florology 101

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Fragrance may be the floral attribute that is most powerful and least understood.

Flowers are intrinsically associated with fragrance. Almost everyone, when presented with a bouquet or even a single blossom, will immediately bring it to his or her nose to see how good it smells. It's one of the things that make us value and appreciate flowers as much as we do. In fact, it's so important that the newly published *AIFD Guide to Floral Design: Terms, Techniques, and Traditions* identifies it as one of the elements of floral design.

How is it that the fragrance of flowers affects us so strongly? What purpose does it serve for the flowers themselves? And if it's so important, why are so many florist flowers relatively weak in fragrance?

Let's first take a look at how olfaction (the technical term for the sense of smell) operates in humans. The human olfactory system can distinguish among thousands of odors. Scientists have identified a large family of genes in our DNA that they believe are coded for specific odor binding sites, or receptors, in the lining of the nasal cavity. It's estimated that there are as many as 10 million olfactory cells in humans. (Don't feel too smug—dogs have 20 times that many.) These receptor cells are relatively long. At one end are the olfactory cilia—slender, hair-like structures that bind to the specific molecules of an odor. The cilia are attached to the olfactory neurons, which generate electrical signals that travel directly to the olfactory bulb, a rounded structure at the front of the brain, located directly above the nose. In the olfactory bulb, information from the receptors is organized into patterns that the brain then interprets as different odors.

The olfactory bulb is part of the brain's limbic system—primitive brain structures that govern emotions, behavior, and memory storage. The limbic system is one of the oldest and most vital parts of the brain. In fact, a very important aspect of smell is that olfactory neurons make up the only sensory pathway that is in direct contact with the brain. For most animals, it is a primary mode of communication that influences many important functions, including reproduction and taste. This is one reason why our olfactory memories are among the most powerful. They frequently have strong emotional qualities and are associated with the good or bad experiences in which they occurred (a fact that florists can use to good advantage). Olfactory information travels not only to the limbic system, however, but also to the brain's cortex, or outer layer, where conscious thought occurs.

Plants create fragrance by producing volatile (easily vaporized) compounds that emanate from the surface of their petals, leaves and other tissues. Scientists have so far identified about 1,000 of these chemicals. However, there are many more as yet to be isolated, and there can be as many as 50 or 100 different chemicals involved in generating a particular scent. In roses alone, more than 80 distinct fragrance compounds have been identified. Imagine the possible combinations—each one different from every other! These compounds function in the manner of enzymes, with distinct molecular shapes that fit precisely with specific receptors in the nasal cavity. This is the reason why the second sniff of a fragrant flower isn't as powerful as the first; the receptors are bound up with the molecules from the first sniff. Typically, only a few of the volatile chemicals in a fragrance are obviously noticeable to human noses, and no two people experience an odor the same way. In other words, a rose may smell sweeter to some people than to others.

Calling all pollinators

Why do flowers smell good (or bad) in the first place? The answer is simple: advertising. The basic biological purpose of flower fragrance is to advertise to insects or other pollinators that food (in the form of nectar or pollen) is available, or to fool them into believing that sex is a possibility (some flowers emit a scent that resembles the pheremonal essence of sexually receptive members of certain insect species). Thus captivated, the insect visits the flower, looking for a meal or a mate. If all goes well (for the flower that is), the insect will take some pollen with it when it leaves and deposit it on the stigma of another blossom of the same species as the first, thereby cross-pollinating the plants. Even if the pollinator is one that's drawn by the color or shape of a blossom, fragrance can announce the presence of the flower from a greater distance, long before it's seen by a passing butterfly, bird or bee.

There are some flowers that don't smell very good at all, at least to the human nose. For example, a succulent plant known as the carrion flower *(Stapelia giganteum)* produces blossoms that smell very much like rotted meat, which is an enticing aroma to the flies that pollinate it. The overpowering stench of the titan arum *(Amorphophallus titanium),* a gigantic member of the Aroid family, is enough to knock a horse over, yet it's so irresistible to dung beetles that they will chew their way through the inflorescence to get at the pollen inside. To give you an idea of what the arum smells like, two of the organic compounds that are partly responsible for its odor are putrescine and cadaverine, both of which are also produced during the decomposition of rotting proteins.

