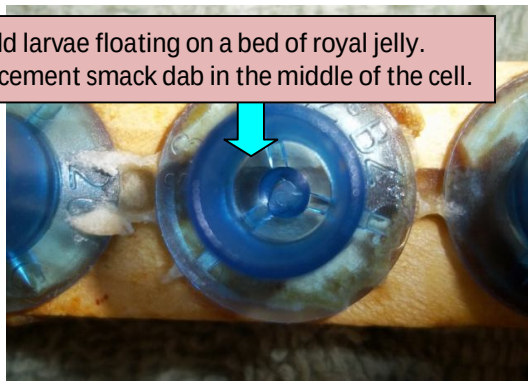
Some grafters like to "prime" their cells prior to transferring larvae by putting a small droplet of royal jelly into the bottom of each cell. This ensures that the larvae have enough food until it can be attended to by nurse bees and will also not dry out. We do not prime our cells. We do look for very well fed young larvae that are "swimming" in royal jelly from which to graft. We use a humidifier and a heater in our grafting room. We also use moist towels to keep breeder brood and grafted larvae in cell cups from dehydrating before being returned to their respective spots in the apiary.

Placing grafted cups on bars upside down on warm, moist towel will help prevent larvae from drying out.

SELECTING GRAFTABLE LARVAE:

There are multiple little techniques for successful grafting and graft acceptance. Many will come as you practice, and the more you practice, the better you will get. Do not be afraid to use reading glasses, lamps, and magnifying glasses if needed. Work on technique first, then speed. Initial practice can focus on transferring larger larvae to center of cell cup, then work on transferring smaller and smaller larvae. Goal is to transfer fertilized larvae that are between 3-5 days old.





3 day old larvae floating on a bed of royal jelly.
Note its placement smack dab in the middle of the cell.

According to the developmental stage calendar of honeybees- all bees: workers, queens and drones are fed royal jelly for the first three days after "hatching". Around the 6th day, workers and drones' diets change to include bee bread- honey and pollen. On the other hand, larvae that are destined to become queens are continued to be fed royal jelly. This diet, and this diet alone- is what changes them physiologically from their sister workers.

Good light to see larvae *Draft-free location (vehicle or room)* *Humidity* *Warm temp*
(text books recommend no less than 65 degrees F). Brood chambers are on average around 93 degrees F.

For grafting purposes, it is then necessary to transfer- or graft- the larvae when it is three days old so that the diet is and remains pure royal jelly. The smaller the larvae- the better!
Size assessment of graft-able larvae is one of the trickiest steps of the whole process. The actual maneuver of grafting is quite simple especially with the variety of tools that are available today.
We use a bamboo and cartilage tool (Mann Lake, ltd) which has a spring action release for sliding the larvae floating on its pillow of royal jelly off the tip of the tool without actually touching the larvae.

[CHAPTER 8: MATING NUCLEUS COLONIES & ZONES

WALK-AWAY SPLITTING

Walk- Away splits are hive divisions which are either composed of brood combs with naturally drawn swarm/queen cells that have been removed from a parent colony or they are queenless (and cell-less) and can be left to rear a queen from their brood or inserted brood or freshly grafted cell cup(s) installed.

A split can be made off of a breeder colony and left to rear queencells. Or, a breeder can be removed from her hive and transferred with a few combs of her bees and some food stores and her original hive is left to rear daughter queens.

One can take advantage of this method to not only rear a few cells but to also rear batches that can be shared. The dates which queenless/cell-less splits are created are to be recorded so that the beekeeper can return to these splits prior to virginal emergence and remove extra cells. If grafting is done in the field and freshly grafted cells are installed, date of graft is to be recorded as well so beekeeper to return and remove extra cells before emergence date.

