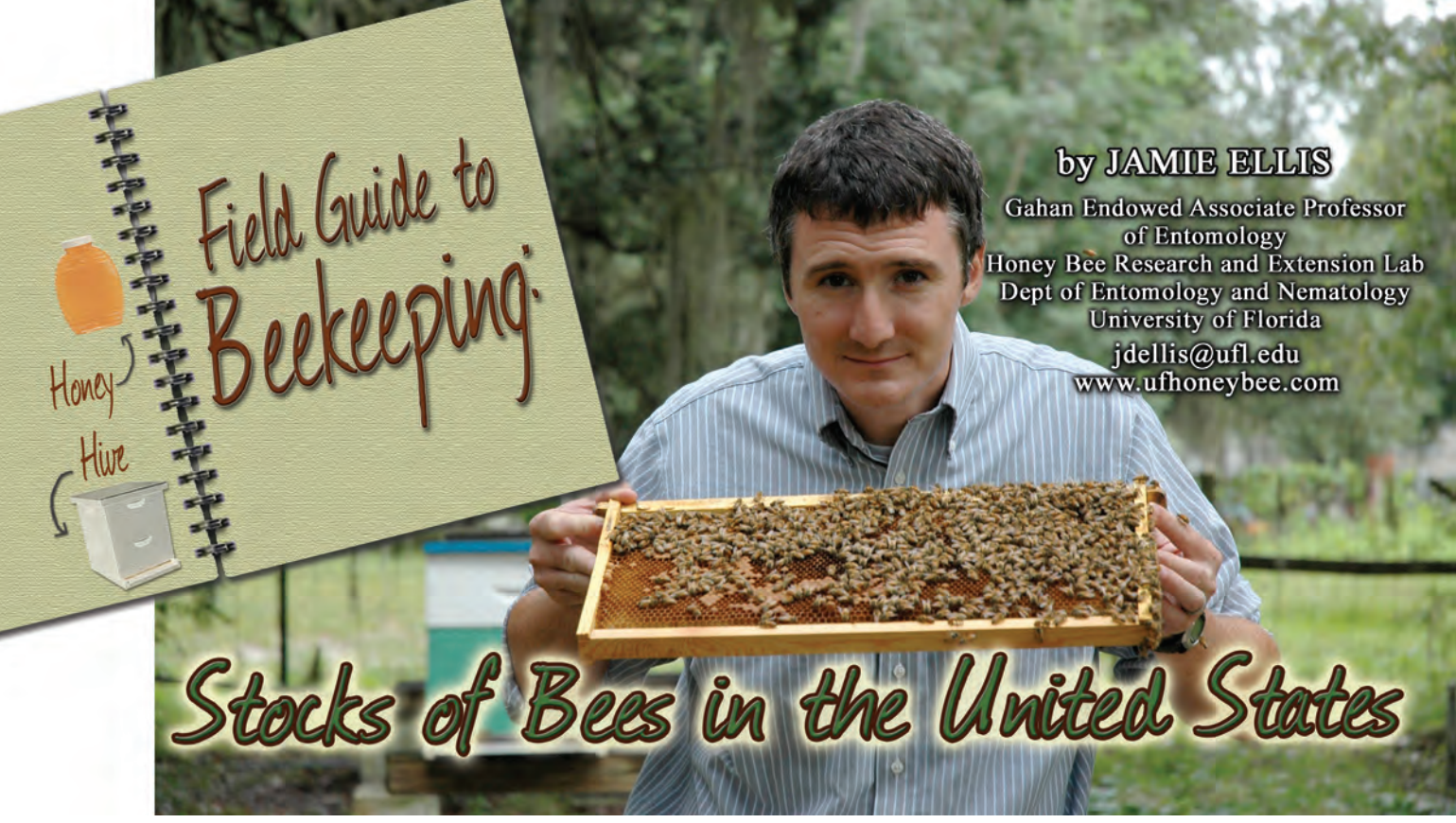

Stocks of Bees in the United States

by JAMIE ELLIS
Gahan Endowed Associate Professor of Entomology
Honey Bee Research and Extension Lab
Dept of Entomology and Nematology
University of Florida
jdellis@ufl.edu
www.ufhoneybee.com

All beekeepers must choose the type of bee that will be the workhorse of their beekeeping operations. Which bee to use can be the subject of intense debate among beekeepers. Should you use Russian bees or Minnesota hygienic bees? Which is better: Italian or New World Carniolan bees? The answers to these questions are not easy. There are, in fact, no right answers to these questions. The average beekeeper will use multiple types of bees during his or her journey through beekeeping. Part of the joy of beekeeping is figuring out which bee(s) is best for you.

What is a honey bee "stock"?

There are a number of terms associated with types of a given organism. These include breed, line, stock, pedigree, etc. Some use these terms interchangeably with the terms subspecies or race. However, each term has its own definition and it is important to use the right one when discussing the types of honey bees available in the U.S.

To understand "type terminology" best, it is important to appreciate a little about honey bee biogeography. There are multiple species of honey bees in the world, perhaps 7-9 depending on who you ask. We use the one species whose natural distribution is exclusively outside of Asia: *Apis mellifera*, the western honey bee. Western honey bees are distributed naturally in Europe, Africa, and parts of the Middle East.