Flowers tend to be most fragrant when they have sufficient nutrition, which is one more reason why the use of commercial flower foods is important. In addition, moderate to warm temperatures and high light tend to increase fragrance. Many flowers display a circadian cycle in the production of fragrance, with the scent being strongest at certain times of the day or night. This phenomenon too is related to the activities of the flowers' pollinators. Snapdragons, for instance, are most fragrant during the day when pollinating bees are likely to be most active. Perhaps you've noticed that the fragrance of Stargazer lilies becomes stronger at night, which would indicate that these and related species are likely to be pollinated by a nocturnal insect such as a moth. It would be a waste of a flower's energy to advertise to insects that don't even pollinate them.

Trade-offs

It does require a certain amount of energy for a plant to produce fragrance, energy that might otherwise be expended in keeping a flower open and thus receptive to pollination. Given that a flower's sole biological purpose is to be pollinated so that it can produce the next generation of seeds, it makes evolutionary sense that a short-lived flower might generate a strong perfume that can quickly attract a pollinator, whereas a longer-lasting blossom has a much greater window of opportunity in which to become pollinated. This is one reason why so many of our "florist" roses don't have much fragrance; in trying to develop more attractive blossoms with longer vase lives, plant breeders have focused on selecting genes that produce those traits rather than genes responsible for fragrance.

It turns out that there is actually a negative relationship between the genes that are responsible for vase life and those that control fragrance. Some of the same chemicals that plants use to make fragrance have been shown to shorten vase life. These are the natural plant chemicals that respond to hormones like ethylene, which is a ripening hormone and gas that causes flowers to wilt. As breeders selected plants that made less of those chemicals in order to achieve long-lasting cut flowers, they also may have removed the plants' abilities to produce floral scent. The same holds true for potted and garden plants as well. For example, the cyclamen used to have a fragrant flower.

Furthermore, pigment compounds (those that produce color in a flower) are derived from some of the same biochemical precursors as scent compounds are. So it's logical that if you make more of one you get less of the other, and as flower breeders have sought to create an ever-widening spectrum of colors among the estimated 18,000 rose cultivars now on the market, fragrance has very often gone by the wayside.

Fortunately, there are breeding programs now underway that seek to put fragrance back into our roses. In the past few years, flower scientists have assembled enough technology to consider resurrecting scents in flowers that have long since lost them, and as genetic engineering progresses, we may start seeing plants that produce fragrances that have never before been experienced by a bee, beetle, or florist.

Designer fragrance, anyone?

Despite the fact that fragrance is so strongly associated with flowers in the mind of the consumer, floral designers for the most part haven't added it into their conscious calculations of the elements within their compositions. We know when it's there of course; yet, we've tended to overlook it as we pay more attention to the visual impact of our designs rather than the olfactory. We haven't really learned how to combine and layer fragrances in the way that the perfume trade, for example, has. And that's a shame, because, as we've already seen, memories associated with the sense of smell can be among the most powerful we experience. Numerous studies have proven that pleasant fragrances simply make us feel and perform better. Aromatherapists have built a multi-million-dollar industry around that fact.

But florists can indulge in a little aromatherapy ourselves. We already do so on occasion; how many times have you gathered around the design bench just to catch a whiff as someone was about to open a fresh box of gardenias or stephanotis? By learning which of the cultivars among the many hundreds available to us have the best fragrances and practicing combining them in different ways, we can elevate floral design to a new dimension, sharing a kind of aromatherapy with our customers. In that next bridal bouquet that you create, remember that you are also creating a lifetime of powerful olfactory memories, and choose your flowers accordingly.

Flowers&