It is best to remove extra cells: leaving too many may incite freshly emerged virgin queens to fight or to swarm and several after swarms. Damaged virgins may be unable to conduct mating flights or mate properly. Sometimes they can mate successfully, but then have difficulty maintaining their balance on the combs if their legs have been maimed. If cells aren't handled carefully, their wings may rub off or be scarred and become unable to carry them during their mating flights.

Nucleus colonies are mini hive families. They contain bees, brood, food stores and comb whereby a queen can be housed. For the purpose of rearing mated queens, beekeepers commonly choose to utilize a small nucleus for the mating of the queens as each queen must be separated from other queens. A virgin queen will need enough bees to care for her and the brood she will begin to lay.



Three different mating apiaries- staggered rows of mating nucleus colonies with good morning sunlight and afternoon shade on well-mowed parcels next to water source/acequia.

A mating nucleus can be of varying size and style. There are two, three, four and five-frame nucs which are used most commonly. There are standard frames/boxes and modified or smaller "toast" square frames for small nuc boxes. For rearing queens en masse, the smaller the nuc, the faster one can find and harvest queens when they are "ripe".

Top bar nuc in a Top Bar- Langstroth nursery hybrid box

- Stocking nucs in sunny and rainy weather. Making splits/nucs in the rain is one of the best times to do so as the bees stay on the comb and drift is avoided. Once stocked, nucs are moved out to mating apiaries.
- When loading nucs into vehicle- best to keep them "in-line" by having frames or bars of comb parallel to the forward direction of the vehicle vs. the side. Entrances of nucs can be stuffed with screen or taped over if transport isn't too lengthy.

Brood can be selected from larger parent colonies or support hives and transferred into empty nuc boxes. Making splits during rainy weather keeps bees in the nucs. Nucs must be transported a few miles away to mating apiaries in order to avoid drift back to parent colonies.

Pieces of cut foam and bricks are placed on top to help small nucs regulate temperature and to keep lid from blowing off.

Once in place, nucs are labeled with date and type of cell/virgin

We have come to find 3-frame/comb to five-frame/comb size nucleus colonies work well for rearing queens. We use a standard box with dividers- entrances on opposing sides to prevent crossovers.

We place a piece of window screen over each box which also helps prevent queens from crossing over where the dividers meet the lid.

It is important to include an open comb for the virgin queens. They will need a space to begin laying once they mate. Darker comb is preferred by laying queens though newly pulled comb will be utilized as well if no other space is available.

We encourage folks to leave their new queens to mate in their nucleus homes for at least three weeks post emergence. Waiting 30 or more days is even better. Disturbance prior to three weeks can result in loss of queen due to absconding or balling. Virgin queens are flighty and rather agile. They scurry and run to hide but can still take flight easily.

REMINDER:

It is a 5 week Process

from egg to laying queen!

CONSIDERATIONS:

Having nucleus boxes of varying colors helps bees and their queen orientate among other hives. Shapes and designs painted or stenciled onto hive bodies gives bees and queens visual clues as to where their home is located.

Depending on location, mating nuclei can be stationed either on the ground, up on perches/benches or stacked on other hives. Ants and other predators, flooding, high heat and tall weeds can affect whether or not a nuc will pull through and successfully mate out virgins. We try to put all of our nucs on pallets to avoid low ground disturbance.

These mating nucs placed on ground 3 weeks prior are now covered by pasture! Pallets can be cut to hold box(es).

Three nucs per box 3-frame mating nucs on stands. Note the nearby water source. Potential for soggy transport and grounds requires waist high stands- which also prevents bending when catching queens.