Apis mellifera, as a species, can be divided further into subspecies, or races. The race name would be the third name in the Latin designation. For example, *Apis mellifera ligustica* is the Italian honey bee, with the race or subspecies name being *ligustica*. Races of honey bees each have unique physical and behavioral attributes and typically a limited geographic distribution, all of which allow them to be distinguished from other races of western honey bees. These differing attributes, or "phenotypes" as scientists would say, confer varying characteristics to the bees, meaning that no two races of honey bees are exactly alike. It is this diversity that is celebrated among beekeepers as it produces bees with varying characteristics that are more/less desirable, depending on the view and management practices of the beekeeper. For example, some bee races swarm more than do others. Some bee races can be quite defensive while others tend not to sting as much. Some bee races overwinter better than do other bee races. Thus, beekeepers are free to choose a race that works best for them, in their particular management system.

Europeans brought honey bees to North America hundreds of years ago. Consequently, the honey bees that we use mostly descend from European races of honey bees. I say "mostly" because we do have one African race of honey bee in the Americas. This is the "killer" bee of lore – *Apis mellifera scutellata*. The various races of western honey bees can hybridize with one another. To be fair and accurate, we no longer have European races of honey bees in the U.S. Instead, the bees we use are derived from purposeful and/or natural breeding between the various European races that were introduced into the U.S. I like to use the designations "European-derived" or "African-derived" honey bees when discussing the bees we have in the U.S. After all, they are no longer European or African! The lines maintained from the original or subsequent introductions of honey bees into the U.S. can be considered "stocks."

I provide two good quotes that will help explain what I mean when using the term "stock." First, Dr. Al Dietz explained the concept of bee races, and how we use them in breeding. He noted:

"The geographic races of bees are the results of natural selection in their homeland. That is, the bees became adjusted to their original environment, but not always to the economic requirements of beekeepers. Therefore, they are not the result, but the raw material for breeding." – Dietz, A. 1992. Honey bees of the world. *The Hive and the Honey Bee* (J. Graham, ed.), Dadant and Sons, Hamilton, IL, USA. 1324 pp.

I really like Dr. Dietz's description of a race and how he noted that bee races provide the raw material for breeding, ultimately producing the stocks that we have in the U.S. today.

Second, Dr. David Tarpy wrote a North Carolina State University Extension Bulletin and made the following statement on bee stocks:

"The term "stock" is defined as a loose combination of traits that characterize a particular group of bees. Such groups can be divided by species, race, region, population, or breeding line in a commercial operation. Many of the current "stocks" in the United States can be grouped at one or more of these levels…" – David Tarpy, 2005. The Different Types of Honey Bees. AG-645, NC State University, Cooperative Extension Service, **http://www.cals.ncsu.edu/entomology/apiculture/pdfs/1.12%20copy.pdf**.

It technically is incorrect to claim that we use one race or another in our beekeeping operations. We have *stocks* of honey bees that originated from multiple European races and one African race, or crosses between the races. Granted, some of the bees available for purchase may exhibit characteristics principally associated with a given race, but they almost certainly are not pure, unadulterated descendants of the original bees of that race. For example, you might purchase Italian-derived honey bees that are yellow in color, produce large colonies, are relatively gentle, and are prolific honey producers. However, they almost certainly are not "pure" Italian honey bees, descended from the original stocks imported into the U.S. Genetic analyses of honey bees across the U.S. support this assertion.

Points to consider when deciding which bee stock to use

There are five key considerations one must remember when searching for and purchasing one's bee of choice. First, many bee breeders claim to raise a given bee race. However, I hope you now appreciate that there are no "pure" races of European honey bees in the U.S. Most of the race designations are assigned based on a given queen's color, the color of the queen's offspring, and sometimes on the colony's behavioral attributes. Color can vary tremendously within a given bee stock (see Figure 1 as a great example). Thus, a bee's color cannot be the sole indicator of its race. Furthermore, even a queen that is true-to-race (i.e. "pure") supplies only ½ of the genes carried by her female offspring. Given that queens mate in the air, away from the nest, usually with multiple, unrelated drones, I suspect that most bees available for purchase in the U.S. are mixtures of multiple stocks. I have known beekeepers who breed multiple stocks of honey bees in the same apiary, selling the queen offspring based solely on the color of the queen. Hmmmmm……

Second, not all members of a bee stock exhibit the same characteristics. Biology is messy, necessarily so. Yet, beekeepers have been working with the various stocks long enough to note the general characteristics of each bee stock. Italian bees illustrate this point well. Italian honey bees generally are docile compared to African honey bees. Of course, some colonies of Italian honey bees can be very defensive (very, *very*, defensive). So, as a stock, they have average defensive tendencies. However, this tendency toward gentleness can vary over the stock. There are outliers for each attribute in each stock. Colonies of all bee races have the ability to break the mold, so-to-speak. Again, the extension bulletin developed by Dr. David Tarpy at North Carolina State University summarizes this well:

> "Wide variation exists within the stocks as well as among them. Any generalities about a particular stock should be treated with caution, since there are always exceptions to the rule. Nonetheless, the long and vast experience of beekeepers allows some oversimplifications to be made in order to better understand the different types of bees available." David Tarpy, 2005. The Different Types of Honey Bees. AG-645, NC State University, Cooperative Extension Service, **http://www.cals.ncsu.edu/entomology/apiculture/pdfs/1.12%20copy.pdf**.