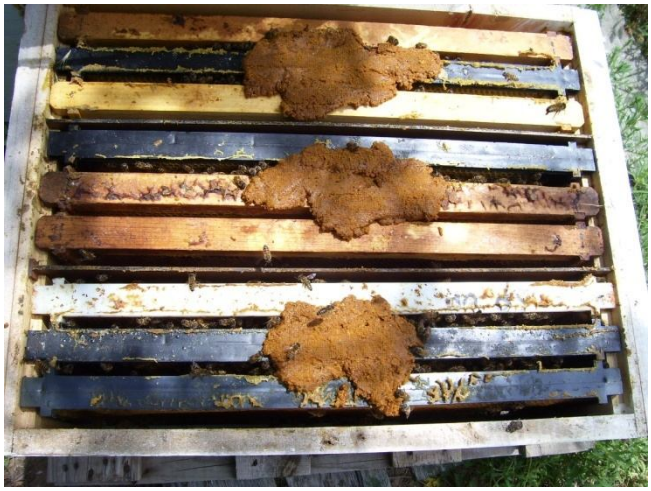
Reviewing nucs for sale- they are transferred into the transport boxes in the truck for easier transport and distribution.

Mating Zones

Placement of mating nucleus colonies should be near known drone supports, suitable forage and protection from extreme elements. Since mating nucleus colonies run smaller than full-size colonies, care should be taken that each has ample brood, food and bees to make each batch of reared queens well fed, fecundated and nurtured. Stationing nucs apart from queenright colonies is essential in order to avoid excessive drift and loss of queens.

We put insulation on the tops of all hives to help with thermal regulation during the spring temp extremes.

Feeding Nucs

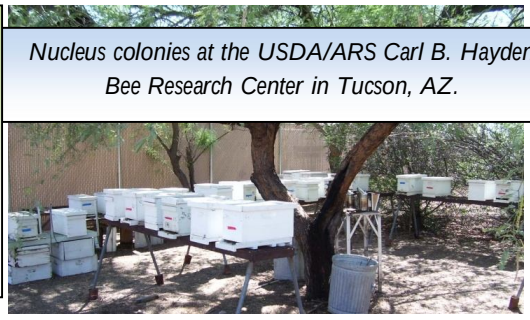


Feeding nucs can be difficult if the mating nuc box cannot accommodate a secure, sizeable feeding apparatus of some sort. On occasion, the flow may dwindle and mating nucs may begin to struggle. If you suspect low food stores, first offer them honey from another pest/disease-free hive. If none is available, then offering pure cane sugar syrup may suffice. Dry sugar can be dumped right into the back of each nuc in emergencies. This sort of action is last resort- caution should be taken to prevent other foraging critters from being enticed: ants, wasps, etc.

Placement of ripe queen cells in mating nucleus colonies can occur in several spots. The first is the place the cell between two top bars. This method works when the weather isn't too hot (a super hot or cold lid can kill a soon to emerge virgin).

The second method is to separate two combs of the brood and place the cell into the brood comb beneath the honey. This second method ensures thermoregulation by the bees (though if using insulation on top of a nuc box, it may prevent heat/cold exposure to the cell from being close to the lid).

Place ripe cell or virgin in her cage in the middle of the brood combs- a few inches down from the top so as to avoid chilling overheating on lid.



Nucleus colonies at the USDA/ARS Carl B. Hayden Bee Research Center in Tucson, AZ.

If using plastic cell cups, handle the cells by the upper plastic portion. If using wax cell cups, take care not to smash the cell. The older the cell, the sturdier the outer wax covering is the easier it can be handled. All cells should be kept in the same position in which they were reared- sealed wax end down.

If putting cells into newly created mating nucleus hives, or nucs whose mated queens were just harvested, installing queen cells that will not be emerging in less than a day is ideal. The bees and brood which was borrowed from other supports to create the mating nuc need time to realize they are indeed queenless. If you insert cells that emerge too quickly, the new virgin queen may be annihilated. Virgin queens, can be installed in cages with ½-full candy tubes. On occasion, you can directly release a virgin by dusting her lightly with powdered sugar or spritzing her with sugar/honey water (not too much so that her wings do not become sticky and useless for flying).

If installing queen cells into recently "harvested" mating nucleus (meaning you "caught" a mated queen and now need to replace her with a cell for continued batches), you should also place cells that are not soon to emerge post catch. Early emergences can result in unsuccessful attempts to rear mated queens.

"Honeybees are unique, as different life forms can be entirely induced by diet. The availability of their genome[1] sequence also makes them a unique system to study how environmental stimuli regulate gene expression."[2]

[1] **Insights into social insects from the genome of the honeybee Apis mellifera**. Weinstock G. M, Robinson G. E, Gibbs R. A, Worley K. C, Evans J. D, et al. (2006) Nature 443: 931–949.

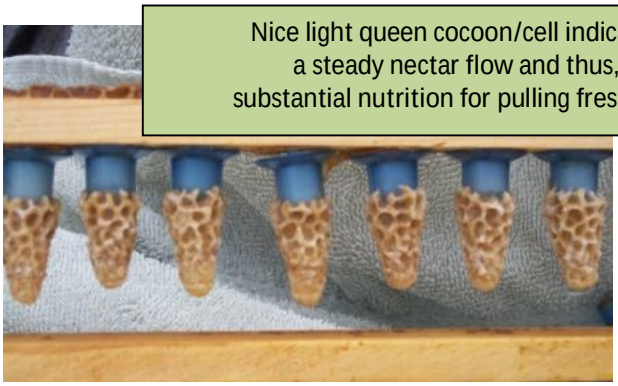
Tip: Utilize a clean soft bee brush to remove nurse bees from cells

[CHAPTER 9: HARVESTING, INCUBATING, CARING & SHIPPING OF CELLS, VIRGINS & MATED QUEENS

SELECTION, PLACEMENT & HANDLING OF CELLS

Once cells are ripe and ready to be moved to mating nuclei, they should be checked for viability. "Candeling" is a method in which cells are held in front a bright light/ candle (avoid high heat!) whereby the reviewer can note the shadowy silhouette of the pupating virgin within her cocoon.

Getting a count of how many ripe and well formed cells are ready for new homes



Nice light queen cocoon/cell indicates a steady nectar flow and thus, substantial nutrition for pulling fresh wax

If using plastic cell cups, you can easily peer down into the top of the cell and note the developing pupae and how well they were fed. Residual royal jelly is a good indication that the virgin was well fed and will not be stunted nor retarded due to nutritional compromises.

[2] **Epigenetics of Royalty** Chittka A, Chittka L (2010) PLoS Biol 8(11): e1000532. doi:10.1371/journal.pbio.1000532 Wolfson Institute for Biomedical Research, University College London, London, United Kingdom, **2** Queen Mary University of London, Research Centre for Psychology, School of Biological and Chemical Sciences, London, United Kingdom http://www.plosbiology.org/article/info%3Adoi%2F10.1371%2Fjournal.pbio.1000532

INCUBATING RIPE CELLS & VIRGINS

Moving and transporting cells should occur with minimal jostling. The wings are the last to form on virgin queens. If they are jostled around, they could rub against the inside of their cocoon and damage their forming wings. With deformed wings, a virgin cannot mate and thus is unviable for herself and for the continuation of her hive.

Incubator should be placed 90-95 degrees F

Ripe cells can be placed in cell-protectors and in between racks for securing

Keep cells from distinct breeders labeled well!

Ripe cells incubated at 94 degrees F. The travelling "chick" incubator should also hold a little water for humidity. When transporting cells from our home yard cell-builders to mating out apiaries, we place the whole incubator on an air cushion/flotation ring. This will help absorb any sudden bumps. It is helpful to have one person hold the cells on their lap while another drives carefully to mating nuc yard. Another option is carry a cooler with a bottle of warm water (reused water/soda bottle with hot tap water is sufficient) for transporting smaller quantities and short distances.

Heating element should not touch cells or cages

Emerged virgins are placed into cages with ½ full candy tubes- ready for placement into nucs

Ripe queen cells in virgin release cages.