Third, I believe bee management is a greater determinant of the success of a given bee stock than even the bee's typical characteristics. I note this because it is common for beekeepers to spend money on a stock of bee that they feel best meets all of their needs. They, then, have a bad experience with the stock and feel that it fails to live up to its billing, ultimately abandoning the stock in disappointment. I especially see this a lot when people purchase and use resistant stocks of bees. They purchase a bee reportedly resistant to something and then do not give it a fair chance, or they misuse it and abandon the stock forever. In practice, a bee stock must be used longer than a year, or maybe even two, before one can know if it will work for them. Regardless, a good bee in the hands of a bad beekeeper becomes a bad bee.

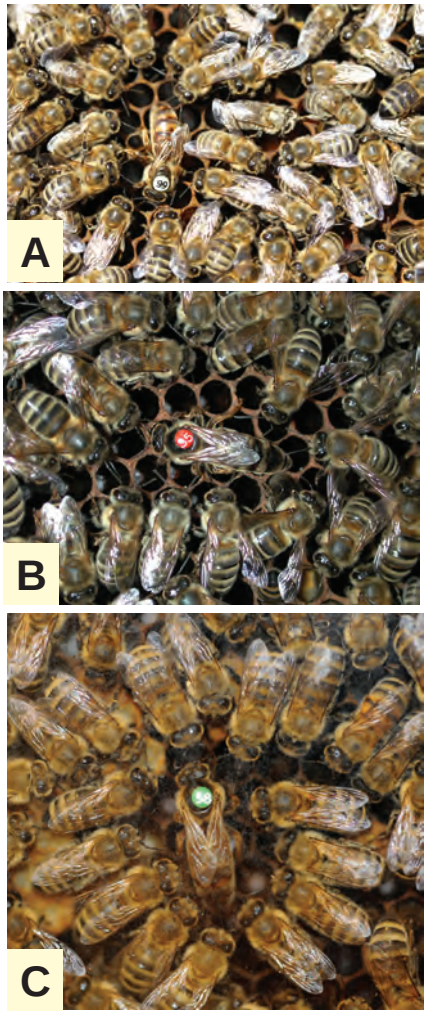

Figure 1: The extreme color variation within bee stocks is represented in this image of three Carniolan queens. Sue Cobey, world expert on Carniolan bees, considers the queen in figure A to be most representative of the stock. Photographs provided by Sue Cobey.

Fourth, be selective when choosing where to purchase your queens. Just because a breeder says a queen is a given race or stock does not make the queen the given race or stock. I always tell people to go straight to the source with questions about a given stock. For example, it often is a university, federal research group, or queen breeder association that is trying to produce a given stock. Therefore, I tell seekers to go to these sources when wanting to find the bee that most typifies the stock. When in doubt, (1) ask other beekeepers, (2) search the web, or (3) look in the beekeeping literature for sources of queens of a given stock. You can find a good list of bee suppliers in the U.S. at **http://www.beesource.com/bees-supplies/united-states/**. More state-specific information on sources of bees typically can be found on each state's beekeepers' association website. Finally, you are reading this article in the *American Bee Journal*. Just flip through the pages of the magazine and you will see advertisements for a number of bee breeders/stock providers.

Fifth, you can lose the traits of a given bee the moment the queen dies, swarms, or is superseded. This is very important to remember. You can go through a lot of effort and expense to purchase and use a queen of a given stock. However, the characteristics of that stock can be lost the moment the queen is lost and resulting daughter mates with drones from other colonies in the area. If you plan to use a given stock exclusively, you will have to either (1) ensure that your apiary is located 3+ miles from feral or managed honey bees or (2) make plans to requeen the colonies yearly with queens from a breeder specializing in the stock. You should know that the F_1 (or daughter) crosses of your stock can produce significantly less desirable bees. For example, Buckfast and Russian queens produce workers with average defensive tendencies but daughter queens crossing with drones from other stocks can produce bees with a significantly higher defensive tendency.

The bee stocks

In Table 1, I summarize the major attributes of each of the main bee stocks in the U.S. I do this in a manner that allows you to compare the bee stocks directly. I chose the characteristics I discuss in the table because they are the ones most mentioned in the literature. However, there are a few additional points I would like to make about each stock.

1) ***Apis mellifera ligustica*** (the Italian honey bee – Figure 2) - Arguably, this is the most popular stock of European honey bee on the planet. It is the most used bee in the U.S. It is known most for its yellow-to-brown color, prolific honey production, and large colonies. Italian-descent queens are

easy to purchase because they are common and typically readily available. A quick internet search or discussion with other beekeepers will help you identify breeders from whom you can purchase Italian-descent bees.

2) ***Apis mellifera carnica*** (the Carniolan honey bee – Figure 3) - Carniolan bees are the second most popular honey bee in the U.S. They originate from east-central Europe. Sue Cobey, bee breeder extraordinaire, developed a line of improved Carniolan bees called New World Carniolans. Sue notes that she continues to work to improve this stock, having recently incorporated carnica stock from Germany and Slovenia into her Carniolan lines.

3) ***Apis mellifera caucasica*** (the Caucasian honey bee – Figure 4) – Caucasian honey bees once were more popular and easier to purchase than they are today. However, Sue Cobey notes that she and her team are beginning to work with Caucasian bees, having reestablished them with stocks from Turkey and the Republic of Georgia. I was able to find breeders of this bee using a quick Google search for "Caucasian honey bees for sale."