Small jar of honey kept warm to feed emerged virgins & small jar of water to maintain humidity

Younger capped cells placed in holding racks DON'T FORGET TO LABEL!

Ripe cells perched on top of cages

As mentioned earlier, brood nest is on average around 93+ degrees F. Chilling of cells can delay emergence time. Severe chilling can damage cellular development and otherwise healthy virgins can be compromised.

TIMING OF CELL PLACEMENT

It is recommended to wait at until cells are minimum 10 days old before moving. We feel comfortable moving them over to the incubator a few days before emergence- if we need the space in our cell building rearing chamber. Otherwise, we feel that the bees are the best ones to incubate the queen cells and to keep the right humidity and "vibrational" surround sound to which naturally reared queens are exposed to.

Much effort and energy is exerted not only on the bees but also on the steward's part. It is sad when batches go unused, wasted or unviable due to negligence. Of course, life happens, but ensuring that you are not overly-taxing your bees and yourself will ensure smoother and more enjoyable rearing experiences.

CARING FOR VIRGIN QUEENBEES

Once emerged, virgin queens require prompt care. They are hungry and will reenter their cell and ingest the remainder of the jelly they left as a pupa. Smearing a small drop of honey on the side of the cage and a small drop of water can help to keep them well-nourished and alert. Virgin queens should be placed as soon as possible into an awaiting queenless nuc or placed into a queen bank for extended care. Virgin queens should be placed into new homes within a week of emerging in respect to their cycle and calendar for mating.

HARVESTING & CARE OF MATED QUEENS

WHEN TO CATCH:

As mentioned previously, virgin queens should be left at minimum 21 days post emergence before being revised. The longer the beekeeper can wait, the better for the sustainable establishment and perpetuity of the mating nuc: it is better for deciphering posture of laying and make sure that, indeed, the newly mated queen is laying fertilized eggs and not just unfertilized eggs (drone layer).

Research by Tarpy and Grozinger shows that the longer you wait to harvest, the lower the supercedure rate on the receiving end and the higher the acceptance. Well- fecundated queens with diverse genetics stored in their spermatheca are very attractive to their hives (Tarpy).

Replacing “harvested” queens with ripe cells is a sustainable method for regularly rearing queens. Whether you need them to replace fall-outs, dead outs, or to increase your hive numbers and to share with neighbors- running a few nucs throughout the summer season will allow you to reevaluate housed queens prior to entering winter and to make necessary adjustments for the proximate warm season’s apiary plans and goals.

If you do not need nor desire to rear multiple batches of queens, mated queens in mating nucleus colonies can be allowed to grow to full size colonies (weather and flow permitting). Requeening colonies with freshly mated queens in the late summer/fall can help hives gain control over mite population issues before going into winter. Come spring, those that overwinter successfully are then considered tested and are much more valuable to you, your hives and even to other beekeepers looking for quality stock.

Overwintering nucleus hives in their small form can be successful. Wrapping them and placing them on top of full size hives may help. This is a great way to develop your own winter hearty stock and to have it available come early spring, hence the initiation and birth of this project, The Rocky Mountain Survivor Queenbee Cooperative. Imported bees may not be ready when you prefer or they may be ready too early for your location and early installation can stunt them. Bees from other areas may not be acclimatized to your specific location. Of course, beekeepers should try diverse stock from reputable sources. However, by envisioning the longer term picture and situation of bee production, YOUR self-produced and collaborative efforts are on the rise! ☺

HOW TO HANDLE A QUEEN

Catching a queen can be tricky. It is highly recommended to practice by catching drones. Care should be given to not handle virgin queens at all (especially not by their wings). Mated queens have already mated and so handling them should also be done with extreme care as their abdomen is now swollen with active reproductive organs.

Approaching from the rear is helpful as the queen cannot see your fingers approaching.
Grasp queen by middle thorax section- do not squeeze head nor abdomen!