4) **Buckfast honey bee –** The Buckfast bee is not a descendant of any one race of honey bee. It is a stock of bee produced by

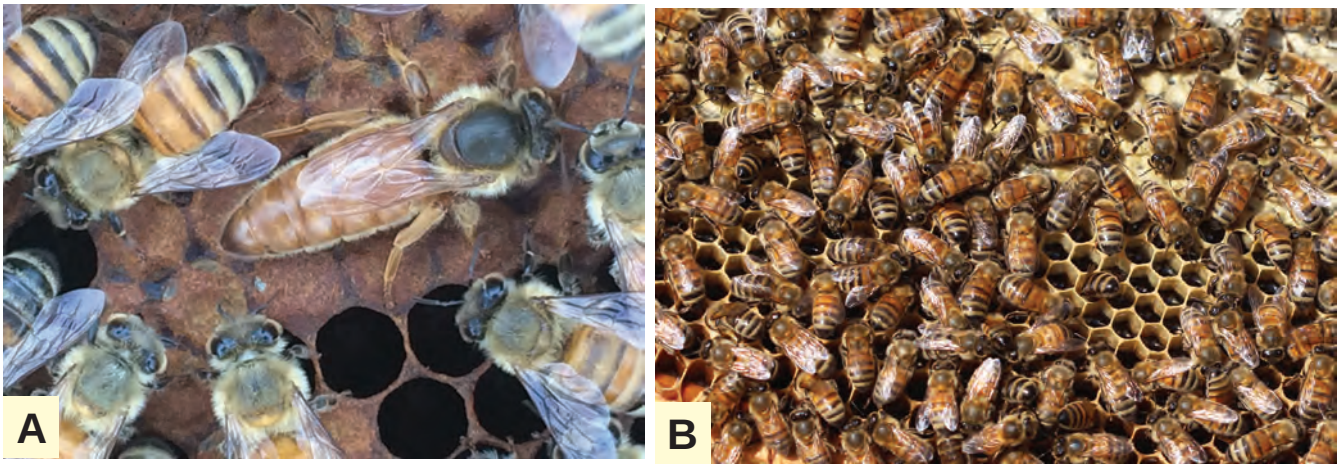

Figure 2: An Italian honey bee queen (A) and workers (B). The workers were photographed from a colony in Italy. Photograph A was provided by Liana Teigen (University of Florida) and B was provided by Sue Cobey.

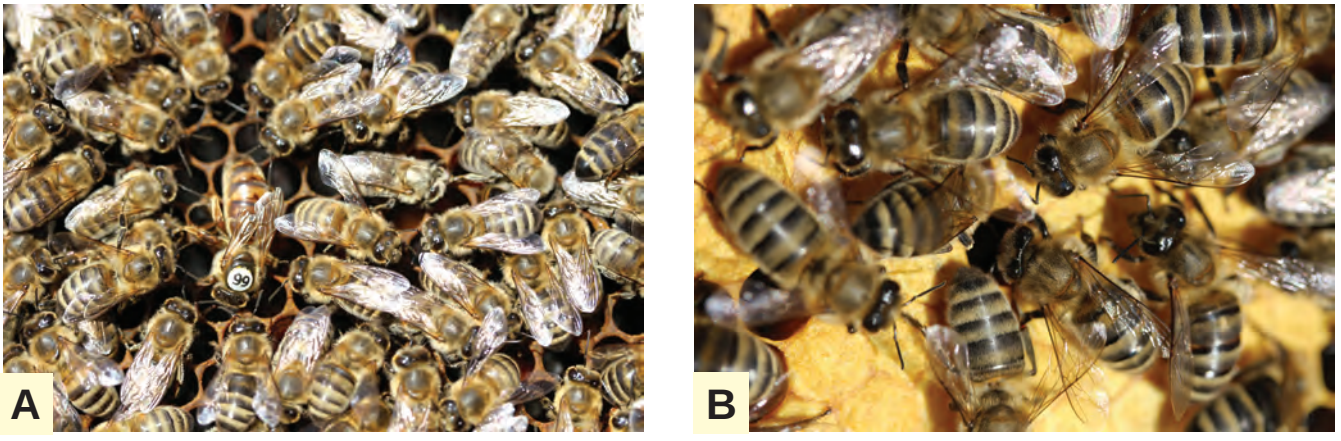

Figure 3: A Carniolan honey bee queen (A) and workers (B). Both photographs were provided by Sue Cobey.

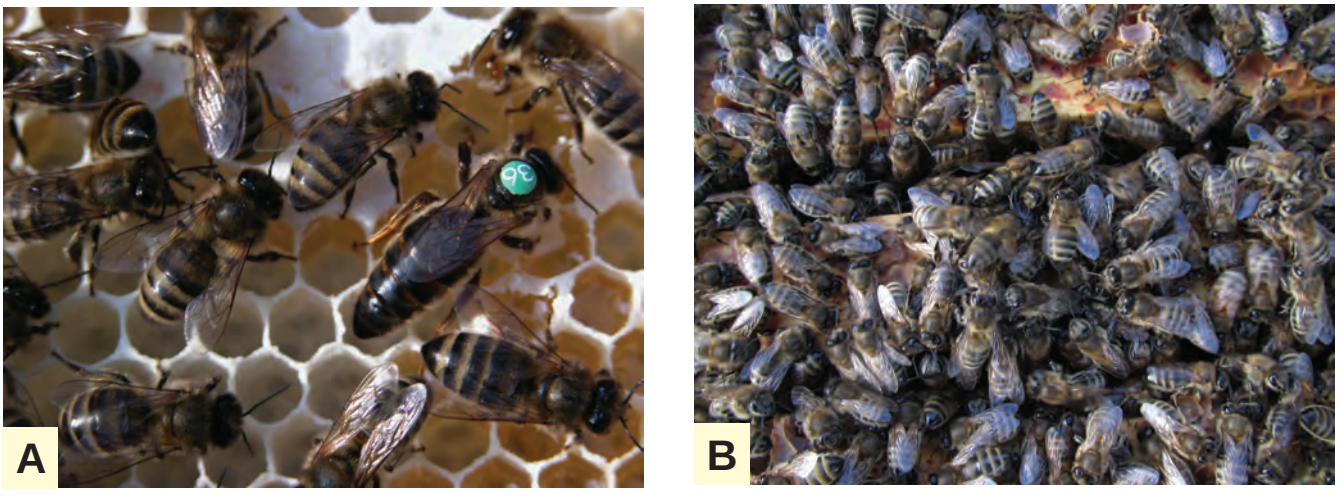

Figure 4: A Caucasian honey bee queen (A) and workers (B). Photograph A was taken of a queen in Turkey by Dr. Irfan Kandemir and B was provided by Sue Cobey.

Brother Adam, a monk at Buckfast Abbey in England. Brother Adam wanted to breed a bee that would have a number of good production and disease tolerance characteristics. He did this originally in an effort to develop a bee that would be resistant to tracheal mites. The story of this bee is fascinating. Basically, Brother Adam traveled Europe and parts of northern Africa to find bees that he considered to have desirable traits. These bees were brought back to his breeding apiary in England and crossed to produce Buckfast bees. The result was a productive bee that many beekeepers around the world like to use. The catch is that Brother Adam is deceased and the program no longer exists at the Abbey. I know because I have been there twice. Thus, the Buckfast bees available today are not necessarily descendants of the original bees, but rather stocks that have been maintained by breeders interested in perpetuating the bee. The original Buckfast bee was an ever-evolving bee as Brother Adam continued to breed the bee to improve upon its many attributes. Because the Buckfast bee is a hybrid bee, the expression of its notable characteristics can vary greatly within the stock.

5) **Russian honey bees** (Figure 5) - Russian honey bees are an interesting lesson in the ability of populations to adapt to various stressors. The original lineage of Russian bees is not known, but it is suspected to be derived from *Apis mellifera macedonica* (the Greek bee) or possibly Carniolan honey bees. Russian bees display many of the same characteristics as those exhibited by Carniolan bees, with the added benefit of elevated *Varroa* tolerance. How did the *Varroa* tolerance develop? In the early 20th century, beekeepers transported bees from western Russia, where *Apis mellifera* is native, to eastern Russia, where *Apis mellifera* is not native but where *Varroa* is native. Thus, Russian bees adapted over time to develop a level of tolerance to *Varroa*. Scientists at the U.S. Department of Agriculture, Honey Bee Breeding, Genetics, and Physiology Laboratory in Baton Rouge, Louisiana imported Russian bees and began selecting lines that had a high tolerance of *Varroa*. This bee has been shown by multiple research groups to be quite tolerant of *Varroa*. For more information on Russian bees and for a list of Russian Honey Bee Breeder members, see: **http://www.russianbreeder.org/**. The USDA-ARS, Baton Rouge Bee Lab posted a series of documents related to their work with Russian honey bees. This can be found at **http://www.ars.usda.gov/Research/docs.htm?docid=2744** and includes a chronology of the Russian bee project found at **http://www.ars.usda.gov/Services/docs.htm?docid=6444**.

6) ***Apis mellifera scutellata*** (the African or Africanized honey bee) – There are many races of honey bees in Africa. Thus, one could argue that assigning *Apis mellifera*

Figure 5: Three color variations of Russian honey bee queens (A – C) and a group of workers (D). Photographs A-C were provided by Bob Ketch and photograph D by the USDA-ARS.

scutellata the name "the African honey bee" is an injustice to the numerous races of African honey bees present in Africa. Some call the bee the "Africanized" honey bee to note its hybridization with European honey bees. I think it is most accurate to call it the African-derived honey bee. Regardless, this one race of honey bee was taken to Brazil in the 1950s in an effort to improve honey production on the continent. In short, African honey bees work better in warmer climates than do European races of honey bees. The idea was that this bee would perform better in South America than would European honey bees. This turned out to be true, but at a cost. The African honey bee typically is very defensive. The bee spread from its point of introduction in Brazil, throughout South and Central America, and into the U.S. I do not include this bee in a discussion of bee stocks available in the U.S. in an attempt to suggest that you consider incorporating the stock into your operations. Instead, I wanted to make you aware of its existence so that you can recognize the bees' traits should they begin to appear in your operation. Many of the major queen breeders in the U.S. produce queens in areas where African bees are present. Consequently, it is possible, though not likely if breeders take steps to minimize this, to purchase queens that have mated with African bee drones. It is illegal to keep African bees in many states.

7) ***Apis mellifera mellifera*** (the German or black honey bee) – Like many events in history, the exact race of honey bee first brought to the U.S. from Europe is debated. It is possible that the Spanish were first to bring honey bees to the New World, then bringing a Spanish race of honey bee to Florida. On the other hand, many authors who have written about bee introductions into the U.S. state that the German black bee was the first honey bee introduced to the Americas. Regardless of which bee was introduced first, the German bee was the one most used by beekeepers in the U.S., and this continued for quite some time. This particular bee is known for its heightened defensiveness, its susceptibility to disease, and its general inclination toward the temperate climate in North America. This was the honey bee of our American ancestors; this was our great grandfathers' bee.