CAGING AND STORING QUEENS

Queens can be caged in a variety of styled cages. We use JzBz plastic cages because they do not waste wood and are slim for storing and installing. They are also reusable.

QUEEN BANKING

Queens can be stored in a queenless bank/nuc for an extended period of time given ample nurse bees to feed and care for them. Queen banks should include full frames of pollen and honey.

A Queen Bank is a queenless colony composed much like a nursery chamber that is prepared to care for mated caged queens. A queen bank can be set up like a cell-building rearing chamber to ensure ample food stores and nurse bees. Queens can be banked for as little as a day or up to several months. Of course, we do not promote prolonged banking. However, if for some reason you are unable to house/install a queen promptly, you can preserve her viability by ensuring that she is cared for well by nurse bees.

QUEEN SHIPPING

Shipping queens must follow US Postal requirements. Utilizing approved and hard exterior containers is best so as to avoid crushing and leaks.

Small quantities of queens can be shipped with a few attendants caged with their queen. Larger quantities in designated shipping containers can have attendants on the outside poured in to care for queens during transit. Spritzing everyone with water before placing lid on will help keep exterior attendants cool

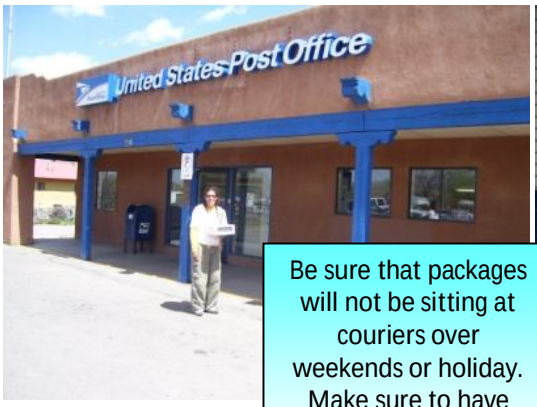
These caged, mated queens were held in a queen bank for a day before being packaged and shipped to expecting beekeepers.

Shipping containers should hold a small sponge soaked in clean water. Larger containers can also have a small pad of fondant placed in the bottom to feed exterior attendants.

Shipping cells must be done overnight and with a trusted carrier. Shipping too early and jostling and dmage to wings of pupae may occur. Shipping too late and cells virgins will emerge and die without proper care.

Shipping containers should be clearly labeled as having LIVE QUEENBEES and to not block vents, keep away from extreme temperatures and pesticides/chemicals. Recipients address & telephone number should be placed on label along with producer's contact info.

Be sure to inform shipping couriers of contents. Suggest Express shipping so as to avoid delays in transit. Track packages and request delivery confirmation.



Be sure that packages will not be sitting at couriers over weekends or holiday. Make sure to have packages at couriers before pick up times.

INSTALLING

❖ *With JzBz cages, it is quite simple to attach the queen in her cage to the comb. The cage can either be pressed into the comb or attached with a twig/toothpick.*

❖ *Care should be given to not drown cage in honey when sandwiching between combs. We recommend candy tube pointing down so as to avoid melting and potential drowning of queen in fondant.*

EXAMPLE GRAFT CALENDAR

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
	1st GRAFT -Day 4					
					1st G EMERGE -Day 15	
				2nd GRAFT		
						1st G HARVEST -Day 36 from egg -Day 21 from hatch
	2nd G EMERGE Replace G1					

GRAFT EXCHANGE CALENDAR 2012:

- 1ST EXCHANGE JUNE 20, 2012: ZQB farm
- First weekend in July small graft/cell/virgin exchange at NM site visit
- Last week in July- graft/cell/virgin exchange at CO site visits
- August site visits NM- graft/cell/virgin exchange
- Last weekend in August- meet halfway- last exchange in Walsenburg, CO
- September- final exchange of mated queens and review of season.
- October-Discuss plans for winter and spring 2013.