In the 19th century, more races of honey bees were introduced from Europe into the U.S. Beekeepers began gravitating toward these bees and away from the German black bee. Thus, the German bee was minimized and likely has disappeared altogether. I often hear rumors of populations of German bees living in forests or other places having minimal human traffic. Though these tales may be true, I suspect that this bee is all-but-gone from the U.S., thanks largely to pathogens, *Varroa*, and beekeeper gravitation toward other bee races. The German bee purists need not worry. The German bee has left its legacy in beekeeping and it, no doubt, left its genes in our current bee population. I include a description of German bees in Table 1 for comparative and historic reasons. To my knowledge, it cannot be purchased in the U.S.

Other stocks of note

The following list includes stocks of honey bees that (A) typically are bred for amplification of one specific trait, though the breeder may be selecting for other favorable traits secondarily (1-3 below), (B) are no longer available (4 below), (C) are derived from "survivor bees" (5 below), or (D) are hybrid crosses between multiple stocks. Regarding the former, many, maybe most, of these traits are present in subpopulations of the bee stocks listed in Table 1. Consequently, they can be selected for in any of the major stocks listed in Table 1.

1) **Minnesota Hygienic bees** (Figure 6) – Dr. Marla Spivak and her team at the University of Minnesota selected for hygienic behavior in the Italian honey bee stock formerly available as Starline bees. Hygienic behavior is the behavior by which worker bees detect sick/diseased/parasitized pupae, uncap the cells in which the pupae reside, and remove the pupae from the cell and, ultimately, the hive. This behavior appears present in all of the major bee stocks listed in Table 1, though to varying degrees. Though Minnesota Hygienic bees were from Italian stocks originally, this trait can be selected for in any bee that one wants to use. For more information on Dr. Spivak's Minnesota Hygienic bees, see: **http://www.beelab.umn.edu/prod/groups/cfans/@pub/@cfans/@bees/documents/asset/cfans_asset_317501.pdf** and **http://www.beelab.umn.edu/prod/groups/cfans/@pub/@cfans/@bees/documents/asset/cfans_asset_317498.pdf**.

2) **Suppressed Mite Reproduction (SMR) honey bees –** Members of the USDA Honey Bee Breeding, Genetics, and Physiology Laboratory in Baton Rouge, Louisiana discovered this trait. This trait may be an enhanced variation of ordinary hygienic behavior. Bees with the SMR trait seem to be able to detect capped brood cells that contain *reproducing Varroa* and selectively remove the bee pupae only from those cells, leaving the pupae developing in cells that contain non-reproducing *Varroa*. You can find more information about SMR bees at **http://www.ars.usda.gov/Research/docs.htm?docid=2744&page=13**.

3) **Cordovan honey bees -** This is an often misunderstood trait of honey bees. In essence, the cordovan trait is a recessive trait in honey bees in which the black cuticular coloration of the bee's body is replaced by brown. The fact that it is recessive means that both parents, the queen and the drone, must carry the trait in order for the offspring to present the characteristic. The amount of black coloration in each bee stocks' cuticle differs naturally. This means that the lighter bees, such as Italian honey bees, look more golden when they are cordovan, while the darker honey bees, such as Carniolans, look brown. The cordovan phenotype presents itself in the bees' antennae, head, thorax, legs, and abdomen, anywhere a black cuticle would otherwise be present. It is worth noting that the cordovan trait does not confer any enhanced level of productivity to bees that possess it. It is simply a color marker that some beekeepers like to have in their bees.

4) **Starline, Midnite, and Double Hybrid honey bees –** Starline bees were developed by the late Dr. G.H. Cale, Jr. of Dadant & Sons, Inc., by crossing several stocks of Italian honey bees. Midnite bees were derived from crossing Carniolan and Caucasian bees. As the name implies, Double Hybrid bees resulted from a cross between Starline and Midnite queens. These bees were available when I was young, but

Figure 6: Minnesota Hygienic queen and workers. Photograph provided by Dr. Marla Spivak, University of Minnesota.

Table 1 - Principal Stocks of Honey Bees Present in the United States

Characteristic*	Italian-derived honey bees (*Apis mellifera ligustica*)	Carniolan-derived honey bees (*Apis mellifera carnica*)	Caucasian-derived honey bees (*A.m. caucasica*)	Buckfast honey bees	Russian honey bees	African-derived honey bees (*Apis mellifera scutellata*)	German or black honey bee (*Apis mellifera mellifera*)
[1]Origin	Italy	Alps of east-central Europe	Caucasus mountains in Eurasia, near the Black Sea	Mixed	Primorsky region of eastern Russia	Central and eastern Africa, to South Africa	Northern regions of central Europe, from UK to Germany
Morphological Characteristics							
[2]Queen color	Golden yellow to leather brown	Generally dark with lighter regions in areas	Very dark, can be jet black	Variable as a hybrid	Variable, but generally brown to black	Variable	Black with some brown coloration
[3]Drone color	Somewhat variable, but generally yellow to dark brown	Dark body with gray and brown thoracic hairs	Black body with black thoracic hairs	Variable as a hybrid	Can be variable, but generally black	Variable, often brownish abdomen	Dark brown to black
[4]Worker color	Golden yellow to brown with yellowish bands on abdomen	Gray to almost black, with gray or brown stripes on abdomen, high color variation	Black body with gray bands on abdomen, black thoracic hairs	Variable as a hybrid, but often brown with black stripes on abdomen	Variable, but generally brown to black	Variable	Dark brown to black
[5]Tongue length	Short-to-medium	Medium-to-Long	Long	Average	Average	**	Short

Key to the stock characteristics discussed in Table 1.
The numbers below correspond to the numbers assigned each characteristic in Table 1.

1. Origin – The natural range of the bee stock. A "mixed" origin means that the bee derives from a mixture of one or more stocks.

2. Queen color – The color pattern associated with a typical queen bee of a given stock.

3. Drone color – The color pattern associated with a typical drone bee of a given stock.

4. Worker color – The color pattern associated with a typical worker bee of a given stock.

5. Tongue length – The relative length of a typical worker's tongue, representative of the stock. This is relative to tongue lengths of workers from other races of *Apis mellifera*. This is important because longer tongued bees access nectaries in deeper corollas. This partly contributed to beekeepers' general migration away from German bees as German bees have short tongues and could not work certain nectar-producing plants well.

6. Defensiveness – All stocks of honey bees exhibit some level of defensiveness, some more so than others. This is rated from low (a colony that is hard to provoke) to very high (a colony that attacks with little provocation). The term "defensiveness" is preferred to "aggression" because the later implies that the bees seek out and preemptively strike potential threats. Honey bees are defensive, not aggressive.

7. Worker behavior on the combs – This is a description of how workers move on the combs when colonies are opened and worked. "Calm" workers go about their jobs while the combs are inspected. "Nervous" workers scurry about the combs rapidly, often migrating to the comb perimeter or vacating the combs altogether. Nervous bees sometimes form masses of bees at the bottom of frames being inspected. This can lead to "flighty" bees which fly from the combs to initiate a defensive response against the beekeeper.

8. Robbing tendency – The propensity of a colony to rob other colonies during times of nectar dearth or when the colonies are being inspected by beekeepers. "Low" means colonies are less likely to rob other colonies while "high" means they are highly likely to rob other colonies.

9. Propolis use – The pattern of propolis use among the stocks ranges from low (little propolis used) to high (considerable propolis used).

10. Swarming tendencies – The propensity of colonies of a given stock to swarm. This ranges from a low propensity (the colony does not swarm a lot or takes some time to reach the swarm threshold) to a very high one (the colony swarms multiple times per year or is quick to reach the swarm threshold).

11. Tendency to abscond – Absconding is a colony behavior whereby all of the bees in the nest, including queens, workers, and drones, leave the nest in response to a colony stress. Some bee stocks rarely abscond (low) while others abscond frequently (high).

12. Overwintering ability – The likelihood that a colony will overwinter successfully. Some colonies do not overwinter well, or even at all, in temperate climates. This ranges from none (colonies from the stock likely will not overwinter in temperate climates) to very good (colonies from the stock possess traits that make them highly likely to overwinter successfully).

13. Honey consumption during winter – Some bee stocks go into winter with high adult populations, thus making them very likely to consume large amounts of their honey stores during the winter (high). This can lead to problems, such as starvation, in prolonged winters. Other colonies overwinter with smaller clusters and have a lower tendency to consume honey (low). These bee stocks are more likely to survive winter than are bee stocks that consume a lot of their winter stores.

14. Colony growth in spring – This refers to how early a colony initiates growth in spring and the rate at which it grows. Slow growing colonies come out of winter with small clusters and are slow to expand. Rapid growth is exhibited in colonies that have nearly explosive growth after winter. These tend to produce more honey during the spring season.

15. Brood production – This relates to a colony's likelihood of producing copious amount of brood during the spring expansion period. "High" indicates that a bee stock produces lots of brood while "low" indicates that the colony produces comparatively little brood.

16. Colony population in summer – This refers to the relative number of adult worker bees in a colony during summer. Some bee stocks produce colonies that have high summer populations while others produce colonies with low populations. This affects a colony's use of resources, vulnerability to pests and pathogens, and use under varying management paradigms.

17. General disease tolerance – The general ability of a given bee stock to tolerate the various bee pests/pathogens that typically affect colonies, Varroa excluded. "Low" indicates a stock generally is vulnerable to many pests/pathogens. "High" indicates that the stock is tolerant of many pests/pathogens.

18. Tolerance of Varroa – Some bee stocks are very tolerant of Varroa infestations (high) while others are not (low). Given that Varroa are considered the number one threat to honey bees, it benefits beekeepers to use stocks that display some level of tolerance toward Varroa.

19. Tolerance of tracheal mites – Some bee stocks are very tolerant of tracheal mite infestations (high) while others are not (low).

20. Tolerance of American Foulbrood – Some bee stocks are very tolerant of American Foulbrood infections (high) while others are not (low).

21. Tolerance of European Foulbrood – Some bee stocks are very tolerant of European Foulbrood infections (high) while others are not (low).

22. Notes on wax production – This characteristic is important to beekeepers who specialize in wax production or wax products. Some bee stocks are quick to build wax in response to nectar flows while others are slower to do this. Some stocks also are known for producing "wet" cappings. This simply means that the cappings constructed over the top of cells of honey contact the honey stored underneath, making them appear "wet." This, typically, is undesirable if the comb is going to be used in comb or cut-comb honey. "Clean" or "dry" cappings do not touch the honey stored within the cell, consequently producing a comb with a more desirable appearance.

23. Honey production – Under average management conditions, this characteristic refers to a colony's typical honey yield. This ranges from "high" (will produce a lot of honey) to "low" (will produce less honey).

Table 1 continued	Italian	Carniolan	Caucasian	Buckfast	Russian	*Scutellata* (African)	German black
Notable Behavioral Characteristics							
[6]Defensiveness	Average	Low	Low	Average	Low-to-average	Very High	Average-to-High
[7]Worker behavior on combs	Calm	Calm	Calm	Variable, but generally calm	Average, but can be runny	Very nervous, flighty, prone to boil out of open hive	Nervous, flighty, prone to boil out of open hive
[8]Robbing tendency	High	Low	Average-to-high	Average	Low-to-average	Average-to-high	**
[9]Propolis use	Low-to-average	Low	High	Low-to-Average	Average	High	Low-to-average
[10]Swarming tendencies	Average	High, swarms earlier in season	Low, swarms later in season	Low-to-average	Average	Very high	Average-to-high
[11]Tendency to abscond	Low	Low	Low	Low	Low	High	Low
Colony Growth Characteristics							
[12]Overwintering ability	Average, with large clusters	Very good, with smaller clusters	Low-to-average, especially in colder climates	Average-to-good	Good, with small to average clusters	None (colonies typically do not survive temperate winters)	Very good
[13]Honey consumption during winter	High	Low	Low	Low	Low	Not applicable	Average
[14]Colony growth in spring	Average-to-rapid	Rapid	Slow	Low-to-average	Average-to-rapid	Rapid	Slow
[15]Brood production	High	Average	Average	Average-to-high	Average	High	Average
[16]Colony population in summer	High	Average	Average	Average	Average	Average	**
Pest and Pathogen Tolerance							
[17]General disease tolerance	Average	Average-to-high	Low-to-average, susceptible to *Nosema*	High, good hygienic behavior	Average-to-high	Average-to-high	Low
[18]Tolerance of *Varroa*	Low	Low	Low	Average	High	High	Variable as reported in the literature
[19]Tolerance of tracheal mites	Low	Low-to-average	Average	High	High	Average	Low
[20]Tolerance of American Foulbrood	Average	High	Average	Average	Average	Average	Low
[21]Tolerance of European Foulbrood	Average	Average	Average	Average	Average	Average	Low
General Productivity							
[22]Notes on wax production	Quick to produce good quality wax	Slow to build comb, but produces nice combs with clean cappings	Tends to produce "wet" cappings on combs	**	Slow to build comb, but produces nice combs with clean cappings	Quick to produce combs	Average propensity to construct combs, but produces good comb
[23]Honey production	High	High	Average	Average-to-high	Average-to-high	Average for colony size	Low-to-Average

*The number given to each characteristic corresponds to the numbered description in table key.
**Could not find information related to given trait.

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Sections of the table were reviewed by Sue Cobey and Carl Webb.

one cannot purchase them in the U.S. any longer.

5) **Survivor honey bees –** These bees are simply bees that survive. It does not matter to the producer of these bees how the bees survive, only that they do. Most survivor bees originate from colonies that, for whatever reason, survive with minimal beekeeper input from year to year. Most often, developers of these stocks note that the bees are surviving without any chemotherapeutic intervention by the beekeeper. Thus, the colonies are not treated for foulbrood, *Varroa*, *Nosema*, etc. The theory is that if the bees can survive from year-to-year, then they must be developing a natural tolerance to the pests/pathogens/other stressors that otherwise kill most colonies. I believe in the theory behind survivor stock; I only doubt the practice of developing such a bee in 5-10 years. Russian honey bees are the best, natural example of survivor stock. They are, in fact, derived from bees that survived constant pressure exerted on them by *Varroa*. However, they took 100+ years to develop on their own, and then had layers of selection placed on them by the USDA bee laboratory in Baton Rouge before their release to beekeepers. The idea of breeding from survivors means that selection is

happening at random, with no clear target in sight. This can be done successfully, in my opinion, though I feel that many of the "survivor" bees produced today are no better than any other bee chosen at random. I do have a romantic idea that there are feral bees out there that have survived for decades and without the intervention of beekeepers. I do not, however, believe that they are as common as the proponents of survivor bees indicate. My recommendation here is be realistic when hunting for and using "survivor" bees. I note this because these bees usually are sold for more than the other stocks that are not touted as survivor bees. Remember, the other stocks had to survive in order to be developed as well.

6) **"Hybrid" honey bees –** A hybrid bee is simply the product of a cross between two stocks. Given that the bee stocks available in the U.S. are hybrids themselves, most "hybrid" bees are really crosses between already existing hybrids. Generally, hybrids are produced in an effort to incorporate the beneficial characteristics of both bee stocks into a single bee. Of course, the opposite can happen as well. Hybrids have a vigor associated with them that often produces a good quality bee.

I think that every beekeeper should try multiple bee stocks before settling on the one they ultimately will use. The varying characteristics of each bee stock virtually ensure that there is a bee stock that can work for every beekeeper, in just about any management situation. I am optimistic that the quality of the existing bee stocks will improve as our understanding of breeding improves. Furthermore, we may one day be able to incorporate other bee stocks, stocks that currently are not present in the U.S., into our beekeeping operations. In conclusion, I hope this article helps you decide among the various stocks of bees available in the U.S.

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